CHAPTER 7

Fundamentals of Capital Budgeting

Chapter Synopsis

7.1 Forecasting Earnings

A firm's **capital budget** lists all of the projects that a firm plans to undertake during the next period. The selection of projects that should be included in the capital budget is called the **capital budgeting** decision. To evaluate a project, the project's future free cash flows must first be estimated. Some aspects of a project will affect the firm's revenues, while others will affect its costs.

The first step is generally to generate revenue and cost estimates and forecast expected incremental income statements for the project. For example, in the HomeNet project example in this chapter, the following income statements were forecasted in Spreadsheet 7.1:

TABLE 7.1 SPREADSHEET **HomeNet's Incremental Earnings Forecast**

	Year	0	1	2	3	4	5
Incremental Earnings Forecast ($000s)							
1	Sales	–	26,000	26,000	26,000	26,000	–
2	Cost of Goods Sold	–	(11,000)	(11,000)	(11,000)	(11,000)	–
3	Gross Profit	–	15,000	15,000	15,000	15,000	–
4	Selling, General, and Administrative	–	(2,800)	(2,800)	(2,800)	(2,800)	–
5	Research and Development	(15,000)	–	–	–	–	–
6	Depreciation	–	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)
7	EBIT	(15,000)	10,700	10,700	10,700	10,700	(1,500)
8	Income Tax at 40%	6,000	(4,280)	(4,280)	(4,280)	(4,280)	600
9	Unlevered Net Income	(9,000)	6,420	6,420	6,420	6,420	(900)

- **Capital Expenditures and Depreciation.** Investments in plant, property, and equipment are not directly listed as expenses when calculating earnings. Instead, the firm deducts a fraction of the cost of these items each year as depreciation. Several different methods

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are used to compute depreciation. The simplest method is straight-line depreciation, in which the asset's cost is divided equally over its life.

- **Interest Expenses.** When evaluating a capital budgeting decision, interest expense is generally not included in the income statement. The effects of using debt financing, such as incurring interest expense, is accounted for in the appropriate discount rate used to evaluate this project, the weighted average cost of capital, which is discussed in detail later in the text. Thus, the net income computed in Spreadsheet 7.1 is referred to as the **unlevered net income** of the project, indicating that it does not include any interest expenses associated with using debt financing.
- **Taxes.** The correct tax rate to use is the firm's marginal corporate tax rate, which is the tax rate it will pay on an incremental dollar of pre-tax income.

Project externalities are indirect effects of the project that may increase or decrease the cash flow of other business activities of the firm.

- The **opportunity cost** of using a resource is the value it could have provided in its best alternative use. Because this value is lost when the resource is used by another project, the opportunity cost should be included as an incremental cost of the project.
- A **sunk cost** is any cost that has been paid (such as past research and development expenses) or will be paid regardless of the decision whether to proceed with the project. Therefore, it is not incremental with respect to the current decision and should not be included in the analysis.
- When sales of a new product displace sales of an existing product, the situation is often referred to as **cannibalization.**
- **Overhead expenses** are associated with activities that are not directly attributable to a single business activity but instead affect many different areas of the corporation. To the extent that these overhead costs are fixed and will be incurred in any case, they are not incremental to the project and should not be included.

7.2 Determining Free Cash Flow and NPV

The incremental effect of a project on the firm's available cash is the project's **free cash flow** (FCF). It can be calculated as:

$$\text{Free Cash Flow (FCF)} = \text{EBIT} \times (1 - \tau) + \text{Depreciation} - \text{Capital Expenditures} - \Delta\text{NWC}$$

- Since depreciation is not a cash expense (it is a method used for accounting and tax purposes to allocate the original purchase cost of the asset over its life), it should be added back to the unlevered net income. Depreciation does have an effect on FCF—it reduces taxes be $\text{Depreciation} \times (1 - \tau)$, the **depreciation tax shield.**
- **Capital expenditures** are cash payments made to acquire fixed assets.
- **Net working capital** is the difference between current assets and current liabilities. The main components of net working capital are cash, inventory, accounts receivable, and accounts payable.

$$\begin{aligned}\text{Net Working Capital (NWC)} &= \text{Current Assets} - \text{Current Liabilities} \\ &\approx \text{Cash} + \text{Inventory} + \text{Accounts Receivable} - \text{Accounts Payable}\end{aligned}$$

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Most projects will require the firm to invest in net working capital—often at a project's inception (time 0). The annual investment required investment is as follows.

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

While it is generally assumed that cash flows occur at annual intervals beginning in one year, in reality, cash flows will typically be spread throughout the year. Cash flows can also be forecasted on a quarterly, monthly, or even continuous basis when greater accuracy is required.

