CAPITAL BUDGETING

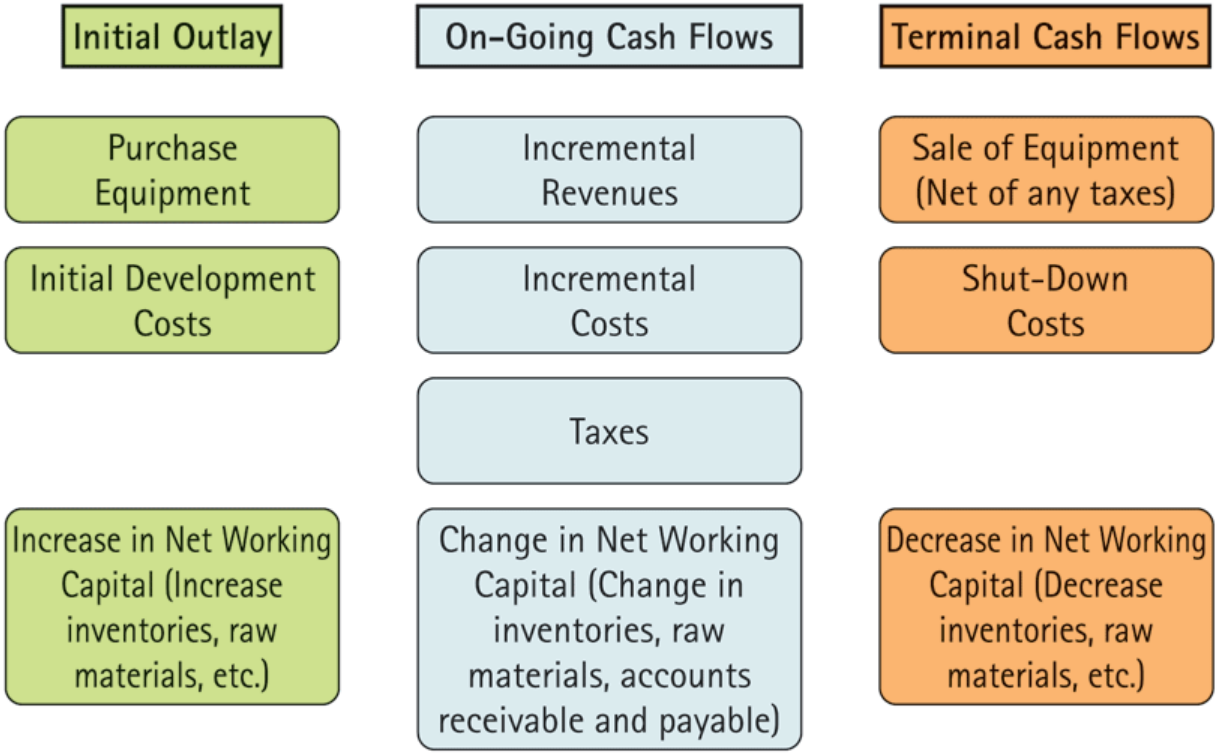
Capital budgeting

- **Capital Budgeting:** Process of analyzing investment opportunities ("projects") and deciding which ones to accept
- **Tool:** the NPV rule
- But to use NPV, we need a project's **cash flows** and **discount rate**!
  - Today: Cash flows
  - Next lecture: Discount rates

Some Capital Budgeting Rules

- The four basic ingredients in cash flows are:
  1. Revenues
  2. Costs
  3. Taxes
  4. Investments (here, we're including both PP&E, working capital, etc)
- Cash flows are NOT the same as accounting earnings
  - We are interested in money that is actually *available to investors*
- Depreciation is NOT a cash flow
  - But, depreciation does affect taxes, which is a tax flow!
- Interest expense is NOT a cash flow
  - We want to *separate* the investment and financing decisions.
  - So, for now, we evaluate projects as if they are "all equity financed"
- We want to consider only cash flows that are *incremental*
  - We should consider *opportunity costs* and *externalities*
  - Ignore *sunk* costs

