the business operations and strategies? What important events are captured in the financial statements on a timely basis and what events are missing? Which assets, liabilities, revenues, and expenses are likely measured with the most error? Is there any evidence suggesting management is manipulating the financial statements? You need to answer all of these questions before you attempt to forecast the firm's future financial statements and produce a valuation.

4.7 QUIZZES, CASES, LINKS AND REFERENCES

Quizzes
- Chipotle Mexican Grill (Problem 2)
- Pandora (Problem 2)
- LinkedIn (Problem 2)
- Salesforce (Problem 2)
- Take-Two (Problem 2)
- Netflix (Problem 2)
- Dropbox (Problem 2)

Cases
- Analyzing Apple (Questions 4-6)
- Apple and the iFad (Questions 4-6)
- Boston Chicken, Inc.
- Diagnosing Accounting Quality at eHealth
- EnCom Corporation (Stages 1 and 2)
- Pre-Paid Legal Services
- Sirius Satellite Radio (Questions 4-9)
- High Yields at Annaly Capital (Questions 3-4)
- Has Zynga Lost Its Zing? (Questions 3-7)
- Is Tesla's Stock Price in Ludicrous Mode? (Questions 3-6)

Links
- Video for Chapter 4-Part 1: https://www.screencast.com/t/tyjC8dAy9Dx
- Video for Chapter 4-Part 2: https://www.screencast.com/t/3Yy628KjI0L
- U.S. Treasury Yield Curve: https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield
- Salesforce.com 2022 Form 10-K on EDGAR: https://www.sec.gov/ix?doc=/Archives/edgar/data/0001108524/000110852422000013/crm-20220131.htm

CHAPTER FIVE

Financial Ratio Analysis

5.1 INTRODUCTION

Valuing an equity security requires you to interpret and forecast a huge quantity of financial data. Ratio analysis provides a framework for doing this in an organized and systematic manner. By converting the financial statement data into ratios, we are converting data into information. For instance, margin analysis reveals how much profit a firm makes from each dollar of revenue it generates and turnover analysis reveals the amount of assets needed to generate each dollar of revenue. It is extremely important that you learn to identify a firm's performance in terms of the financial ratios presented here. This is the language that analysts and management use to discuss a company's performance, and we will use this language to construct forecasts of the future. Ratio analysis is traditionally applied to historical data to evaluate past performance, but we will also use it to evaluate the plausibility of our forecasted future financial statements.

5.2 TIME-SERIES AND CROSS-SECTIONS

Ratio analysis involves comparing individual ratios with their levels in prior years and their levels in other firms. Comparing a firm's ratios with their levels in prior years is called *time-series analysis*. Time-series analysis identifies changes in financial performance and helps to detect the underlying cause. It also helps you to see whether the firm's most recent performance is unusual, in which case it may be less likely to recur in the future, or whether it is just one in a series of normal outcomes. If you have a flair for quantitative analysis, you might be tempted to estimate a complicated time-series model of a firm's past ratios in order to predict their future values. We don't recommend such an approach. As a general rule, financial ratios don't follow mechanical time-series models. Instead, it is more important that you evaluate changes in ratios in the context of changes in the underlying business operations and strategy of the firm.

Comparing a firm's ratios with the corresponding ratios in competitor firms is called *cross-sectional analysis*. This type of ratio analysis is also called *comparative analysis* (often shortened to *comps*). If management has done a consistently good job, then this will not be readily apparent in a time-series analysis. But it will be revealed by a cross-sectional ratio analysis with competitors. Does the company command a higher margin on its products? Is it the most efficient producer in its industry? Is it gaining market share from competitors? These are the types of questions that you can only answer by comparing a firm's financial ratios with competitor firms or the industry average. It isn't always easy, but you should try to triangulate a firm's ratios with its business strategy. If the firm is attempting to differentiate its product, it should enjoy higher margins than its competitors. If a firm is attempting to be a cost leader, it should have a higher asset turnover than its competitors. We'll discuss how different strategies influence particular ratios later in the chapter.

You conduct cross-sectional analysis by computing the same set of ratios for a comparable firm and then comparing ratios across the two firms. If you want help in finding a comparable firm, you can find details about a company's industry membership and competitors using the *eVal with XBRL data* workbook that is available from the software section of our website. To do so, download and open the workbook, then click on the 'Financial Statements' tab at the bottom of the workbook. The workbook is pre-loaded with Dollar Tree's 2021 financial data. Use the input options at the top of the 'Financial Statement' sheet to load the company of your choice and then click the Link to Industry Comps in cell F5 to take you to a list of comparable firms with the same SIC code.

