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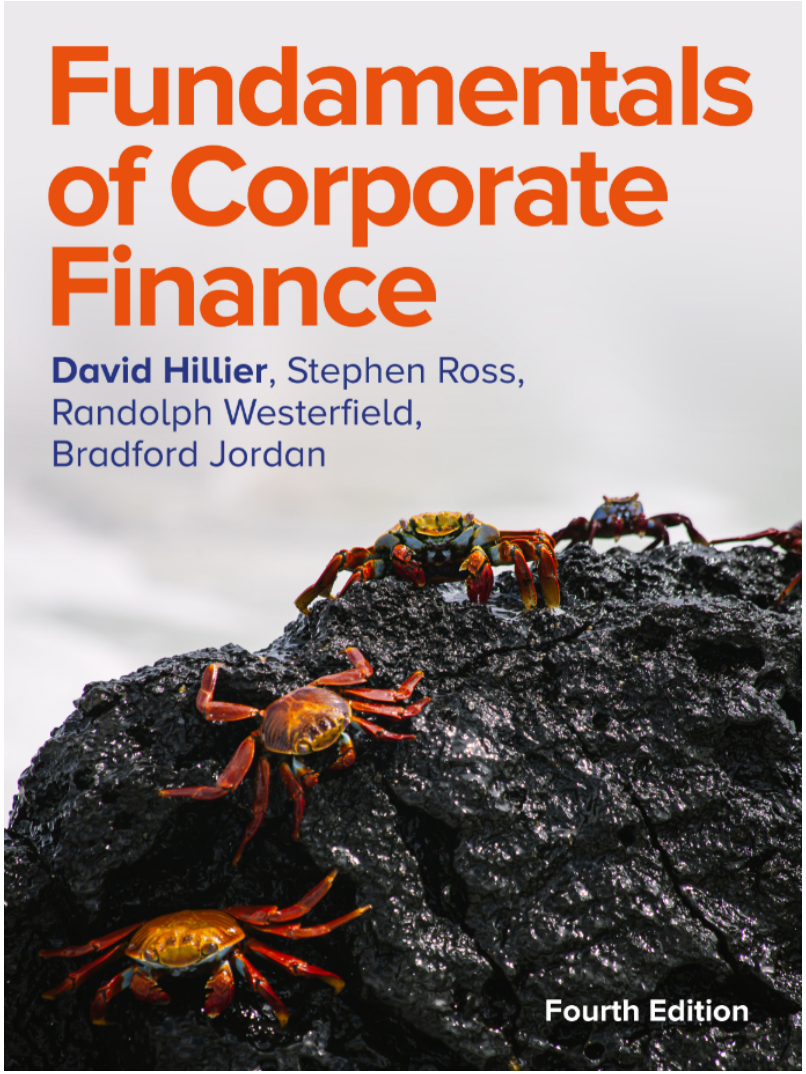
Chapter 10

Project Analysis and Evaluation

Hillier, Fundamentals of Corporate Finance 4e



Chapter Overview

- Evaluating NPV Estimates
- Scenario and Other What-if Analyses
- Break-Even Analysis
- Operating Cash Flow, Sales Volume and Break-Even
- Operating Leverage
- Capital Rationing

Evaluating NPV Estimates

Evaluating NPV Estimates: Considerations

The Basic Problem

Projected versus Actual Cash Flows

Forecasting Risk

Sources of Value

Scenario and Other What-If Analyses

Methods to Assess Robustness of Analysis

Scenario Analysis

The determination of what happens to NPV estimates when we ask what-if questions.

Sensitivity Analysis

Investigation of what happens to NPV when only one variable is changed.

Simulation Analysis

A combination of scenario and sensitivity analysis.

Case Study – Core Analysis

The following project is under consideration:

- Cost = €200,000
- 5-year life, no salvage value
- Depreciation is straight-line to zero
- Required return = 12 per cent
- Tax rate = 34 per cent.

In addition:

	Base case	Lower bound	Upper bound
Unit sales	6,000	5,500	6,500
Price per unit (€)	80	75	85
Variable costs per unit (€)	60	58	62
Fixed costs per year (€)	50,000	45,000	55,000

Sales (€)	480,000
Variable costs (€)	360,000
Fixed costs (€)	50,000
Depreciation (€)	40,000
Profit before taxes (€)	30,000
Taxes (34%) (€)	10,200
Net income	19,800

Operating cash flow = €19,800 + 40,000 = €59,800 per year.

At 12 per cent, the 5-year annuity factor is 3.6048, so the base-case NPV = -€200,000 + 59,800 x 3.6048 = €15,567.