Because depreciation contributes positively to the firm's cash flow through the depreciation tax shield, the most accelerated method of depreciation that is allowable for tax purposes increases the value of a project. In the United States, the most accelerated depreciation method allowed by the IRS is Modified Accelerated Cost Recovery System (MACRS) depreciation. With MACRS depreciation, assets are categorized according to their asset class, and a corresponding MACRS depreciation tables assigns a fraction of the purchase price that the firm can depreciate each year.

For the HomeNet project considered in the chapter, FCFs were forecasted in Spreadsheet 7.3.

TABLE 7.3 SPREADSHEET **Calculation of HomeNet's Free Cash Flow (Including Cannibalization and Lost Rent)**

	Year	0	1	2	3	4	5
Incremental Earnings Forecast ($000s)							
1	Sales	–	23,500	23,500	23,500	23,500	–
2	Cost of Goods Sold	–	(9,500)	(9,500)	(9,500)	(9,500)	–
3	**Gross Profit**	–	14,000	14,000	14,000	14,000	–
4	Selling, General, and Administrative	–	(3,000)	(3,000)	(3,000)	(3,000)	–
5	Research and Development	(15,000)	–	–	–	–	–
6	Depreciation	–	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)
7	**EBIT**	(15,000)	9,500	9,500	9,500	9,500	(1,500)
8	Income Tax at 40%	6,000	(3,800)	(3,800)	(3,800)	(3,800)	600
9	**Unlevered Net Income**	**(9,000)**	**5,700**	**5,700**	**5,700**	**5,700**	**(900)**
Free Cash Flow ($000s)							
10	Plus: Depreciation	–	1,500	1,500	1,500	1,500	1,500
11	Less: Capital Expenditures	(7,500)	–	–	–	–	–
12	Less: Increases in NWC	–	(2,100)	–	–	–	2,100
13	**Free Cash Flow**	**(16,500)**	**5,100**	**7,200**	**7,200**	**7,200**	**2,700**

Once the FCFs over the life of a project have been determined, the NPV can be calculated as:

$$\text{NPV} = \text{FCF}_0 + \frac{\text{FCF}_1}{(1+r)^1} + \frac{\text{FCF}_2}{(1+r)^2} + \cdots + \frac{\text{FCF}_T}{(1+r)^T} = \sum_{t=0}^{T} \frac{\text{FCF}_t}{(1+r)^t}.$$

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For the HomeNet example in the chapter, the NPV was found to be positive; it was calculated in Spreadsheet 7.5.

TABLE 7.5 SPREADSHEET **Computing HomeNet's NPV**

	Year	0	1	2	3	4	5
Net Present Value ($000s)							
1 Free Cash Flow		(16,500)	5,100	7,200	7,200	7,200	2,700
2 Project Cost of Capital	12%						
3 Discount Factor		1.000	0.893	0.797	0.712	0.636	0.567
4 PV of Free Cash Flow		(16,500)	4,554	5,740	5,125	4,576	1.532
5 NPV		5,027					

7.3 Choosing Among Alternatives

In many situations, you must compare mutually exclusive alternatives, each of which has consequences for the firm's cash flows. In such cases, you can make the best decision by first computing the free cash flow associated with each alternative and then choosing the alternative with the highest NPV.

7.4 Further Adjustments to Free Cash Flow

A number of complications can arise when estimating a project's free cash flow, such as non-cash charges, alternative depreciation methods, liquidation or continuation values, and tax loss carryforwards.

Other non-cash items that appear as part of incremental earnings should not be included in the project's free cash flow. The firm should include only actual cash revenues or expenses. For example, the firm adds back any amortization of intangible assets (such as patents) to unlevered net income when calculating free cash flow.

Because depreciation contributes positively to the firm's cash flow through the depreciation tax shield, it is in the firm's best interest to use the most accelerated method of depreciation that is allowable for tax purposes. By doing so, the firm will accelerate its tax savings and increase its present value. In the United States, the most accelerated depreciation method allowed by the IRS is MACRS (Modified Accelerated Cost Recovery System) depreciation. With MACRS depreciation, the firm first categorizes assets according to their recovery period. Based on the recovery period, MACRS depreciation tables assign a fraction of the purchase price that the firm can recover each year.

Assets that are no longer needed often have a resale value or some salvage value if the parts are sold for scrap. When an asset is liquidated, any gain on sale is taxed. The gain on sale is the difference between the sale price and the book value of the asset. The book value is equal to the asset's original cost less the amount it has already been depreciated for tax purposes. You must adjust the project's free cash flow to account for the after-tax cash flow that would result from an asset sale as:

After-Tax Cash Flow from Asset Sale = Sale Price – (t_c x Gain on Sale).

