

Corporate Finance, Berk, Jonathan and Demarzo, Peter, 3rd Edition

Chapter 8: Fundamentals of Capital Budgeting

Key Points:

- Determine what components to include in the Cash Flow
- Determining Free Cash Flows
- Calculating NPV and choosing projects
- Further adjustments to cash flows

8.1 Forecasting Earnings

- Capital budgeting lists the projects/investments that a company can undertake

Memorization: Definition

Incremental Earnings: the amount by which the firm's earnings change as a result of the investment

Revenue and Cost Estimates

- Consider a new project in the Linksys division of Cisco called HomeNet.
- HomeNet will generate 100,000 units of sales per year and will have a 4 year life
- It will be sold for \$375 with a wholesale price of \$260
- Total engineering and design costs will be \$5 million
- The production will be outsourced at a cost of \$110 per unit
- A one time investment in new equipment will cost \$7.5 million upfront
- A team of 50 software engineers at \$200,000 per engineer is needed upfront as well
- Marketing will be \$2.8 million per year

Incremental Earnings Forecast

- The expected revenue is 26 million per year ($100,000 * \$260$) and the expected production cost is \$11 million per year ($\$100,000 * \110)
- HomeNet has a Gross Profit of \$15 million per year
- Selling, General and Admin expenses are \$2.8 million per year (marketing expense above)
- Research and Development is an upfront cost of \$15 million ($\$5.0M + \$0.2M * 50$ engineers)
- Capital Expenditure of \$7.5M is needed for new equipment (utilize straight-line depreciation over 5 years)
- Depreciation is then $\$7.5/5$ years = \$1.5M per year

Year	0	1	2	3	4	5
Sales	-	26,000	26,000	26,000	26,000	-
COGS	-	(11,000)	(11,000)	(11,000)	(11,000)	-
Gross Profit	-	15,000	15,000	15,000	15,000	-
Selling, General, Admin	-	(2,800)	(2,800)	(2,800)	(2,800)	-
R&D	(15,000)	-	-	-	-	-
Depreciation	-	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)
EBIT	(15,000)	10,700	10,700	10,700	10,700	(1,500)
Income Tax (40%)	6,000	(4,280)	(4,280)	(4,280)	(4,280)	600
Unlevered Net Income	(9,000)	6,420	6,420	6,420	6,420	(900)

$$\text{Unlevered Net Income} = \text{EBIT} \times (1 - \tau_c) = (\text{Revenues} - \text{Costs} - \text{Depreciation}) \times (1 - \tau_c)$$

Indirect Effects on Incremental Earnings

Opportunity Costs

Memorization: Definition

Opportunity Cost: the value the resources being used could have provided in its best alternative use

- Projects use resources that the company already owns
- Since this value is lost it should be removed from the incremental earnings in our analysis
- Common mistake is to assume that any asset that is currently not in use has an opportunity cost of \$0, this is not true because the firm could choose to sell the asset or rent the asset out.

Example:

Suppose HomeNet's new lab will be housed in a warehouse that the company would have otherwise rented for \$200,000 per year during years 1-4. How does this opportunity cost affect HomeNet's Incremental Earnings?

Solution:

The opportunity cost of using the warehouse instead of renting it out would be the lost earnings, which are equal to $\$200,000 \times (1 - 40\%) = \$120,000$ per year.

HomeNet:

- The lost rental income of \$200,000 per year will result in Selling, General and Admin expenses increasing from \$2.8 million to \$3.0 million for the HomeNet project.

Project Externalities

- Indirect effects of the project that may increase or decrease the profits of the business activities of the firm

Memorization: Definition

Cannibalization: when sales of a new product displace sales of an existing product

HomeNet:

- Suppose that 25,000 units of an older model selling for \$100 a unit will be cannibalized by HomeNet
- This will cost Cisco \$2.5 million per year in lost sales revenue, the cost of the existing router is \$60 per unit so Cisco will also save $60 \times 25,000 = \$1.5$ million in COGS each year.
- The resulting effect on the incremental earnings is as follows:

Year	0	1	2	3	4	5
Sales	-	23,500	23,500	23,500	23,500	-
COGS	-	(9,500)	(9,500)	(9,500)	(9,500)	-
Gross Profit	-	14,000	14,000	14,000	14,000	-
Selling, General, Admin	-	(3,000)	(3,000)	(3,000)	(3,000)	-
R&D	(15,000)	-	-	-	-	-
Depreciation	-	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)
EBIT	(15,000)	9,500	9,500	9,500	9,500	(1,500)
Income Tax (40%)	6,000	(3,800)	(3,800)	(3,800)	(3,800)	600
Unlevered Net Income	(9,000)	5,700	5,700	5,700	5,700	(900)

Sunk Costs and Incremental Earnings

Memorization: Definition

Sunk Cost: unrecoverable cost for which the firm is already liable

Fixed Overhead Expenses

- Overhead Expenses: expenses associated with activities that are not directly attributable to a single business activity but instead affect many business areas of the corporation
- You would not include overhead expenses in incremental expenses unless they are “additional” overhead expenses that the project creates