The project looks good so far.

Case Study – Scenario Analysis

	Worst case	Best case
Unit sales	5,500	6,500
Price per unit (€)	75	85
Variable costs per unit (€)	62	58
Fixed costs per year (€)	55,000	45,000

Scenario	Net income (€)	Cash flow (€)	Net present value (€)	IRR (%)
Base case	19,800	59,800	15,567	15.1
Worst case*	–15,510	24,490	–111,719	–14.4
Best case	59,730	99,730	159,504	40.9

**We assume a tax credit is created in our worst-case scenario.*

Case Study – Sensitivity Analysis

Scenario	Fixed costs (€)	Cash flow (€)	Net present value (€)	IRR (%)
Base case	50,000	59,800	15,567	15.1
Worst case	55,000	56,500	3,670	12.7
Best case	45,000	63,100	27,461	17.4

Freeze Everything except Fixed Costs

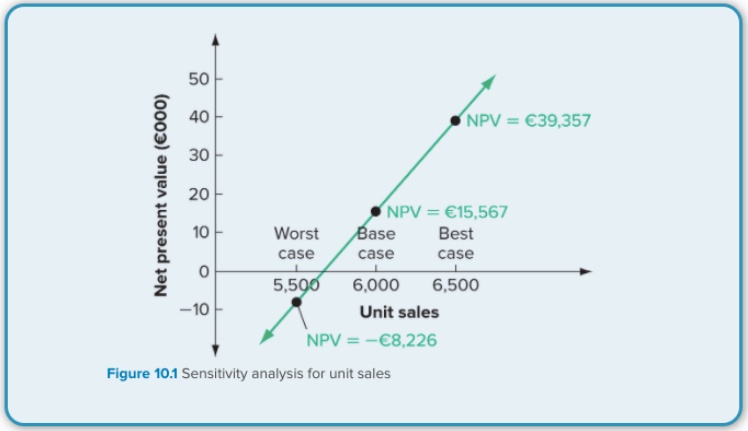


Figure 10.1 Sensitivity analysis for unit sales

Break-Even Analysis

Project Costs Analysis

Fixed Costs

Costs that do not change when the quantity of output changes during a particular time period.

Variable Costs

Costs that change when the quantity of output changes.

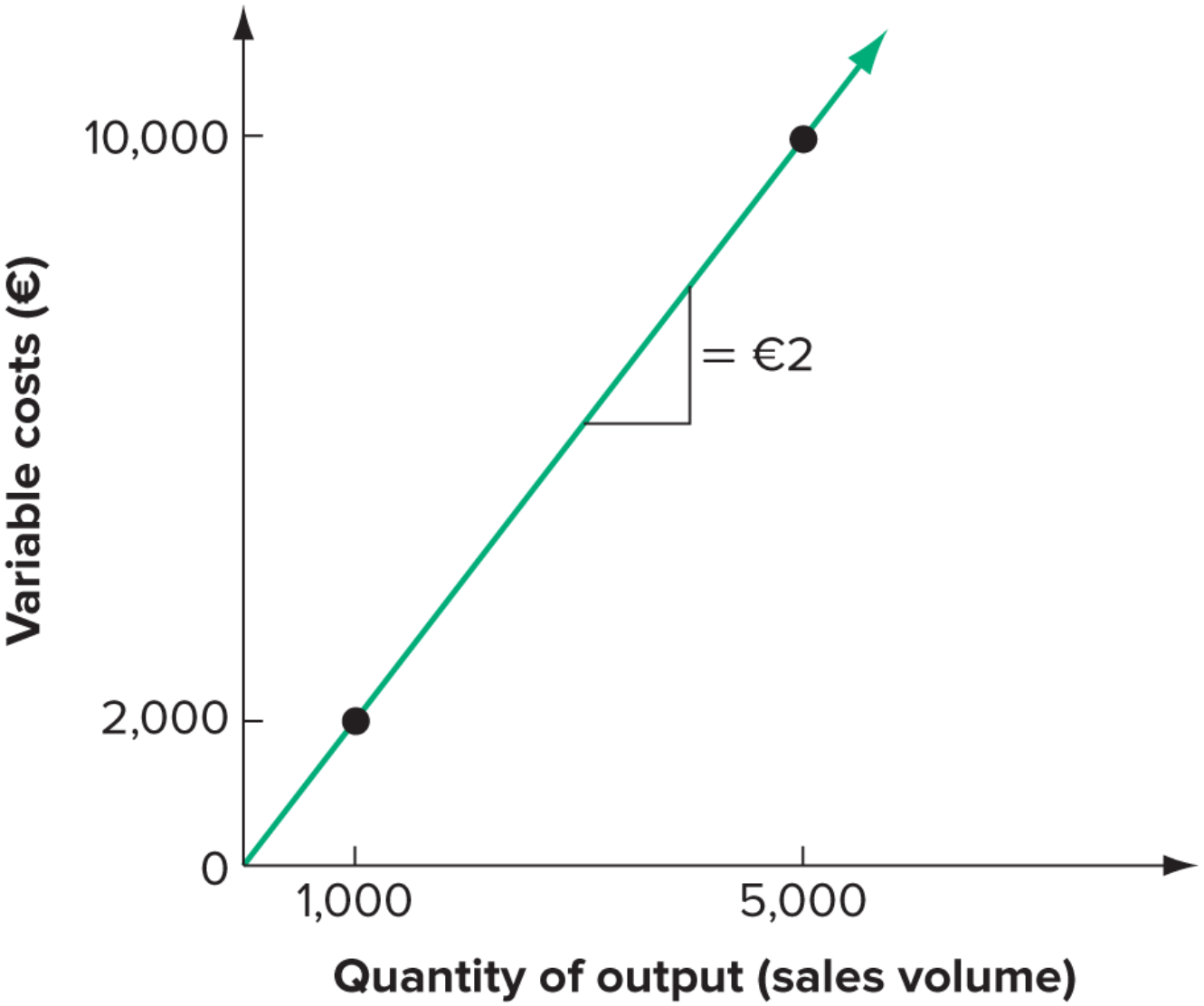
Total variable cost = Total quantity of output x Cost per unit of output