Sometimes the firm explicitly forecasts free cash flow over a shorter horizon than the full horizon of the project or investment. This is necessarily true for investments with an indefinite life, such as an expansion of the firm. In this case, we estimate the value of the remaining free cash flow beyond the forecast horizon by including an additional, one-time cash flow at the end of the forecast horizon called the **terminal** or **continuation value** of the project. This amount represents the market value (as of the last forecast period) of the free

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cash flow from the project at all future dates. For example, when analyzing investments with long lives, it is common to explicitly calculate free cash flow over a short horizon, and then assume that cash flows grow at some constant rate beyond the forecast horizon.

Since 1997, companies can utilize **tax loss carrybacks** from the last two years to offset taxable income in the current year. They can also utilize **tax loss carryforwards** and use losses in the current year to reduce taxable income for up to 20 years in the future.

7.5 Analyzing the Project

Sensitivity analysis shows how the NPV varies when changing one variable. **Scenario** analysis considers the effect on the NPV of changing multiple project variables together. As part of a project analysis it is useful to perform **break-even analysis** by studying how far a variable can be changed until the project's NPV is 0.

Selected Concepts and Key Terms

Capital Budgeting, Capital Budget

The capital budget lists all of the projects that a firm plans to undertake during the next period. The selection of projects that should be included in the capital budget is called the capital budgeting decision.

Unlevered Net Income

When evaluating a capital budgeting decision, interest expense is generally not included in the income statement, and the effects of using debt financing, such as incurring interest expense, is accounted for in the appropriate discount rate used to evaluate this project, the weighted average cost of capital, discussed in detail later. Thus, the net income does not include interest expense, and it is referred to as the unlevered net income.

Marginal Corporate Tax Rate

The tax rate a firm will pay on the next incremental dollar of pre-tax income.

Cannibalization

When sales of a new product displace sales of an existing product.

Opportunity Cost

The value an asset could provide in its best alternative use. Because this value is lost when the resource is used by another project, it should be included as an incremental cost of the project.

Sunk Cost

Any unrecoverable cost for which the firm is already liable. Sunk costs have been or will be paid regardless of the decision whether to proceed with the project, and therefore they should not be included in the analysis of the project.

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Free Cash Flow

The periodic incremental effect of a project on the firm's available cash. It can generally be calculated as operating cash flow minus capital spending minus the increase in net working capital.

Trade Credit

The difference between accounts receivable and accounts payable; it is the net amount of the firm's capital that is used as a result of credit transactions.

Depreciation Tax Shield

The tax savings that results from the ability to deduct depreciation. It generally equals depreciation expense $\times$ tax rate.

Modified Accelerated Cost Recovery System (MACRS) Depreciation

The most accelerated depreciation method allowed by the Internal Revenue Service. Assets are categorized according to their asset class and a corresponding MACRS depreciation tables assigns a fraction of the purchase price that the firm can depreciate each year.

Terminal Value, Continuation Value

The present value (as of the last forecast period) of the free cash flow from the project at all future dates after the last forecast period.

Break-Even Analysis

Studying how far a variable can be changed until the project's NPV is 0.

Sensitivity Analysis

An analysis of how the NPV of a project varies when changing one variable.

Scenario Analysis

An analysis of how the NPV of a project varies when changing multiple project variables together.

Concept Check Questions and Answers

7.1.1. How do we forecast unlevered net income?

Interest and other financing-related expenses are excluded from the forecasted income statements to determine a project's unlevered net income.

7.1.2. Should we include sunk costs in the cash flows of a project? Why or why not?

We should not include sunk costs in the cash flows of a project because sunk costs must be paid regardless of whether or not the firm decides to proceed with the project. Sunk costs are not incremental with respect to the current decision.

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7.1.3. Explain why you must include the opportunity cost of using a resource as an incremental cost of a project.

We must include the opportunity cost of using a resource as an incremental cost of a project because that resource can be used in the next-best alternative way. It is a mistake to assume that the resource is free.

7.2.1. What adjustments must you make to a project's unlevered net income to determine its free cash flows?

You must add depreciation back (because it is a non-cash expense) and subtract capital spending and the change in working capital.

7.2.2. What is the depreciation tax shield?

The depreciation tax shield is the reduction in tax expense from the ability to deduct depreciation expense before determining taxable income.

7.3.1. How do you choose between mutually exclusive capital budgeting decisions?

You can make the best decision by first computing the free cash flows and NPVs of each alternative and then choosing the alternative with the highest NPV.

7.3.2. When choosing between alternatives, what cash flows can be ignored?

Components of free cash flow that are the same in each alternative can be ignored.

7.4.1. Explain why it is advantageous for a firm to use the most accelerated depreciation schedule possible for tax purposes.