Figure Cash Flows in a Typical Project



4 steps to Capital Budgeting

1. Forecast incremental *earnings* for a project
2. Make adjustments to get incremental *free cash flows*
3. Calculate NPV (using the correct cost of capital)
4. Do sensitivity analysis

1. Forecasting Incremental Earnings

- Incremental EBIT
  = Incr. Revenues – Incr. Cost – Incr. Depreciation
- Incremental Earnings (after taxes)
  = (Incr. EBIT) * (1 – Marginal Tax Rate)
  - Notice: No interest expense!
  - Marginal Tax Rate: The tax rate a firm will pay on an incremental ("extra") dollar of pre-tax income
  - (It's sometimes hard to know a firm's *marginal* tax rate, in which case we might need to guesstimate what it is or use the *average* corporate tax rate instead)

Example: Incremental Earnings

- Linksys is considering making a new wireless home networking gadget, “HomeNet”
- Sales and cost forecasts:
  - Annual sales of 50,000 units per year; for each of four years of forecasted product life
  - Wholesale price of $260
  - Unit production costs of $110
  - HomeNet would be ready to ship in one year
- The project requires:
  - Purchasing new equipment for $7.5 million
    - Will be depreciated (straight-line) over a 5-year life
  - A new testing and support lab, which will cost $2.8 million per year (rent, personnel costs, etc…)
- Linksys' marginal tax rate is 40%
- What are the forecasted incremental earnings from the HomeNet project?

Example: Incremental Earnings (cont.)

- We need four items to calculate incremental earnings:
  1. Incremental revenues
  2. Incremental costs
  3. Incremental depreciation
  4. The marginal tax rate
- Incremental Revenues:
  - units sold * price = 50,000 * $260 = $13,000,000 per year
- Incremental Production Costs:
  - units sold * variable production costs = 50,000 * $110 = $5,500,000 per year
- Incremental Selling, General and Administrative (SG&A) costs:
  - $2,800,000 per year
- Incremental Depreciation:
  - Capex / Depreciable Life = $7,500,000 / 5 = $1,500,000 per year over five years
- Marginal Tax Rate: 40%

Example: Incremental Earnings (cont.)

1	Year	0	1	2	3	4	5
2	Revenues		13,000	13,000	13,000	13,000	–
3	Cost of Goods Sold		−5,500	−5,500	−5,500	−5,500	–
4	**Gross Profit**		7,500	7,500	7,500	7,500	–
5	Selling, General, and Administrative		−2,800	−2,800	−2,800	−2,800	–
6	Depreciation		−1,500	−1,500	−1,500	−1,500	−1,500
7	**EBIT**		3,200	3,200	3,200	3,200	−1,500
8	Income Tax at 40%		−1,280	−1,280	−1,280	−1,280	600
9	**Incremental Earnings**		**1,920**	**1,920**	**1,920**	**1,920**	**−900**

- The new equipment purchase ($7.5 million) does not affect earnings in the year it is purchased (year 0), but does affect future years' earnings through depreciation
- Even though the project only lasts for 4 years, the new equipment has a 5-year depreciation period, so we must include the final depreciation charge in year 5
- Why positive cash flow effect from taxes in year 5?
  - Negative EBIT provides a tax credit
  - ➢ Results in lower taxes on the firm's *other* projects as long as the firm is profitable overall

2. Converting from Earnings to Free Cash Flow

Need to consider items where cash flows differ from earnings, for example:

i. Capital expenditures (“Capex”)
ii. Depreciation
iii. Changes in Net Working Capital

Capex and Depreciation

- Investments in capital expenditures are cash flows when these investments are paid for, but this is not captured as a cost in earnings at that time
  - Capex recognized in earnings over time in the form of added depreciation
- Conversely, depreciation is included as a cost in earnings but does not correspond to actual cash outflows!

