

Diagnosing a Business with Ratios

A ratio is a question asked of a set of accounts. Raw figures cannot answer questions about performance because they are contaminated by size: a firm with twice the revenue has roughly twice of everything, and comparing the two firms in currency compares their scale rather than their skill. Dividing one figure by another removes scale and leaves the economic property you were interested in.

That is the whole idea, and it means the difficulty of ratio analysis is never the arithmetic. Every ratio in this chapter is one division. The difficulty is knowing which question to ask, what a given answer would have to mean, and which of several defensible definitions the number in front of you was built from. This chapter is about those three things.

HOW TO USE THIS CHAPTER

This chapter defines each ratio in general form, states the denominator conventions that firms and data providers disagree about, sizes the errors that follow from getting them wrong, and gives illustrative benchmark ranges so that a computed number can be judged rather than merely reported.

The videos run the full set across three consecutive years of one distributor's accounts and assemble the results into a single diagnosis. The pattern that emerges is not the one the headline figures suggest, and it is worth meeting there rather than here.

The case puts you on a lender's side of the desk with a credit file to form a view on.

2.1 What Ratios Are For, and the Three Comparisons

Ratios fall into four families, and each family answers a different question about the business. Learning the families rather than a list of formulas is what makes the tool portable: faced with an unfamiliar ratio, you can usually place it and infer what it is for.

THE FOUR FAMILIES

FAMILY	QUESTION	TYPICAL MEMBERS
Profitability	How much of what comes in is kept	Gross, operating, and net margin; ROA; ROE; ROIC
Efficiency	How hard the assets work	Asset turnover; days receivable, inventory, payable
Leverage and coverage	How much is borrowed, and how comfortably it is serviced	Debt to equity; debt to EBITDA; interest cover
Liquidity	Whether near-term obligations can be met	Current ratio; quick ratio

A single ratio in isolation means nothing at all. It acquires meaning only through comparison, and there are exactly three comparisons available.

- **Against the same firm over time.** The most reliable comparison, because accounting policy is usually held constant within a firm. Three years is the practical minimum: two points make a line, three make a trend.
- **Against peers.** Powerful and treacherous. The peer set must genuinely be comparable in business model, and their accounting policy may differ from the subject's in ways the ratio cannot see.
- **Against a fixed threshold.** Loan covenants, internal policy, and regulatory minima. This comparison has consequences that the other two do not: breaching a covenant can make a loan repayable immediately.

One discipline is worth adopting from the start. **Compute a ratio only when you can say in advance what would make it good or bad.** If you cannot name the direction that would worry you, the number will tell you nothing when it arrives, and you will find yourself reasoning backwards from whatever it turned out to be.

2.2 Common-Size and Trend Analysis

Before any ratio is computed, two techniques strip size out of a set of statements.

A **common-size statement** divides every line by one base. For the income statement the base is revenue; for the balance sheet it is total assets. What survives is the structure of the business rather than its scale, and structure is what changes when something goes right or wrong.

The technique earns its keep on a growing firm, where every line rises in currency and the currency therefore tells you nothing. Consider two firms, each with an operating margin of exactly 12 percent.

IDENTICAL OPERATING MARGIN, OPPOSITE COST STRUCTURE

Common-size income statements, per 100 of revenue

LINE	DISTRIBUTOR	CONSULTANCY
Revenue	100	100
Cost of sales	(82)	(45)
Gross profit	18	55
Operating expenses	(6)	(43)
Operating income	12	12

The two businesses are not remotely alike, and the bottom line cannot see it. The distributor keeps 18 of every 100 after paying for goods and spends only 6 running itself; the consultancy keeps 55 and spends 43. **The distributor is vulnerable to input prices and the consultancy is vulnerable to utilisation**, and a common-size statement makes that visible at a glance while the operating margin conceals it.

The second technique is simpler. **Trend analysis** compares the growth rates of lines that ought to move together. Receivables should roughly track revenue, because selling twice as much on the same terms means being owed roughly twice as much. Inventory should roughly track cost of

sales. Payables should roughly track cost of sales. When one of these pairs comes apart, the terms of trade have changed even though nothing on the income statement says so.

- Receivables growing much faster than revenue means either collection has deteriorated or credit terms were loosened to win the revenue.
- Inventory growing much faster than cost of sales means either stock is not selling or purchasing has run ahead of demand.
- Fixed assets growing far more slowly than revenue means capacity is being used harder — which is efficiency up to a point, and a constraint after it.

IN THE VIDEOS Video 2.1 applies both techniques to three years of one distributor's statements, where the currency figures and the percentages tell opposite stories.

