Chapter 08 Fundamentals of Capital Budgeting

Learning objectives

- Given a set of facts, identify relevant cash flows for a capital budgeting problem.
- Explain why opportunity costs must be included in cash flows, while sunk costs and interest expense must not.
- Calculate taxes that must be paid, including tax loss carryforwards and carrybacks.
- Calculate free cash flows for a given project.
- Illustrate the impact of depreciation expense on cash flows.
- Describe the appropriate selection of discount rate for a particular set of circumstances.
- Use breakeven analysis, sensitivity analysis, or scenario analysis to evaluate project risk.

Capital Budgeting and Incremental Earnings

- Capital Budgeting
  - Process used to analyze alternate investments and decide which ones to accept.
- Incremental Earnings
  - The amount by which the firm's earnings are expected to change as a result of the investment decision.

Example

- United is considering a proposal to produce hog feed.
- The hog feed project requires an investment in new plant and equipment of $2.20 million. This could be depreciated for tax purposes straight-line over 10 years to zero salvage value. However, the plant and equipment will be sold when the project is terminated for $1.8 million.
- The project will generate sales for 3 years and will be terminated at the end of year 4.

Example

- Year 1 sales of hog feed are expected to be 10,000 tons at $520 per ton, and thereafter quantity is forecasted to grow by 4% a year while the price remains constant.
- Costs are expected to be $416 per ton.
- Profits are subject to tax at 40% and the cost of capital is 13%.
- The project requires an initial investment in working capital of $450,000 due to increase in inventory ($350,000), receivables ($200,000) and payables ($100,000). Thereafter, receivables will be 10% of sales, inventories and payables will be 10% of costs in years 1 through 3.
- What is the NPV of the project?

Incremental Earnings Forecast

	0	1	2	3	4
Quantity sold (tons)		10,000	10,400	10,816	
Price per ton		520.00	520.00	520.00	
Change in quantity			4.00%	4.00%	
Change in price			0.00%	0.00%	
Costs per ton		416.00	416.00	416.00	

	0	1	2	3	4
Sales					0
Cost of goods sold					
Depreciation					
EBIT					
Tax					
Unlevered net income					

Capital Expenditures and Depreciation

- The $2.2 million in new plant and equipment is a cash expense, but it is not directly listed as an expense when calculating earnings. Instead, the firm deducts a fraction of the cost of these items each year as depreciation.
- Straight line depreciation
  - The asset's cost is divided equally over its life.
  - Annual depreciation = ($2.2 million - $0) ÷ 10 years = $220,000 per year

Interest Expense, Taxes and Unlevered Net Income

- In capital budgeting decisions, interest expense is typically not included. The rationale is that the project should be judged on its own, not on how it will be financed.
- Taxes are based on marginal corporate tax rate
  - The tax rate on the marginal or incremental dollar of pre-tax income.
  - $Income\ tax = EBIT \times \tau_c$
  - Note: A negative tax (if taxable income is negative or there is a capital loss) is equal to a tax credit.
- Unlevered net income
  - $Unlevered\ net\ income = EBIT \times (1 - \tau_c)$
  - $Unlevered\ net\ income = (Sales - Costs - Depreciation) \times (1 - \tau_c)$

Indirect Effects on Incremental Earnings

- Opportunity cost
  - The value a resource could have provided in its best alternative use – typically it is the sale price.
  - If the hog feed project utilizes previously unused plant, then we need to incorporate the opportunity cost of the plant, selling price (after-tax).
- Project externalities
  - Indirect effects of the project that may affect the profits of other business activities of the firm. Cannibalization is when sales of a new product displaces sales of an existing product.
  - If the hog feed project increases the sales of other feeds by $100,000 per year then there is a positive externality to include together with the added cost.

Sunk Costs

- Sunk costs are costs that have been or will be paid regardless of the decision whether or not the investment is undertaken.
  - Sunk costs should not be included in the incremental earnings analysis.
- Fixed overhead expenses
  - Typically overhead costs are fixed and not incremental to the project and should not be included in the calculation of incremental earnings.
- Past research and development expenditures
  - Money that has already been spent on R&D is a sunk cost and therefore irrelevant. The decision to continue or abandon a project should be based only on the incremental costs and benefits of the product going forward.
- Unavoidable competitive effects
  - When developing a new product, firms may be concerned about the cannibalization of existing products.
  - However, if sales are likely to decline in any case as a result of new products introduced by competitors, then these lost sales should be considered a sunk cost.

Determining Free Cash Flow and NPV

- The incremental effect of a project on a firm's available cash is its free cash flow.
- $Free\ cash\ flow = Unlevered\ net\ income + Depreciation - Capital\ expenditures - Change\ in\ net\ working\ capital$
- $Free\ cash\ flow = (Sales - Costs - Depreciation) \times (1 - \tau_c) + Depreciation - Capital\ expenditures - Change\ in\ net\ working\ capital$
- $Free\ cash\ flow = (Sales - Costs) \times (1 - \tau_c) - Capital\ expenditures - Change\ in\ net\ working\ capital + \tau_c \times Depreciation$
- The $\tau_c \times Depreciation$ is the depreciation tax shield or tax savings due to tax deductible depreciation expense.
- Capital expenditures and depreciation
  - Capital expenditures are the actual cash outflows when an asset is purchased. These cash outflows are included in calculating free cash flow.
  - Depreciation is a non-cash expense. The free cash flow estimate is adjusted for this non-cash expense.