➢ We need to adjust incremental earnings for Capex and depreciation to accurately capture when these cash flows *actually happen*

Example: CapEx and depreciation

- We add back the $1.5 million depreciation between year 1 and year 5
- Recognize the $7.5 million cash outflow associated with the equipment purchase in year 0

1	**Year**	**0**	**1**	**2**	**3**	**4**	**5**
2	Revenues		13,000	13,000	13,000	13,000	–
3	Cost of Goods Sold		−5,500	−5,500	−5,500	−5,500	–
4	**Gross Profit**		7,500	7,500	7,500	7,500	–
5	Selling, General, and Administrative		−2,800	−2,800	−2,800	−2,800	–
6	Depreciation		−1,500	−1,500	−1,500	−1,500	−1,500
7	**EBIT**		3,200	3,200	3,200	3,200	−1,500
8	Income Tax at 40%		−1,280	−1,280	−1,280	−1,280	600
9	**Incremental Earnings**		1,920	1,920	1,920	1,920	−900
10	Add Back Depreciation		1,500	1,500	1,500	1,500	1,500
11	Purchase of Equipment	−7,500					
12	**Incremental Free Cash Flows**	**−7,500**	**3,420**	**3,420**	**3,420**	**3,420**	**600**

Why first subtract depreciation only to add it back? Can't we instead just ignore depreciation?

	Correct	Incorrect!
Gross profit	7,500	7,500
SG&A	-2,800	-2,800
Depreciation	-1,500	
EBIT	3,200	4,700
Tax at 40%	-1,280	-1,880
Incr. earnings	1,920	2,820
Add back depreciation	1,500	
Incr. FCF	3,420	2,820

Changes in Net Working capital

- Net Working Capital (NWC)
  = Current Assets – Current Liabilities
  = (Excess) Cash + Inventory + Receivables – Payables
- An increase in NWC ties up cash!
  - E.g., if the project requires inventory or results in higher receivables (most projects do), the cash that is tied up to pay for this working capital is not available to investors
- Conversely, decreases in NWC frees up cash for investors

Example: Changes in Net Working Capital

- Suppose receivables related to HomeNet are expected to be 15% of annual sales ($13 million * 15% = $1.95 million), and payables are expected to be 15% of the annual cost of goods sold ($5.5 million *15% = $825,000)
  - (And suppose, for simplicity, no inventory is required---if we had inventory, it would have the same sign as receivables)
- How does this NWC affect the project's FCFs?

1	**Year**	**0**	**1**	**2**	**3**	**4**	**5**
2	**Net Working Capital Forecast ($000s)**						
3	Cash Requirements	0	0	0	0	0	0
4	Inventory	0	0	0	0	0	0
5	Receivables (15% of Sales)	0	1,950	1,950	1,950	1,950	0
6	Payables (15% of COGS)	0	−825	−825	−825	−825	0
7	**Net Working Capital**	**0**	**1,125**	**1,125**	**1,125**	**1,125**	**0**

Example: Changes in Net Working Capital (cont.)

- Only *changes* in NWC count!
- In year 1, NWC increases by $1.125 million
  - ➢ Negative $1.125 million effect on cash flows
- In years 2–4, net working capital does not change
  - ➢ No effect on cash flows
- In year 5, when the project is shut down, net working capital falls by $1.125 million
  - (The payments of the last customers are received and the final bills to suppliers are paid)
  - ➢ Positive $1.125 million effect on cash flows

1	**Year**	**0**	**1**	**2**	**3**	**4**	**5**
2	Net Working Capital	0	1,125	1,125	1,125	1,125	0
3	Change in NWC		+1,125	0	0	0	−1,125
4	Cash Flow Effect		−1,125	0	0	0	+1,125

Example: Changes in Net Working Capital

Now we have our estimate of incremental free cash flows for the project:

1	Year	0	1	2	3	4	5
2	Revenues		13,000	13,000	13,000	13,000	0
3	Costs of Goods Sold		−5,500	−5,500	−5,500	−5,500	0
4	**Gross Profit**		7,500	7,500	7,500	7,500	0
5	Selling, General, and Administrative		−2,800	−2,800	−2,800	−2,800	0
6	Depreciation		−1,500	−1,500	−1,500	−1,500	−1,500
7	**EBIT**		3,200	3,200	3,200	3,200	−1,500
8	Income Tax at 40%		−1,280	−1,280	−1,280	−1,280	600
9	**Incremental Earnings**		1,920	1,920	1,920	1,920	−900
10	Add Back Depreciation		1,500	1,500	1,500	1,500	1,500
11	Purchase of Equipment	−7,500					
12	Subtract Changes in NWC		−1,125	0	0	0	1,125
13	**Incremental Free Cash Flows**	**−7,500**	**2,295**	**3,420**	**3,420**	**3,420**	**1,725**

Calculating Free Cash Flow Directly

- We just calculated Free Cash Flow (FCF) in the following way:
  FCF = EBIT*(1 – taxrate) + Depreciation – “Investments”
  - “Investments” here combines both CapEx and ΔNWC
- A way to get to this directly without forecasting EBIT first is:
  FCF = Revenues – Costs – “Investments” – Taxes
  - To see this:
    Free Cash Flow = Revenues – Costs – Investments – Taxes
    = Revenues – Costs – Investments – taxrate*(Revenues – Costs – Depreciation)
    = (1 – taxrate)(Revenues – Costs) – Investments + taxrate*Depreciation
    = (1 – taxrate)(Revenues – Costs – Depreciation) – Investments + taxrate *Depreciation + (1 – taxrate)* Depreciation
    = EBIT*(1 – taxrate) + Depreciation – Investments

3. Calculating the NPV

- To get NPV, we discount all incremental FCFs at an appropriate discount rate *r* (“cost of capital”)
  - Figuring out the correct cost of capital will be the subject of the next lecture!

Example: Calculating the NPV

- Suppose that the HomeNet project has a cost of capital of 12%
- What's the NPV of the HomeNet project?

Solution:

- The incremental free cash flows for the HomeNet project are:

1	Year	0	1	2	3	4	5
2	Incremental Free Cash Flows	−7,500	2,295	3,420	3,420	3,420	1,725

- Using a cost of capital of 12%, we can calculate the NPV:

$$NPV = -7500 + \frac{2295}{(1.12)^1} + \frac{3420}{(1.12)^2} + \frac{3420}{(1.12)^3} + \frac{3420}{(1.12)^4} + \frac{1725}{(1.12)^5} = 2862$$

Other Effects to consider

1. Opportunity costs
   - A resource (e.g., a warehouse that the company owns) is almost never “free”
2. Project externalities
   - E.g., cannibalization
3. Sunk costs
   - Do not affect *incremental* free cash flows, and therefore should not affect the NPV and the decision!
   - E.g., fixed overhead expenses, past research and development
   - May be “related” to a project, but no longer incremental if they aren’t affected by the decision to be taken!
4. Tax adjustments
   - E.g., accelerated depreciation, tax carry-forwards/carry-backs
5. Terminal value