Because depreciation contributes positively to the firm's cash flow through the depreciation tax shield, it is in the firm's best interest to use the most accelerated method of depreciation that is allowable for tax purposes. By doing so, the firm will accelerate its tax savings and increase its present value.

7.4.2. What is the continuation or terminal value of a project?

The continuation or terminal value of a project is the estimated value of the remaining free cash flow beyond the forecast horizon of the project. This amount represents the market value (as of the last forecast period) of the free cash flow from the project at all future dates.

7.5.1. What is sensitivity analysis?

Sensitivity analysis breaks the NPV calculation into its component assumptions and shows how the NPV varies as the underlying assumptions change. In this way, sensitivity analysis allows us to explore the impact of errors in NPV estimates for the project.

7.5.2. How does scenario analysis differ from sensitivity analysis?

Sensitivity analysis changes one parameter at a time. Scenario analysis changes the effect on NPV of changing multiple project parameters simultaneously.

Examples with Step-by-Step Solutions

Solving Problems

Problems using the concepts in this chapter generally involve finding the NPV of potential projects given a cost of capital. The NPV is the present value of a project's free cash flow from time 0 to the end of the project. This requires forecasting income statements over the

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life of the project, calculating free cash flow = EBIT(1 – t) + depreciation – capital expenditures – the increase in net working capital each year, and calculating the NPV. You may also need to determine a project's IRR, which is the discount rate that makes the NPV of the project's FCFs equal to $0.

Examples

1. **Your firm owns a Volkswagen dealership, and you are considering entering into a 5-year agreement to also sell Audi A4s. The cars would cost $26,000, and you believe that you can sell 50 Audis per year at an average price of $30,000. You would have to hire 2 new sales people that you would pay $30,000 per year each plus 5% of the revenue they each generate. Audi would require that you invest $200,000 (depreciable straight line over 5 years) in Audi-related signs, equipment, and furniture to place in your dealership. You would also be required to invest in 20 cars to keep in inventory over the life of the project. After 5 years, you can recover any investment in working capital, and the unneeded equipment would have a market value of $50,000. Your firm requires a 12% return on all new investments, and the tax rate is 40%. Should you accept the project? Show your work and justify your answer.**

Step 1. Determine how you should make the decision.

The project's NPV will indicate whether the project will add value to your firm, so the NPV should be calculated.

Step 2. Determine the income statements for years 1 through 5 of the project.

Since there is straight line depreciation on the $200,000 investment in capital assets, annual depreciation is $200,000 / 5 = $40,000.

Each year will be the same.

Sales	1,500,000
Cost of goods sold	1,300,000
Gross profit	200,000
Selling, general & admin. costs	
Salary	60,000
Commission	75,000
EBITDA	65,000
Depreciation	40,000
EBIT	25,000
–Tax @ 40%	10,000
Net Income	$15,000

Step 3. Determine the Free Cash Flows for years 0 through 5.

Operating cash flow equals net income + depreciation each year, which is $15,000 + $40,000 = $55,000.

Capital spending is $200,000 at time 0.

At the end of year 5, the equipment can be sold for $50,000, resulting in an after-tax cash flow = sale price $- \tau \times$ (sale price – book value) = $50,000 – 0.40($50,000 – 0) = $30,000.

The time 0 investment in working capital is 20 cars at $26,000, or $520,000.

At the end of the project, the investment in working capital could be recovered. The year 5 income statement's cost of goods sold would be overstated by $520,000, since you

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effectively bought 20 of the cars you sold in year 5 at time 0, so the decrease in working capital is a $520,000 cash inflow.

	0	1	2	3	4	5
Operating cash flow	--	55,000	55,000	55,000	55,000	55,000
– Capital expenditures	200,000	0	0	0	0	–30,000
– Increases in working capital	520,000	0	0	0	0	–520,000
Free Cash Flow	–720,000	55,000	55,000	55,000	55,000	605,000

Step 4. Calculate the project's NPV.

$$\text{NPV} = -720{,}000 + \frac{55{,}000}{(1.12)} + \frac{55{,}000}{(1.12)^2} + \frac{55{,}000}{(1.12)^3} + \frac{55{,}000}{(1.12)^4} + \frac{55{,}000+30{,}000+520{,}000}{(1.12)^5} = -\$209{,}653 < 0$$

Since the NPV is less than zero, the project cannot be justified given the forecasts. In other words, the project costs $720,000 and is only worth about $510,347 (720,000 – 209,653). This implies that the IRR is less than 12% and can be calculated to be about 3%.