Past Research and Development Expenditures

- Any money that has already been spent on R&D is a sunk cost and is irrelevant to the incremental cash flows

Unavoidable Competitive Effects

- If sales of existing products will decline due to cannibalization but would also decline because competitors will release new products that would replace them, then these costs are sunk costs and we would not include them in incremental cash flows

Real World Complexities

- Estimates of revenues and costs will be more complex in reality

HomeNet:

Suppose that the expected sales units are 100,000 in year 1, 125,000 in year 2-3 and 50,000 in year 4. Also suppose that the cost to manufacture the products declines by 10% per year. Also assume that selling, general and admin expenses increase with inflation of 4% per year. The new projection is:

Year	0	1	2	3	4	5
Sales	-	23,500	26,438	23,794	8,566	-
COGS	-	(9,500)	(10,688)	(9,619)	(3,463)	-
Gross Profit	-	14,000	15,750	14,175	5,103	-
Selling, General, Admin	-	(3,000)	(3,120)	(3,245)	(3,375)	-
R&D	(15,000)	-	-	-	-	-
Depreciation	-	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)
EBIT	(15,000)	9,500	11,130	9,430	228	(1,500)
Income Tax (40%)	6,000	(3,800)	(4,452)	(3,772)	(91)	600
Unlevered Net Income	(9,000)	5,700	6,678	5,658	137	(900)

8.2 Determining Free Cash Flow and NPV

Calculating Free Cash Flow from Earnings

Capital Expenditures and Depreciation

- Depreciation is not a cash item so we do not include it in the cash flow forecast, we include capital expenditures that are used to purchase the asset instead

Year	0	1	2	3	4	5
Sales	-	23,500	23,500	23,500	23,500	-
COGS	-	(9,500)	(9,500)	(9,500)	(9,500)	-
Gross Profit	-	14,000	14,000	14,000	14,000	-
Selling, General, Admin	-	(3,000)	(3,000)	(3,000)	(3,000)	-
R&D	(15,000)	-	-	-	-	-
Depreciation	-	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)
EBIT	(15,000)	9,500	9,500	9,500	9,500	(1,500)
Income Tax (40%)	6,000	(3,800)	(3,800)	(3,800)	(3,800)	600
Unlevered Net Income	(9,000)	5,700	5,700	5,700	5,700	(900)
Free Cash Flows						
Plus: Depreciation	-	1,500	1,500	1,500	1,500	1,500
Less: CapEx	(7,500)	-	-	-	-	-
Less: Inc in NWC	-	(2,100)	-	-	-	2,100
Free Cash Flow	(16,500)	5,100	7,200	7,200	7,200	2,700

Net Working Capital (NWC)

- Difference between Current Assets and Current Liabilities

$$Net\ Working\ Capital = Current\ Assets - Current\ Liabilities$$

$$Net\ Working\ Capital = Cash + Inventory + Receivables - Payables$$

- Most projects require firm’s to invest in net working capital
- Firm’s may need to keep a cash balance to fund unexpected expenditure, inventories and raw materials
- Trade Credit: Difference between a firm’s receivables and payables
- The increase in networking capital each year needs to be included in the incremental cash flows
- The increase in networking capital is:

$$\Delta NWC_t = NWC_t - NWC_{t-1}$$

HomeNet:

- Assume that there will be no inventory held as products will ship directly from manufacturer to customer
- Assume that 15% of sales will be on account (A/R is 15% of sales) and 15% of COGS will be on account (A/P is 15% of COGS)

Year	0	1	2	3	4	5
Cash Requirements	-	-	-	-	-	-
Inventory	-	-	-	-	-	-
A/R	-	3,525	3,525	3,525	3,525	-
A/P	-	(1,425)	(1,425)	(1,425)	(1,425)	-
Net Working Capital	-	2,100	2,100	2,100	2,100	-

Calculating Free Cash Flow Directly

Free Cash Flow

$$= (Revenues - COGS - Depreciation)(1 - \tau_c) + Depreciation - CapEx - \Delta NWC$$

- This formula can be simplified through algebra to the following:

$$FCF = (Revenue - COGS)(1 - \tau_c) - CapEx - \Delta NWC + \tau_c \times Depreciation$$

- The $\tau_c \times Depreciation$ field is called the “Depreciation Tax Shield”, the tax savings that result from the ability to deduct depreciation

Calculating the NPV

- Need to discount HomeNet’s Free Cash Flows using the appropriate cost of capital
- The discount rate is developed later, for now assume that the rate is 12%

$$PV(FCF_t) = \frac{FCF_t}{(1+r)^t}$$

Free Cash Flow	(16,500)	5,100	7,200	7,200	7,200	2,700
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$$NPV = -16500 + \frac{5100}{1.12} + \frac{7200}{1.12^2} + \frac{7200}{1.12^3} + \frac{7200}{1.12^4} + \frac{2700}{1.12^5} = 5,025.97$$