2.3 The DuPont Decomposition

Return on equity is the most quoted figure in finance and, on its own, close to useless. The reason is that three unrelated things drive it, one of which is not a business achievement at all.

The decomposition is a piece of algebra from the 1920s. Multiply return on equity by sales over sales, and by assets over assets. Both are equal to one, so nothing has been changed.

$$\text{Net income / Equity} = (\text{Net income / Sales}) \times (\text{Sales / Assets}) \times (\text{Assets / Equity})$$

Sales cancels, assets cancels, and the identity returns to where it started. The arithmetic is harmless; the decomposition does the work, because the three factors are separately meaningful.

THE THREE DRIVERS

DRIVER	FORMULA	WHAT IT MEASURES
Profit margin	Net income / Sales	How much of each unit of sales the owners keep
Asset turnover	Sales / Assets	How many units of sales each unit of assets produces
Leverage	Assets / Equity	How many units of assets sit on each unit of owners' money

The first two are things the business does. The third is a financing choice. **Return on equity can therefore be raised without the business improving in any respect**, simply by funding more of it with debt — and that is the single most important fact about the most quoted number in finance.

The decomposition has a second use, which is to reveal that two firms with identical returns can be opposite kinds of business. Consider a market trader and a jeweller, both earning 18 percent on equity with the same modest leverage.

THE SAME RETURN FROM OPPOSITE MODELS

DRIVER	TRADER	JEWELLER	COMMENT
Profit margin	1.5%	15.0%	Ten times apart
Asset turnover	8.0	0.8	Ten times apart, the other way
Return on assets	12.0%	12.0%	Identical
Leverage	1.5	1.5	Identical
Return on equity	18.0%	18.0%	Identical

Every summary measure agrees and the two businesses have nothing in common. The trader survives on speed and is destroyed by stock that stops moving; a single slow month removes the entire margin. The jeweller survives on margin and is destroyed by a competitor willing to undercut; volume was never the point. **The headline is the same and the vulnerabilities are opposite**, which is exactly why the decomposition is worth performing on any firm whose return you are being asked to admire.

The five-factor form

The three-factor version blends financing effects into the margin, because net income is after interest. Where the financing effect needs to be isolated, the margin term splits further.

$$\text{ROE} = (\text{EBIT} / \text{Sales}) \times (\text{Sales} / \text{Assets}) \times (\text{Assets} / \text{Equity}) \times (\text{Pre-tax income} / \text{EBIT}) \times (\text{Net income} / \text{Pre-tax income})$$

The first three terms are now purely operational; the fourth is the interest burden, which falls below 1.0 as borrowing rises; the fifth is the tax burden. The value of this form is that it separates the two effects of debt, which push in opposite directions: leverage raises the third term and lowers the fourth. When the fourth term falls faster than the third rises, borrowing has begun to destroy the return it was taken on to improve.

IN THE VIDEOS Video 2.2 decomposes three years of one firm whose return on equity rises every year for a reason that should worry its lender.

2.4 Profitability: Which Return to Use

Chapter 1 defined the three margins. The returns are the other half of profitability, and the choice among them matters more than students expect, because each has a different denominator and therefore a different question inside it.

THE THREE RETURNS

MEASURE	FORMULA	THE QUESTION IT ASKS
Return on assets	Net income / Total assets	What the asset base produced, financing included
Return on equity	Net income / Equity	What the owners earned on their own money
Return on invested capital	NOPAT / Invested capital	What the operations earned, financing removed

The third is the most useful and the least often quoted. NOPAT is net operating profit after tax — operating income multiplied by one minus the tax rate — and **invested capital** is equity plus debt less cash. Both numerator and denominator exclude financing entirely, so the result measures the operation and nothing else. Two firms with identical operations report the same ROIC regardless of how they are funded, which is exactly what a comparison should do.

Numbers make the distinction concrete. Take a firm with operating income of 30, tax at 25 percent, equity of 100, and debt of 80 on which it pays interest of 8 — a rate of 10 percent, or 7.5 percent once the tax deduction is allowed for. It holds no surplus cash.

RETURN ON INVESTED CAPITAL AGAINST RETURN ON EQUITY

STEP	VALUE	
Operating income	30.0	
NOPAT at 25% tax	22.5	
Invested capital: 100 + 80	180.0	
Return on invested capital	12.5%	
Net income: $(30 - 8) \times 0.75$	16.5	
Return on equity	16.5%	

The gap of four percentage points is the contribution of borrowing, and it can be read directly off the two rates. The firm earns 12.5 percent on its capital and pays 7.5 percent after tax for the portion of it that was borrowed; the five-point difference, earned on 80 of debt and credited to 100 of equity, is 4.0 points of additional return to the owners.