2. **Calaveras Vineyards, a highly profitable wine producer, is considering the purchase of 10,000 French oak barrels at a cost of $900 each, or $9 million for all of them. The barrels would be considered a capital expense and would be depreciated straight line over 5 years. After 4 years, the barrels will be useless for making fine wine, but they expect to be able to sell them for $3 million to Gallo. The increase in the quality of its zinfandel line of wines due to the use of the new French oak barrels is expected to increase revenue by $7 million in years 3 and 4. The barrels would have no influence on COGS, SG&A, other operating expenses, or working capital. The tax rate is 40%, and the required return is 15%.**
   [A] According to the NPV rule, is the purchase of the barrels a good idea?
   [B] According to the IRR rule, is the purchase of the barrels a good idea?

Step 1. In order to calculate the NPV and IRR, the FCFs over the life of the project (years 0 through 4) need to be calculated. Thus, the each year's income statement must be determined.

Step 2. Determine the income statements from years 1 through 4 for the project.

	1	2	3	4
Sales	0	0	7,000,000	7,000,000
– Cost of goods sold	0	0	0	0
– Selling, general & admin. costs	0	0	0	0
EBITDA	0	0	7,000,000	7,000,000
– Depreciation	1,800,000	1,800,000	1,800,000	1,800,000
EBIT	–1,800,000	–1,800,000	5,200,000	5,200,000
– Tax	–720,000	–720,000	2,080,000	2,080,000
Net income	–1,080,000	–1,080,000	3,120,000	3,120,000

Step 3. Determine operating cash flow in years 1 through 4.

	1	2	3	4
Net income	–1,080,000	–1,080,000	3,120,000	3,120,000
+ Depreciation	1,800,000	1,800,000	1,800,000	1,800,000
= Operating cash flow	720,000	720,000	4,920,000	4,920,000

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Step 4. Determine the Free Cash Flows for years 0 through 4.

	0	1	2	3	4
Operating cash flow	0	720,000	720,000	4,920,000	4,920,000
– Capital expenditures	9,000,000	0	0	0	2,520,000
– Increase in working capital	0	0	0	0	0
Free Cash Flow	–9,000,000	720,00	720,00	4,920,00	7,440,000

Since the book value of the barrels is $1.8 million after 5 years, the after-tax cash flow from selling the barrels in year 5 is = sale price $-\tau\times$(sale price – book value) = $3 million – 0.40($3 million – 1.8 million) = $2.52 million.

Step 5. Calculate the project's NPV.

$$\text{NPV}= -9{,}000{,}000 + \frac{720{,}000}{(1.15)}+\frac{720{,}000}{(1.15)^2}+\frac{4{,}920{,}000}{(1.15)^3}+\frac{7{,}440{,}000}{(1.15)^4}=-\$340{,}666 < 0$$

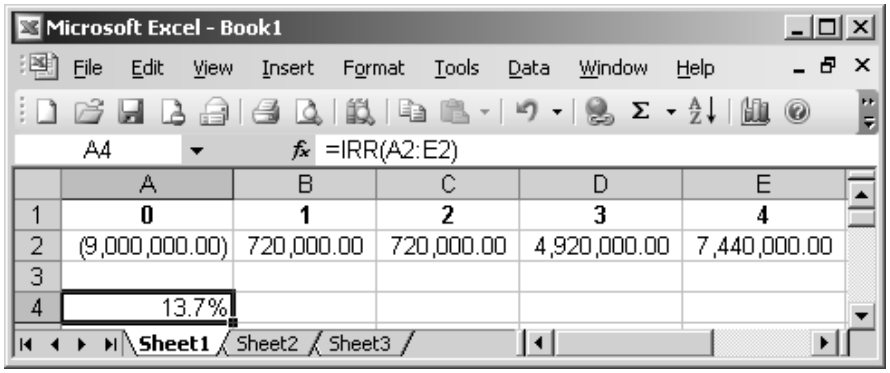
Since the NPV is less than zero, the project cannot be justified given the forecasts. However it is pretty close, the project costs $9,000,000 and is worth about $8,660,000 and there may be other strategic issues (such as an increase in the perceived value of the brand due to the quality increase from the zinfandel) that are not included in this scenario.

Step 6. Calculate the project's IRR.

$$\text{NPV}= -9{,}000{,}000 + \frac{720{,}000}{(1+\text{IRR})}+\frac{720{,}000}{(1+\text{IRR})^2}+\frac{4{,}920{,}000}{(1+\text{IRR})^3}+\frac{7{,}440{,}000}{(1+\text{IRR})^4} = 0 \Rightarrow \text{IRR} = 13.7\%$$

The IRR is less than 15%, so the project cannot be justified based on the forecasts.

Note that the determination of IRR requires iteration, i.e., trying various IRRs until the NPV=$0. This process is best performed using the IRR function in a spreadsheet as shown below.