VC = *Q* x *v*

Variable costs (*v*) are €2 per unit. If total output (*Q*) is 1,000 units, what will total variable costs (VC) be?

VC = *Q* x *v* = 1,000 x €2 = €2,000

If *Q* is 5,000 units, then VC will be 5,000 x €2 = €10,000


10,000
2,000
0
= €2
1,000
5,000
Variable costs (€)
Quantity of output (sales volume)

Total costs (TC) for a given level of output are the sum of variable costs (VC) and fixed costs (FC):

$TC = VC + FC$

$= v \times Q + FC$

If we have variable costs of €3 per unit and fixed costs of €8,000 per year, our total cost is:

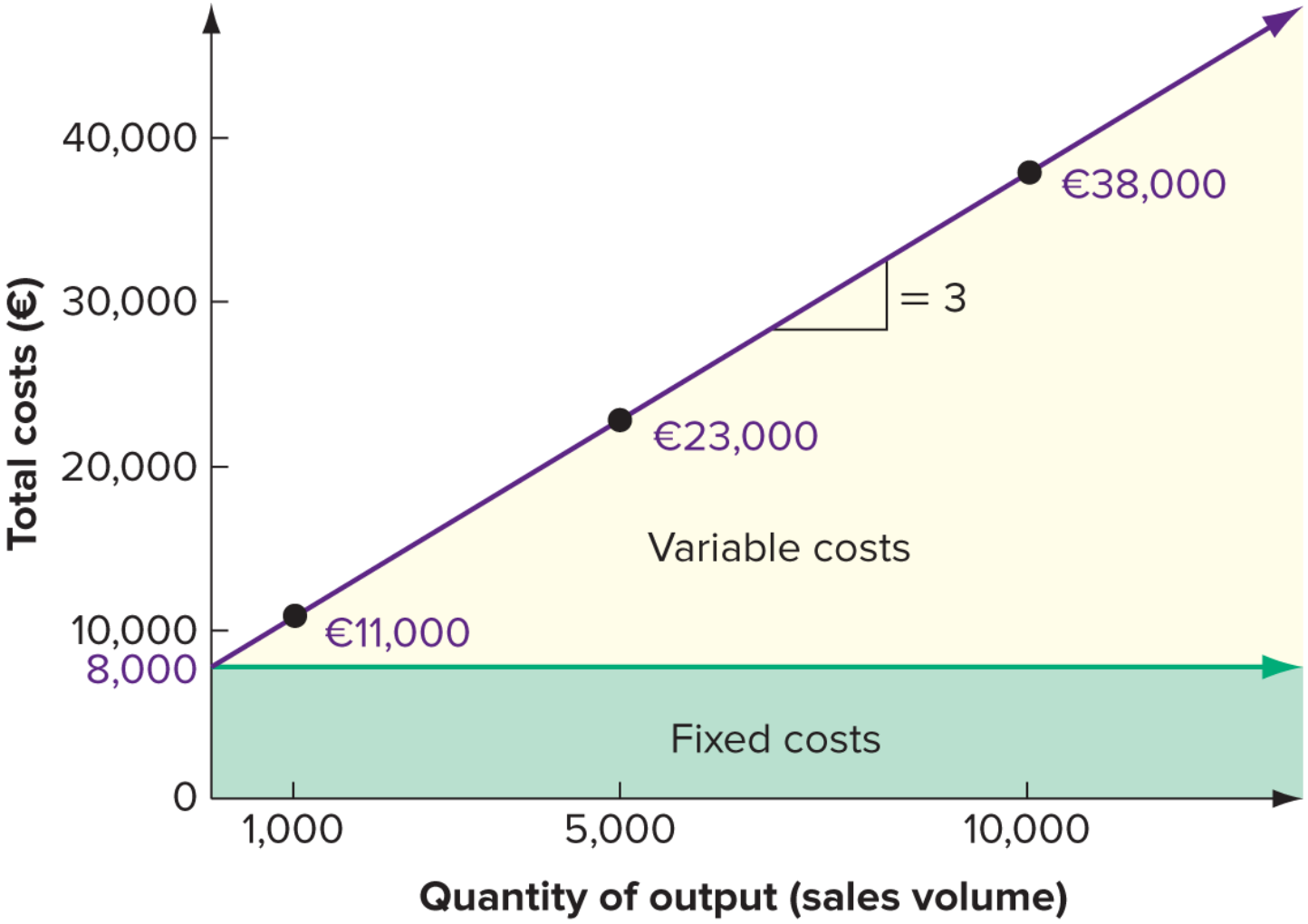
$TC = €3 \times Q + €8,000$

If we produce 6,000 units, our total production cost will be:

€3 x 6,000 + €8,000 = €26,000

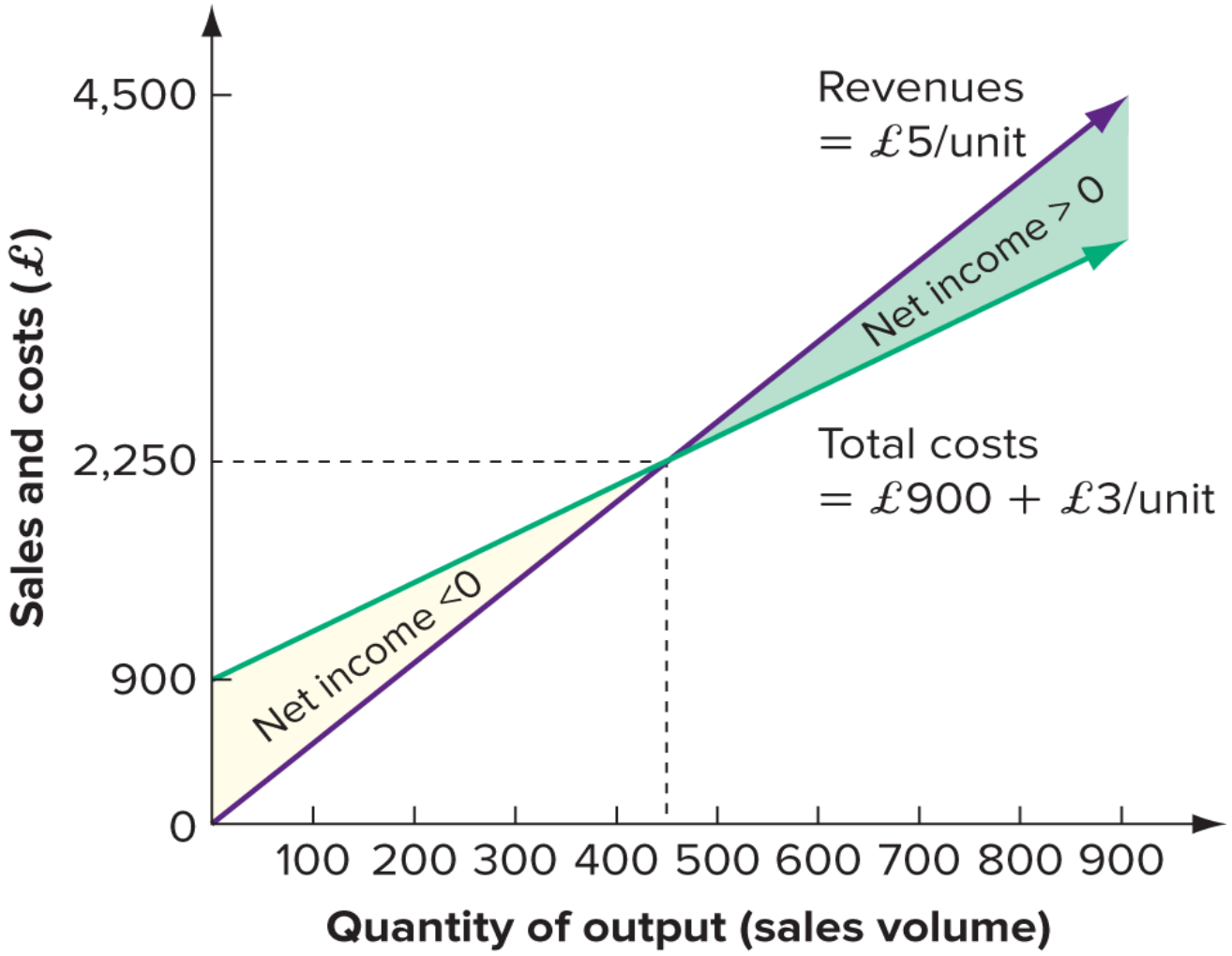
Marginal or Incremental Costs

The change in costs that occurs when there is a small change in output.


Total costs (€)
40,000
30,000
20,000
10,000
8,000
0
€38,000
= 3
€23,000
Variable costs
€11,000
Fixed costs
1,000
5,000
10,000
Quantity of output (sales volume)

Accounting Break-Even

The sales level that results in zero project net income.


4,500
2,250
900
0
Sales and costs (£)
Revenues
= £5/unit
Net income > 0
Total costs
= £900 + £3/unit
Net income <0
100 200 300 400 500 600 700 800 900
Quantity of output (sales volume)

Operating Cash Flow, Sales Volume and Break-Even

Accounting Break-Even: A Closer Look

Variables:

P = Selling price per unit

v = Variable cost per unit

Q = Total units sold

S = Total sales = P x Q

VC = Total variable costs = v x Q

FC = Fixed costs

D = Depreciation

T = Tax rate

Accounting Break-Even and Cash Flow

A project's operating cash flow, OCF, can be written as:

OCF = EBIT + Depreciation + Taxes

Sales Volume and OCF

Ignoring taxes a project's operating cash flow, OCF, can be written as EBIT plus depreciation:

$$OCF = [(P - v)] \times Q - FC - D] + D$$
$$= (P - v) \times Q - FC$$

Cash Flow, Accounting and Financial Break-Even Points

We know the relationship between OCF and sales volume ignoring taxes is:

$$OCF = (P - v) \times Q - FC$$

If we rearrange and solve for Q we get:

$$Q = \frac{FC + OCF}{P - v}$$

This tells us what sales volume (Q) is necessary to achieve any given OCF, so this result is more general than the accounting break even.

Cash Break-Even

Cash break-even occurs when operating cash flow is zero.

The cash break even point is thus:

$$Q = \frac{FC}{P - v}$$