That gives the general rule. **Leverage raises return on equity above return on invested capital whenever the business earns more than its debt costs after tax, and drags it below whenever it does not.** The second half of that sentence is the one that surprises people, and it is worth showing rather than asserting. Hold everything constant and let operating income fall.

THE SAME BALANCE SHEET IN THREE YEARS

Debt of 80 at 7.5% after tax throughout

ITEM	GOOD YEAR	WEAK YEAR	BAD YEAR
Operating income	30.0	18.0	14.0
Return on invested capital	12.5%	7.5%	5.8%
Return on equity	16.5%	7.5%	4.5%

Follow the bottom row. A forty percent fall in operating income takes fifty-five percent off the owners' return. In the weak year the business earns exactly what its debt costs, and the two returns meet — borrowing has contributed nothing at all. In the bad year the firm earns 5.8 percent on capital costing 7.5 percent, and the owners' return falls **below** the return on the business itself. **Leverage is not a way of earning more. It is a way of earning more when things go well and less when they do not,** and the whole of it turns on a single comparison: the return on invested capital against the after-tax cost of the debt.

One refinement, because it explains a number that otherwise looks wrong. Surplus cash is deducted from invested capital, so a firm holding cash that earns nothing reports a **higher** return on invested capital than its operations alone would justify. Had the firm above been sitting on 30 of idle cash, invested capital would have been 150, the reported return 15.0 percent, and the apparent contribution of leverage only 1.5 points — because the cash drags the owners' return down by 4.5 points at the same time as the borrowing lifts it by 6.0. Chapter 9's bridge treats surplus cash as a separate item for exactly this reason.

- Use **ROIC** when comparing operations across firms, or when judging whether a business earns more than its capital costs. Chapter 10 computes the number to compare it against, and section 11.3 makes the comparison — it turns out to decide whether the firm's growth is worth anything at all.
- Use **ROE** when the question is genuinely about the owners' return, and always alongside the leverage figure that produced it.
- Use **ROA** cautiously. Its numerator is after interest and its denominator includes debt-funded assets, so it mixes two perspectives.

2.5 Efficiency and the Working-Capital Days

Asset turnover asks how much revenue each unit of assets produces. When it falls, the question is which assets grew faster than sales, and converting working capital into days answers it. Days have the useful property of being comparable across firms of any size and any currency.

THE THREE WORKING-CAPITAL RATIOS

MEASURE	GENERAL FORMULA	READS AS
Days sales outstanding	Receivables $\times$ 365 / Revenue	How long customers take to pay
Days inventory outstanding	Inventory $\times$ 365 / Cost of goods sold	How long stock sits before it sells
Days payable outstanding	Payables $\times$ 365 / Cost of goods sold	How long the firm takes to pay suppliers

The denominators are where most errors occur, and the logic behind them is worth stating once. **Receivables are measured against revenue**, because customers owe the selling price. **Inventory and payables are measured against cost of goods sold**, because stock is bought at cost and suppliers are owed cost. Mixing these is not a rounding problem.

Sizing the denominator error

Suppose inventory is 20, cost of goods sold is 85, and revenue is 100. The correct inventory figure is $20 \times 365 / 85$, which is 85.9 days. Using revenue instead gives $20 \times 365 / 100$, which is 73.0 days.

$$\text{Days using revenue} \div \text{Days using cost of sales} = \text{Cost of sales} / \text{Revenue} = 1 - \text{gross margin}$$

The error is therefore not random: **using revenue understates inventory days by exactly the gross margin**. At a 15 percent gross margin the figure is 15 percent too low, which might survive unnoticed. At a 60 percent gross margin it is 60 percent too low — a firm genuinely holding 100 days

of stock is reported as holding 40 — and any conclusion drawn from it is worthless. The higher the margin, the more dangerous the mistake.

Conventions worth checking before comparing

- **Closing or average balances.** Days computed on closing balances describe the year end; on the average of opening and closing they describe the year. Both are used. A firm that grew quickly shows materially higher days on closing balances, and comparing one firm computed each way manufactures a difference that does not exist.
- **365 or 360 days.** Banking convention often uses 360, which raises every day-count by about 1.4 percent. Immaterial for diagnosis, material for a covenant test.
- **Credit sales or total sales.** The technically correct denominator for days sales outstanding is credit sales, since cash sales create no receivable. Almost no published statement separates them, so nearly everyone uses total revenue. Know that the assumption has been made, and flag it where a business has a large cash-sales component — a pharmacy or a supermarket will look far better than it is.
- **Gross or net receivables.** Receivables shown after a bad-debt provision give lower days than the gross figure. A firm that raises its provision appears to collect faster.