Change in Net Working Capital

- Net Working Capital (NWC)
  - Most projects will require an investment in net working capital.
  - $Net\ working\ capital = Current\ assets - Current\ liabilities$
  - $Net\ working\ capital = Cash + Inventory + Receivable - Payables$
  - Trade credit is the difference between receivables and payables.
  - The increase in net working capital is defined as: $\Delta NWC_t = NWC_t - NWC_{t-1}$

Change in Net Working Capital

	0	1	2	3	4
Inventory (% of costs)	350,000	10.00%	10.00%	10.00%	
Receivables (% of sales)	200,000	10.00%	10.00%	10.00%	
Payables (% of costs)	100,000	10.00%	10.00%	10.00%	
Sales		5,200,000	5,408,000	5,624,320	0
Cost of goods sold		4,160,000	4,326,400	4,499,456	
Inventory	350,000				0
Receivables	200,000				0
Payables	100,000				0
Net working capital	450,000				0
Change in net working capital	450,000				

After-Tax Salvage Value

Plant and equipment purchase	2,200,000
Accumulated depreciation	
Book value	
Sale of plant and equipment	1,800,000
Book value	
Gain or loss from sale	
Tax on gain or loss	
Sale of plant and equipment	1,800,000
Tax on gain or loss	
After-tax salvage value	

Free Cash Flow

Free Cash Flow	0	1	2	3	4
Unlevered net income					
Plus: Depreciation					
Less: Capital expenditures					
Plus: After-tax salvage value					
Less: Change in net working capital					
Free cash flow					
NPV					

Outsourcing

- Suppose that United could outsource the production of hog feed to a nearby plant with unused capacity.
- In this case, costs per ton to United would be $480 with an additional transportation costs of $200,000 per year.
- Outsourcing the production would cause an increase in payables of $210,000 at the beginning of the project and 5% of all costs thereafter.
- Outsourcing will have no impact on inventory and receivables.
- Assume other variables are the same.
- Should United outsource the production?
- How does the outsourcing alternative compare to actual production?

Outsourcing

	0	1	2	3	4
Quantity sold (tons)		10,000	10,400	10,816	
Price per ton		520.00	520.00	520.00	
Change in quantity			4.00%	4.00%	
Change in price			0.00%	0.00%	
Costs per ton		480.00	480.00	480.00	

	0	1	2	3	4
Sales		5,200,000	5,408,000	5,624,320	0
Cost of goods sold					
Transportation		200,000	200,000	200,000	
Depreciation		0	0	0	
EBIT					
Tax					
Unlevered net income					

Outsourcing

	0	1	2	3	4
Inventory (% of costs)	0	0.00%	0.00%	0.00%	
Receivables (% of sales)	0	0.00%	0.00%	0.00%	
Payables (% of costs)	210,000	5.00%	5.00%	5.00%	
Total costs					
Inventory	0	0	0	0	0
Receivables	0	0	0	0	0
Payables					0
Net working capital					0
Change in net working capital					
Free Cash Flow	0	1	2	3	4
Unlevered net income					
Plus: Depreciation		0	0	0	
Less: Capital expenditures	0				
Plus: After-tax salvage value					0
Less: Change in net working capital					
Free cash flow					
NPV					

Further Adjustments to Free Cash Flow

- Other non-cash Items
  - Amortization is not a cash expense and should not reduce unlevered net income.
- Timing of cash flows
  - Cash flows are often spread throughout the year.
- Accelerated Depreciation
  - Modified Accelerated Cost Recovery System (MACRS) depreciation. Depreciation expense is based on cost recovery periods and rates.

Further Adjustments to Free Cash Flow

- Continuation value
  - This amount represents the market value of the free cash flow from the project at all future dates.
  - $Continuation\ value_t = \frac{FCF_t \times (1+g)}{r-g}$
- Example
  - If United's fog feed project generates free cash flows that grow at 2% per year forever after year 3, what would be the net present value? Assume that NWC recovery and after-tax salvage value are irrelevant.

Continuation Value

Free cash flow growth rate	2.00%				
Free Cash Flow	0	1	2	3	4
Free cash flow	-2,650,000	642,000	716,160	741,286	
Continuation value					
Free cash flow	-2,650,000	642,000	716,160		
NPV					

Replacement

- Example
  - Suppose you are evaluating if an old machine used in the production of pens be replaced.
  - Existing machine has a current salvage value of $1 million with a $0.5 million book value. If the existing machine is kept, its depreciation expense would be $0.1 million per year for the next 10 years.
  - A new machine can be purchased for $2.0 million and be depreciated over 10 years to zero salvage value.
  - After 10 years both machines would have no salvage values.
  - New machine is expected to generate $400,000 more in EBITDA.
  - If the tax rate is 35% and cost of capital is 8%, should the existing machine be replaced.

Rent or Purchase

- Example
  - Suppose you are evaluating if the a new machine be purchased or rented to produce pens – see previous example.
  - Machines (whether purchased or rented) are identical.
  - If purchased the maintenance cost would be $150,000 per year.
  - If rented the annual cost is $520,000. Which option is more attractive?

Sensitivity Analysis

- Break-even analysis

Parameter	Break-even level
Quantity sold (tons)	7,265
Price per ton	493.78
Costs per ton	441.72
Cost of capital	18.38%

Sensitivity Analysis

- Scenario analysis

Parameter	Initial assumptions	Worst case	Best case
Quantity sold (tons)	10,000	6,000	14,000
Price per ton	520	500	530
Costs per ton	416	485	405
Cost of capital	13.00%	16.00%	8.00%
NPV	**377,887**	**-1,098,365**	**1,902,947**