3. **Your firm has a vacant warehouse in Louisiana that has a market value of $15 million and a book value of $0. You are considering entering into a 10-year contract to become the exclusive Coca-Cola bottler for your region. You would need to purchase $10 million worth of equipment, which you would depreciate straight line over 5 years; after 10 years, the equipment would have a market value of $2 million. You would also need to invest $2 million in working capital, which you can recover at the end of the project. You would sell $5 million worth of Coke products each year. Total costs (excluding taxes and depreciation) would be 60% of sales per year. You anticipate that the value of the warehouse will increase by about 2% per year and be worth $18 million in 10 years. The tax rate is 40% and the firm's cost of**

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capital is 12%. Does the project satisfy your investment criteria? Show your work and justify your answer.

Step 1. Determine how you should make the decision.

The project's NPV will indicate whether the project will add value to your firm, so the NPV should be calculated.

Step 2. Determine the income statements from years 1 through 10 for the project along with the operating cash flows.

	1-5	6-10
Sales	5,000,000	5,000,000
Cost of goods sold + SG&A	3,000,000	3,000,000
EBITDA	2,000,000	2,000,000
Depreciation	2,000,000	0
EBIT	0	2,000,000
– Tax @ 40%	0	800,000
Net Income	0	1,200,000
+ Depreciation	2,000,000	0
= Operating cash flow	2,000,000	1,200,000

Note that depreciation =$10,000,000/5 = $2,000,000 for years 1–5 and $0 in years 6–10.

Step 3. Calculate the Free Cash Flows.

Free Cash Flows for years 0 through 10 are:

	0	1-5	6-9	10
Operating cash flow	0	2,000,000	1,200,000	1,200,000
– Capital expenditures	19,000,000	0	0	–12,000,000
– Increase in working capital	2,000,000	0	0	–2,000,000
Free Cash Flow	–21,000,000	2,000,000	1,200,000	15,200,000

Time 0 capital spending includes the $10 million of equipment that would need to be purchased. There is also an opportunity cost associated with using the warehouse. The after-tax cash flow = sale price – $\tau \times$ (sale price – book value) = $15 million – 0.40($15 million – 0) = $9 million. Thus, capital spending is $19 million.

NWC will increase by $2 million at time 0, and it will decrease by $2 million in year 10.

Step 4. Calculate the NPV.

$$\text{NPV} = -21{,}000{,}000 + 2{,}000{,}000\left[\frac{1}{.12} - \frac{1}{.12(1.12)^5}\right] + \frac{1{,}200{,}000\left[\frac{1}{.12} - \frac{1}{.12(1.12)^4}\right]}{1.12^5} + \frac{15{,}200{,}000}{1.12^{10}}$$

$$= -\$6{,}828{,}286 < 0$$

Since the NPV is above zero, the project cannot be justified given the forecasts, and it should be rejected.

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Questions and Problems

1. Your large, highly profitable golf course management firm owns 200 acres in Surprise, Arizona. The land is surrounded by a housing development and is zoned exclusively for a golf course. The non-depreciable land has increased in value over the year since you bought it from $10 million to $35 million, and someone has offered to buy it for this price. Your original plan was to develop the land over the next 3 years by spending $20 million per year in pre-tax development costs. You would also have to spend $30 million in capital equipment today, and this would be depreciated straight line over 3 years. Based on the performance of the other courses you own, you expect annual revenue from the course to be $40 million when it opens 3 years from today and that all operating costs (excluding tax and depreciation) will amount to 50% of revenue. From then on, you expect that the free cash flow the course generates will grow by 3% forever. The tax rate is 40%, and you require a 15% return.

2. You are considering the purchase of super-automatic espresso machines to replace the existing manually operated machines in your chain of 1,000 coffee shops around the country. Each machine has a cost of $10,000, and you would have to buy 1,000. You could then sell the 1,000 existing La Marzocco machines in the stores now for $2,000 each. The old machines have zero book values. The new machines would have no effect on revenues, but you could save an estimated $3,000 per store per year in labor and training costs since operating a super-automatic espresso machine is easier. The new machines would have a 10-year depreciable life and be worthless after 10 years. You require a 15% return on all investments and are taxed at 40%. Does the project satisfy your investment criteria? Show your work and justify your answer.

3. You are considering the purchase of 1,000 Coke machines in the greater Chicago area. The machines cost $2,500 each and are depreciable straight-line over 5 years. Sales are expected to be 3,000 bottles per machine in the first year at a selling price of $1 per bottle. Sales revenue is expected to be constant every year thereafter. The cost of each bottle is $0.30. Operating expenses include stocking and maintenance and are expected to amount to $1,000 per year per machine. You would have to stock each machine with 200 bottles at the beginning of the project. After 5 years, you plan to sell the machines for $1,000 each and recover any investment in working capital. The tax rate is 40%. The firm uses all equity financing, and stockholders require a 15% return. Determine whether the project is a good idea. Does the project have an IRR above or below 15%?