None of these makes a ratio wrong. They make it incomparable, which in practice is the same problem, and the remedy is always the same: recompute both firms yourself from the raw figures rather than accepting two published numbers.

IN THE VIDEOS *Video 2.4 computes all three day-counts across three years and traces a falling asset turnover to its source.*

2.6 The Cash Conversion Cycle

The three day-counts combine into a single measure of how long the firm's money is trapped between paying for something and being paid for it.

$$\text{Cash conversion cycle} = \text{Days inventory} + \text{Days sales outstanding} - \text{Days payable outstanding}$$

Follow one unit of currency through a wholesaler operating on 40 days of inventory, 50 days of collection, and 30 days of supplier credit. Day zero, stock arrives. Day thirty, the supplier is paid and the money has genuinely left. Day forty, the stock is sold on credit. Day ninety, the customer pays and the money returns. Sixty days elapse between the payment going out and the receipt coming in, and during every one of them the firm is funding that unit from somewhere else — its own capital, an overdraft, or a delayed payment to someone else.

The minus sign in front of payables is the part worth dwelling on. **Every day of supplier credit is a day the firm does not have to fund itself**, which makes trade credit the cheapest financing most businesses ever obtain and often genuinely free. Chapter 4 shows that it is not always free and how to tell.

When the cycle is negative

A negative cash conversion cycle means customers pay before suppliers are paid, so the firm is funded by its own trading. It is not a curiosity; several of the strongest business models in the world work this way.

A NEGATIVE CYCLE, AND WHERE IT COMES FROM

COMPONENT	DAYS	SOURCE	
Days inventory	25	Fast-moving stock	
Days sales outstanding	2	Customers pay at the till	
Less days payable	(45)	Scale gives supplier terms	
Cash conversion cycle	(18)	Funded by trading	

A supermarket, an airline selling tickets in advance, and a subscription business collecting annually all share this structure. **Growth releases cash for these firms rather than consuming it**, which reverses the central problem of Chapter 4 and explains why such businesses can expand quickly without raising capital. When you meet one, the working-capital analysis runs in the opposite direction: the risk is not that growth starves them of cash, but that a sudden contraction leaves them with payables due and no incoming trade.

2.7 Leverage, Coverage, and Liquidity

These three families all address the same underlying question — whether the firm can meet its obligations — from three distances. Leverage looks at the stock of debt, coverage at the flow available to service it, and liquidity at the next few months.

THE SOLVENCY MEASURES

MEASURE	FORMULA	READS AS
Debt to equity	Total debt / Equity	How much is borrowed against owners' money
Debt to EBITDA	Total debt / EBITDA	Years of earnings required to repay
Interest cover	EBIT / Interest expense	How many times over the interest is earned
Current ratio	Current assets / Current liabilities	Near-term claims against near-term resources
Quick ratio	(Current assets – inventory) / Current liabilities	The same, excluding the least liquid asset

Lenders in practice weight coverage above leverage, and the reason is that debt is repaid out of earnings rather than out of a ratio. Two firms can carry identical debt-to-equity and be in entirely different positions.

One caution about the denominator of debt to EBITDA, since it is the ratio most often quoted in a credit paper. EBITDA is struck before capital expenditure, so a firm whose EBITDA is entirely

consumed by replacing worn-out assets repays nothing at all out of it — the ratio will look identical to that of a firm with no such obligation. Chapter 8 builds the measure that closes the gap.

IDENTICAL LEVERAGE, DIFFERENT SAFETY

ITEM	FIRM A	FIRM B
Debt	100	100
Equity	100	100
Debt to equity	1.0	1.0
Interest at 12%	12	12
Operating income	48	18
Interest cover	4.0×	1.5×

Firm A can lose two-thirds of its operating income and still pay its lenders. Firm B can lose a third. The balance-sheet ratio is blind to the difference because it never looks at the income statement. **Debt to EBITDA and interest cover are the ratios that decide whether a loan is made; debt to equity is the one that gets quoted.**

Two warnings about the liquidity ratios

- **The current ratio can rise while a firm is running out of cash.** Its numerator includes receivables and inventory, so a firm whose customers have stopped paying and whose stock has stopped moving reports an improving current ratio precisely as its position deteriorates. Read it alongside the day-counts, never alone.
- **The composition matters more than the level.** A current ratio of 1.8 made of cash is a different fact from a current ratio of 1.8 made of slow inventory. The quick ratio exists to make this visible, and comparing the two is more informative than either.