8.3 Choosing Among Alternatives

- Compute the FCF for each project and compare the NPVs to determine which project to choose

Evaluating Manufacturing Alternatives

- Currently Cisco is outsourcing the production at a cost of \$110 per unit
- The A/P in year 1 for the Outsourced Assembly scenario is $0.15 \times 11M = 1.645M$, this means that the increase in NWC is $-1.645M$, this adds to the FCF in year 1. This is reversed at time 5.
- If brought internally, the cost would be \$95 per unit with an initial \$5 million investment upfront
- Starting in year 1, Cisco will need to maintain inventory of one month's production as a result of needing to hold inventory now, this is equal to $\$9.5M/12 = 0.792M$
- The NWC in year 1 for this scenario is: $0.792 - 0.15 \times 9.5 = -0.633M$, this adds to the FCF in year 1. This is reversed at time 5.
- To choose between these two alternatives we compute the NPV of each and select the one with the highest value

Outsourced Assembly (NPV of Costs only)

Year	0	1	2	3	4	5
EBIT	-	(11,000)	(11,000)	(11,000)	(11,000)	-
Income Tax	-	4,400	4,400	4,400	4,400	-
Unlevered Net Income	-	(6,600)	(6,600)	(6,600)	(6,600)	-
Less: Inc in NWC	-	(1,650)	-	-	-	1,650
Free Cash Flow	-	(4,950)	(6,600)	(6,600)	(6,600)	(1,650)

$$NPV(12\%) = (19,510)$$

In-House Assembly (NPV of Costs only)

Year	0	1	2	3	4	5
EBIT	(5,000)	(9,500)	(9,500)	(9,500)	(9,500)	-
Income Tax	2,000	3,800	3,800	3,800	3,800	-
Unlevered Net Income	(3,000)	(5,700)	(5,700)	(5,700)	(5,700)	-
Less: Inc in NWC	-	(633)	-	-	-	633
Free Cash Flow	(3,000)	(5,067)	(5,700)	(5,700)	(5,700)	(633)

$$NPV(12\%) = (20,107)$$

Comparing Free Cash Flows for Cisco's Alternatives

- The above two tables compare the costs of each alternative and the different Net Working Capital components.
- Outsourcing is cheaper as it has an NPV of 19.5 million versus 20.1 million

8.4 Further Adjustments to Free Cash Flow

Other Non-Cash Items:

- Other non-cash items that appear as part of incremental earnings should not be included in free cash flow (Ex: amortization of patents)

Timing of Cash Flows:

- Cash flows will be spread out throughout the year, can forecast on quarterly, monthly or even continuous basis

Accelerated Depreciation:

- It is in the interest of the firm to depreciate its assets as fast as possible to get the depreciation tax shields sooner
- The fastest method allowed in the US is the MACRS (Modified Accelerated Cost Recovery System)
- Categorize assets to their recovery period, based on the recovery period MACRS assigns a fraction of the purchase price the firm can recover each year

Liquidation or Salvage Value:

- Assets that are no longer needed have a resale/salvage value if they are sold
- Some assets have a negative liquidation value (costs money to dispose of them after they are used)
- We should include the liquidation value or salvage value in the NPV calculation

$$\begin{aligned} \textit{Gain on Sale} &= \textit{Sale Price} - \textit{Book Value} \\ &= \textit{Sale Price} - (\textit{Purchase Price} - \textit{Accumulated Depreciation}) \end{aligned}$$

- Must adjust the project's free cash flow to account for the after-tax cash flow that results from liquidation or salvage:

$$\textit{After - Tax Cash Flow from Asset Sale} = \textit{Sale Price} - (\tau_c \times \textit{Gain on Sale})$$

Terminal or Continuation Value:

- When a firm forecasts the free cash flow over a shorter time horizon than the full horizon of the project/investment, then we need to estimate the future value that the project creates
- We include a one-time cash flow at the end of the forecast period to account for this, known as the terminal or continuation value

Tax Carryforwards:

- Companies can carryforward or carryback losses to offset previous/future gains and lower the resulting tax paid

8.5 Analyzing the Project**Break-Even Analysis**

- Determine what assumption for a certain input produces an NPV equal to 0
- The IRR is the break-even analysis for the discount rate
- Can test what level of sales is needed to produce an NPV of 0, what price produces an NPV of zero, etc.

Sensitivity Analysis

- Breaks the NPV calculation into its component assumptions and shows how the NPV changes when we vary the underlying assumptions
- Allows us to understand how sensitive the results are to different assumptions in the model
- We can invest further into the assumptions that are the most sensitive

Scenario Analysis

- Considers the effect on the NPV of changing multiple project parameters at once
- Use scenario analysis to evaluate alternative pricing strategies for the product being sold