4. Your firm manufactures custom-labeled, purified bottled water. Your plant generates $10 million in annual sales and runs at full capacity. You currently have four full-time employees who are paid $50,000 each per year and are responsible for removing the bottles from the manufacturing line and packaging them in boxes for delivery. You are considering replacing these four employees with a packaging machine that will do their same jobs. The machine costs $900,000 and would be depreciable straight line over 4 years. The purchase price includes a full warranty that guarantees to keep the machine in working order for 6 years. After 6 years, you would sell the machine back for $100,000. You require a 15% return on investments and the tax rate is 40%. Should you buy the machine?

5. 3com is considering producing a new handheld, wireless internet device. Management spent $3 million last year on test marketing and has developed a set of forecasts. Total cash costs (COGS, SG&A, etc…) of the device will be $30 each, and they will sell them all for $100 each. They can produce 50,000 each year for the next five years, and they expect to sell them all each year. They would have to construct a manufacturing plant, which would cost $10 million to be constructed immediately and be depreciable over 10 years using straight-line depreciation. They would have to invest $2 million in inventory beginning today, and this

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amount would not change over the life of the project. In 5 years, they will quit, dispose of the plant for $1 million, and recover working capital. The tax rate is 40%, the firm uses stock financing, and stockholders require a 15% return. Should 3com accept the project? Show any needed calculations and justify the answer.

Solutions to Questions and Problems

1. The project's NPV will indicate whether the project is worth more than the value of just selling the land, so it should be calculated.

   Determine the income statements from years 1 through 4 for the project along with the operating cash flows.

	1-3	4
Sales	0	40,000,000
Cost of goods sold + SG&A	20,000,000	20,000,000
EBITDA	–20,000,000	20,000,000
Depreciation	10,000,000	0
EBIT	–30,000,000	20,000,000
– Tax @ 40%	–12,000,000	8,000,000
Net Income	–18,000,000	12,000,000
+ Depreciation	10,000,000	0
= Operating cash flow	-8,000,000	12,000,000

   Depreciation =$30,000,000 / 3 = $10,000,000 for years 1–3 and $0 in year 4 and on.

   Calculate the Free Cash Flows for years 0–4:

	0	1-3	4
Operating cash flow	--	–8,000,000	12,000,000
– Capital expenditures	30,000,000	0	0
– Increases in working capital	0	0	0
Free Cash Flow	–30,000,000	–8,000,000	12,000,000

   Calculate the NPV.

$$\text{NPV} = -30 + \frac{-8}{1.15} + \frac{-8}{1.15^2} + \frac{-8}{1.15^3} + \frac{\left(\frac{12}{.15-.03}\right)}{1.15^3} = \$17.5 \text{ million}$$

   You would generate 35 – (35 – 10).4 = $25 million > $17.5 million by selling the land, so you should sell.

2. The project's NPV or IRR will indicate whether the project will add value to your firm, so at least the NPV should be calculated.

   Determine the income statements from years 1 through 10 for the project.

   Each year will be the same.

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Sales	0
Cost of goods sold	0
Gross profit	0
Selling, general & admin. costs	–3,000,000
EBITDA	3,000,000
Depreciation	1,000,000
EBIT	2,000,000
–Tax @ 40%	800,000
Net Income	$1,200,000

Since there is straight line depreciation on the $10 million investment in capital assets, annual depreciation is $10 millon/10 = $1 million.

The Free Cash Flows for years 0 through 10 are:

Year	**0**	**1-10**
Operating cash flow	--	2,200,000
Capital expenditures	–8,800,000	0
Increases in working capital	0	0
Free Cash Flow	–8,800,000	2,200,000

Operating cash flow equals net income + depreciation each year, which is $1,200,000 + $100,000 = $2,200,000.

Capital spending on the new machines is 1,000($10,000) = $10 million at time 0. You can also sell the old machines for $2,000 each resulting in an after-tax cash flow = sale price – $\tau \times$ (sale price – book value) = $2,000 – 0.40($2,000 – 0) = $1,200 each or $1,200(1,000) = $1.2 million for all of them. Thus, capital spending is $8.8 million.

Calculate the project's NPV.

$$\text{NPV} = -8{,}800{,}000 + 2{,}200{,}000\left[\frac{1}{.15} - \frac{1}{.15(1.15)^{10}}\right] = 2{,}241{,}291 > 0$$

Since the NPV is above zero, the project can be justified given the forecasts. This implies that the IRR is above 15%, and can be calculated to be about 21%.