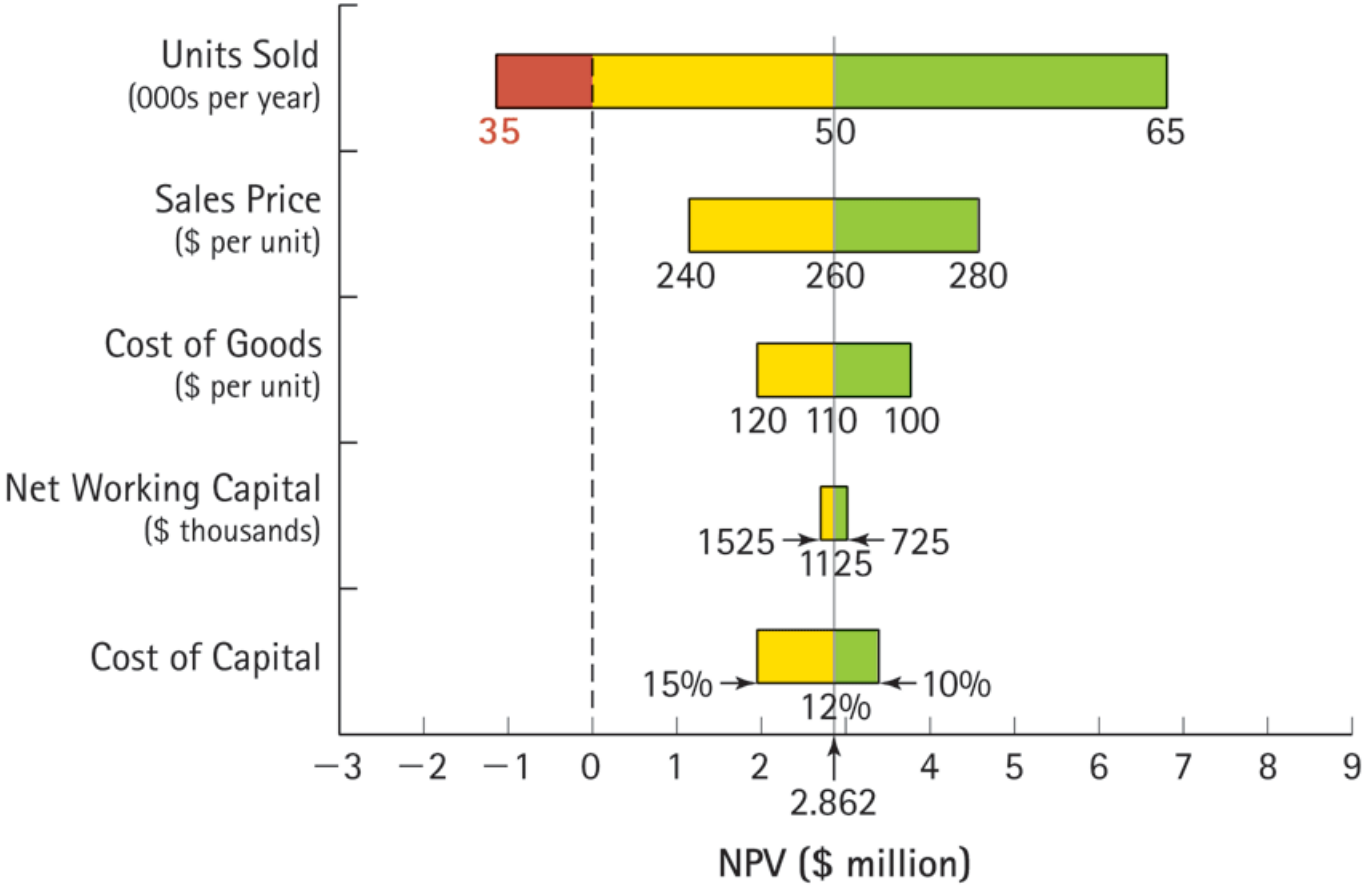
Terminal Value

- At our the end of our explicit forecast horizon (e.g., five or ten years), a project may still have some value
- Two main ways to calculate a terminal value: Salvage Value, or Continuation Value
- A) Salvage Value ("Liquidation method")
  - Appropriate if everything related to project (e.g., machines, factory, or division) is to be liquidated/sold at the end of the forecast horizon
  - Estimate resulting cash flow from selling everything that remains from the project, add this to the final year's cash flow (or to the year after, depending on when the sale is expected to happen)
  - Cash flow = Expected sale price +/- Possible tax consequences
  - Tax consequences:
    - If selling price > book value, the firm pays tax on gain
    - If book value > selling price, the firm realizes a tax shield on the loss
    - Simplest case: selling price = book value → no tax consequence
- B) Continuation Value ("Perpetuity Method")
  - Appropriate if project will continue indefinitely (with a steady growth pattern) after the explicit forecast horizon
  - Take cash flows at time T (the last forecasted period), estimate a constant future growth rate *g* for cash flows, and apply the *growing perpetuity* formula
  - Growth rate *g* can be either positive or negative
    - But, it would be unreasonable to assume that cash flows could grow at a higher rate than the economy!
    - Remember: we're assuming this growth rate continues forever!