IN THE VIDEOS Video 2.6 assembles the full set of measures into a single diagnosis, including a firm whose current ratio improves in every year it misses a payment.

2.8 Illustrative Benchmarks

A ratio needs a reference point. The ranges below are typical rather than authoritative, and business models within any category vary widely; treat them as a first sense of whether a number deserves a second look, and replace them with a genuine peer set whenever one is available.

TYPICAL RANGES BY BUSINESS TYPE

Illustrative only. Verify against a current peer set before relying on any figure.

BUSINESS TYPE	GROSS MARGIN	OPERATING MARGIN	ASSET TURNOVER	CASH CYCLE
Food and produce distribution	10–20%	3–6%	2.0–3.0	15–35 days
General wholesale and trading	15–25%	4–8%	1.5–2.5	40–70 days
Grocery retail	20–28%	2–5%	2.5–3.5	Negative to 10
Light manufacturing	25–40%	8–15%	0.8–1.5	60–110 days
Professional services	40–60%	10–20%	1.0–2.0	40–80 days
Construction and contracting	10–20%	3–8%	1.0–2.0	70–140 days

Two patterns in that table are worth reading directly, because they recur throughout the course. **Margin and turnover trade against each other** — every high-margin row has low turnover and every low-margin row has high turnover — which is the DuPont point in a different form: businesses can earn a respectable return either way, and almost never both ways. And **the cash cycle lengthens as the product becomes less standard**, because non-standard work means holding materials, waiting for acceptance, and being paid slowly.

2.9 What Ratios Cannot Tell You

Ratio analysis has a hard limit, and stating it is part of using the technique honestly.

- **They are backward-looking.** Every input is historical. A firm that lost its largest customer last week reports the same ratios it reported a month ago.
- **They inherit every accounting judgement.** The depreciation life, the revenue-recognition point, and the bad-debt provision from Chapter 1 all flow directly into these numbers.
- **They cannot see concentration.** Two firms with identical receivable days are in different positions when one has four hundred customers and the other has three.
- **They cannot see the reason.** A ratio locates a change; it never explains it. Receivable days rising by twenty could be a deliberate commercial decision to win a large account, a collections department that stopped functioning, or one disputed invoice. The numbers cannot distinguish these, and the next step is always to ask someone.

The last point defines the boundary of the technique, and it is worth being clear about. **Ratios tell you where to ask questions. They do not answer them.** An analysis that ends at the table is half-finished; the half that matters is the conversation the table makes possible.

2.10 Reference

CHAPTER 2 • RATIO REFERENCE

RATIO	FORMULA	NOTE
Return on equity	Net income / Equity	Raised by leverage alone
Return on assets	Net income / Total assets	Mixes perspectives
Return on invested capital	NOPAT / (Equity + Debt – Cash)	Financing-neutral; the comparable one
NOPAT	Operating income × (1 – tax rate)	Operating profit after tax
DuPont, three factors	Margin × Asset turnover × Leverage	Two are operating, one is financing
DuPont, five factors	Adds interest burden and tax burden	Separates the two effects of debt
Asset turnover	Revenue / Total assets	Falls when assets grow faster than sales
Days sales outstanding	Receivables × 365 / Revenue	Denominator is revenue
Days inventory outstanding	Inventory × 365 / Cost of sales	Denominator is cost of sales
Days payable outstanding	Payables × 365 / Cost of sales	Denominator is cost of sales
Cash conversion cycle	DIO + DSO – DPO	Negative means funded by trading
Debt to equity	Total debt / Equity	Blind to earnings
Debt to EBITDA	Total debt / EBITDA	Years of earnings to repay
Interest cover	EBIT / Interest	The lender's ratio
Current ratio	Current assets / Current liabilities	Can rise as cash runs out
Quick ratio	(Current assets – inventory) / Current liabilities	Read against the current ratio

CARRY FORWARD

A rising return on equity is not evidence of a better business. Decompose it before admiring it; one of its three drivers is a financing choice.

Check the denominator before comparing any day-count. Inventory measured against revenue rather than cost of sales is understated by exactly the gross margin.

Coverage decides lending; leverage gets quoted. Interest cover and debt to EBITDA look at the earnings that actually repay a loan.

Ratios locate questions. The analysis is finished when someone has explained the change, not when the table is complete.