3. If the NPV is greater than 0, the project is acceptable. Once the NPV is calculated, it can be determined if the IRR is above or below 15%.

   Determine the income statements from years 1 through 5 for the project (each year is the same) and calculate operating cash flow each year.

Sales	3,000,000
Cost of goods sold	900,000
Gross profit	2,100,000
Selling, general & admin. Costs	1,000,000
EBITDA	1,100,000
Depreciation	500,000
EBIT	600,000
– Tax @ 40%	240,000
Net Income	360,000
+ Depreciation	500,000
= Operating cash flow	860,000

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Sales = 3,000(1,000)$1 = $3 million.

Cost of goods sold is 0.30($1)/$1 = 30% of sales each year.

SG&A is $1,000 per machine, or 1,000($1,000) = $1,000,000 for all of them.

Depreciation = $2,500(1,000)/5 = $500,000 each year.

Free Cash Flows for years 0 through 5.

Year	0	1-4	5
Operating cash flow	--	860,000	860,000
– Capital expenditures	2,500,000	0	–600,000
– Increases in working capital	60,000	0	–60,000
Free Cash Flow	–2,560,000	860,000	1,520,000

The after-tax cash flow = sale price $-\tau\times$(sale price – book value) = $1 million – 0.40($1 million – 0) = $600,000.

Now, the NPV can be calculated.

$$\text{NPV} = -2{,}560{,}000 + 860{,}000\left[\frac{1}{.15} - \frac{1}{.15(1.15)^4}\right] + \frac{1{,}520{,}000}{1.15^5} = 650{,}990 > 0$$

Since the NPV is above zero, the project can be justified given the forecasts. This implies that the IRR is above 15%, and it can be calculated to be about 24%.

4. The project's NPV will indicate whether the project will add value to your firm, so the NPV should be calculated.

   Determine the income statements in years 1 through 6 for the project along with the operating cash flows.

	1-4	5-6
Sales	0	0
Cost of goods sold + SG&A	–200,000	–200,000
EBITDA	–200,000	200,000
Depreciation	225,000	0
EBIT	–25,000	200,000
– Tax @ 40%	–10,000	80,000
Net Income	–15,000	120,000
+ Depreciation	225,000	0
= Operating cash flow	210,000	120,000

Depreciation =$900,000 / 4 = $225,000 for years 1–4 and $0 in years 5–6.

Free Cash Flows for years 0 through 6 are:

	0	1-4	5	6
Operating cash flow	--	210,000	120,000	120,000
– Capital expenditures	900,000	0	0	–60,000
– Increases in working capital	0	0	0	0
Free Cash Flow	–900,000	210,000	120,000	180,000

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The after-tax cash flow in year 6 from selling the machine = sale price $-\tau \times$(sale price – book value) = \$100,000 – 0.40(\$100,000 – 0) = \$60,000.

Calculate the NPV.

$$\text{NPV} = -900{,}000 + \frac{210{,}000}{(1.15)} + \frac{210{,}000}{(1.15)^2} + \frac{210{,}000}{(1.15)^3} + \frac{210{,}000}{(1.15)^4} + \frac{120{,}000}{(1.15)^5} + \frac{120{,}000 + 60{,}000}{(1.15)^6}$$

$= -\$162{,}974$, so the firm is worth more with the employees given these assumptions.

5. If the NPV is greater than 0, the project is acceptable.

Determine the income statements and operating cash flow in years 1 through 5.

Sales	5,000,000
Cost of goods sold	1,500,000
Gross profit	3,500,000
Selling, general & admin. Costs	0
EBITDA	3,500,000
Depreciation	1,000,000
EBIT	2,500,000
– Tax @ 40%	1,000,000
Net Income	1,500,000
+ Depreciation	1,000,000
= Operating cash flow	2,500,000

Free Cash Flows for years 0 through 5 are:

Year	**0**	**1–4**	**5**
Operating cash flow	--	2,500,000	2,500,000
– Capital expenditures	10,000,000	0	–2,600,000
– Increases in working capital	2,000,000	0	–2,000,000
Free Cash Flow	–12,000,000	2,500,000	7,100,000

The after-tax cash flow = sale price $-\tau \times$ (sale price – book value) = \$1 million – 0.40(\$1 million – \$5 million) = \$2.6 million.

Now, the NPV can be calculated.

$$\text{NPV} = -12{,}000{,}000 + 2{,}500{,}000\left[\frac{1}{.15} - \frac{1}{.15(1.15)^4}\right] + \frac{7{,}100{,}000}{1.15^5} = -\$1{,}332{,}599 < 0$$

Since the NPV is below zero, the project cannot be justified given the forecasts. This implies that the IRR is below 15%, and it can be calculated to be about 11%.

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