4. What-if analysis

- Sensitivity Analysis
  - How the NPV varies if we change *one* underlying variable/assumption
- Scenario Analysis
  - How the NPV varies if we simultaneously change *several* underlying variables/assumptions
  - Often, variables are connected so it may not make sense to only change just one at a time:
    - For example, if we sell at a lower price, we may sell more units
    - Or, if there's a recession, we may sell fewer units at a lower price, but our production costs may also be cheaper

Sensitivity Analysis with Best & Worst-Case Parameter Assumptions



Scenario Analysis of Alternative Pricing Strategies

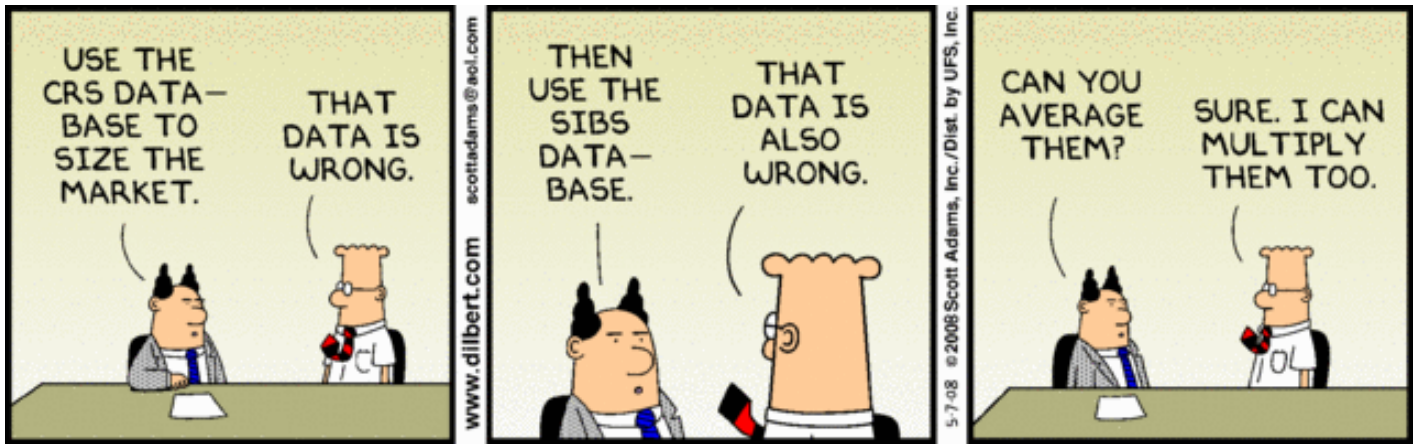
Strategy	Sale Price ($/unit)	Expected Units Sold (thousands)	NPV ($ thousands)
Current Strategy	260	50	2862
Price Reduction	245	55	2729
Price Increase	275	45	2729

Cash flows will be uncertain – Use the mean estimate!

- We need to discount the project's *expected* cash flows (*i.e.,* the probability-weighted average cash flow)
  - Not "best case", not "if successful", not mode, etc…
- Wrong (but oh so common…) method:
  - Use a "if successful" scenario cash flow, and adjust the discount rate *r* upwards to account for the "risk" that the project may not be a success
  - Take care to avoid this fallacy!

Forecasting is difficult in practice

- Remember: Garbage in → Garbage out!



Summary

- We want to make investment decisions based on the NPV rule:
  - Accept all projects with NPV > 0 , and Reject all projects with NPV < 0
- Calculating NPV requires two ingredients: (a) Cash flows, and (b) Discount rate
- Today, to calculate cash flows:
  - Start with incremental earnings
  - Adjust for CapEx, depreciation, and working capital
  - Also think about:
    - Opportunity costs
    - Project externalities
    - Terminal value
    - Tax adjustments (accelerated depreciation, tax carry-forwards/carry-backs)
    - Sunk Costs (ignore them)
- Then calculate NPV using an appropriate cost of capital
- Perform sensitivity and scenario analysis