A project that always just breaks even on a cash basis never pays back, has an NPV that is negative and equal to the initial outlay, and has an IRR of -100 per cent.

Financial Break-Even

Financial break-even occurs when the NPV of the project is zero.

The financial break-even point is thus:

$$Q = \frac{FC + OCF^*}{P - v}$$

Where OCF* is the level of OCF that results in a zero NPV.

A project that breaks even on a financial basis has a discounted payback equal to its life, a zero NPV and an IRR just equal to the required return.

Operating Leverage

What is Operating Leverage?

Operating Leverage

The degree to which a firm or project relies on fixed costs

Degree of Operating Leverage (DOL)

The percentage change in operating cash flow relative to the percentage change in quantity sold

Degree of Operating Leverage (DOL)

Percentage change in OCF =

DOL x Percentage change in Q

Based on the relationship between OCF and Q, DOL can be written as:

DOL = 1 + FC/OCF

Capital Rationing

Types of Capital Rationing

Capital Rationing

- The situation that exists if a firm has positive NPV projects but cannot find the necessary financing.

Soft Rationing

- The situation that occurs when units in a business are allocated a certain amount of financing for capital budgeting.

Hard Rationing

- The situation that occurs when a business cannot raise financing for a project under any circumstances.

Concept Quiz

What is meant by forecasting risk and why is it a concern for a financial manager?

What are scenario, sensitivity and simulation analyses? What are the drawbacks to these various what-if analyses?

Why might the accounting break-even point be of interest to a financial manager? If a project does break-even on an accounting basis, what is its operating cash flow?