Ratios Tend to Mean-Revert

From a valuation perspective, the main reason we want to study the historical performance of a firm's financial ratios is to guide us in forecasting the future values of these ratios. To this end, you should remember a common theme in the evolution of financial ratios over time – they tend to mean-revert. This means that if they are unusually high, they tend to fall and if they are unusually low, they tend to rise. For example, firms that experience an extremely high or extremely low return on equity (net income over common equity) in a given year probably had something unusual happen – a windfall gain on the sale of an asset, a write-off of inventory, a surprisingly successful advertising campaign, or an embarrassing product recall, to list just a few possibilities. In these cases, it is unlikely that the extreme return on equity will persist into the future, because the unusual event that happened once is unlikely to happen again. Later we will graph some common ratios to illustrate their rates of mean reversion.

We don't want to over-sell the power of mean-reversion. It is an observable tendency for many different ratios in a large sample of firms, but there are many exceptions. And, as we discuss below, how quickly and how completely a ratio mean reverts varies greatly by both ratio and firm.

5.3 SOME CAVEATS

Despite their usefulness, ratios are also frequently misunderstood and abused. So before launching into a discussion of specific ratios, we offer some important caveats regarding ratio analysis.

There is no 'correct' way to compute many ratios

Many people assign the same name to ratios that are computed quite differently. Consider the Return on Assets (ROA) ratio. The numerator (income) is sometimes measured on a before-tax basis and sometimes measured on an after-tax basis. It is sometimes measured on a before interest basis and sometimes on an after-interest basis. It may or may not include any non-recurring and/or non-operating items for the period. The denominator (assets) usually represents total assets, but it is sometimes measured as net operating assets (in which case the ratio is sometimes referred to as the Return on Net Operating Assets). The key point here is that there are no standards like 'GAAP' governing the computation of ratios. Basically, anything goes, and both management and sell-side analysts can be creative in coming up with ratios that put firms in the best possible light. Thus, when interpreting a ratio, you should first make sure you understand how it was computed.

Ratios do not provide answers, they just tell you where to look for answers

It is common to hear rules of thumb that attach certain interpretations to ratios falling in certain ranges. For example, a firm with an Interest Coverage ratio less than 2 is often deemed to be financially distressed, or a firm with a return on assets less than the yield on the 10-year US Treasury is deemed to be a candidate for liquidation. Unfortunately, financial analysis is not that simple. There are many reasons why ratios can have unusual values, from accounting distortions to subtle differences in firms' strategies. Ratio analysis guides you in your search for answers, but ratios themselves rarely provide the answers.

Managers know that investors use ratios

Managers are well aware that investors rely on ratios to summarize their firm's financial performance. Hence, they can and do use their discretion over accounting, operating, investing, and financing decisions to make their key ratios look more appealing. This practice is often referred to as 'window dressing'. An example is delaying the purchase of inventory until right after the end of the quarter in order to improve inventory and working capital turnover ratios. It is therefore important to anticipate and undo the effects of any managerial window dressing of a firm's financial ratios.

5.4 A FRAMEWORK FOR RATIO ANALYSIS

We suggest that as you read through this section you conduct your own ratio analysis on a real company (see the cases at the end of the chapter for some suggestions). If you are using a spreadsheet program like *eVal* you will find it helpful to display Excel's formula bar so that you can see how the ratios in each cell have been computed. The formula bar can be displayed by selecting the Formula Bar menu item from the View menu in Excel.

Ratio analysis begins with the two pillars of firm value: *growth* and *profitability*.

Growth measures changes in the scale of the business on which the firm is able to generate profitability. Profitability measures the return on investment generated by the business, which we already encountered in chapter 4. The key to value creation is to simultaneously achieve high growth and high profitability. Our ratio analysis starts with summary measures of each of these pillars. We then examine the underlying drivers of profitability to learn more about its sources and sustainability.

5.5 GROWTH

The analysis of growth is relatively straightforward. Growth rates are commonly reported for a variety of financial statement line items such as sales, assets, common equity, earnings and free cash flows. But *growth in sales* is the most commonly discussed growth statistic. Growth rates in assets, common equity, earnings and free cash flows are closely related to the sales growth rate. In fact, when sales growth and profitability reach 'steady state' (which we will define in detail later), the growth rates in all financial statement line items converge to the steady-state sales growth rate. However, during years when sales growth and profitability are fluctuating, the growth rates in the other line items will generally differ from the growth rate in sales. The intuition behind these differences is usually straightforward. For example, asset growth will differ from sales growth when there is a change in the level of assets that is required to generate a given level of sales.

The final growth rate that we will define is the **Sustainable Growth Rate**. This ratio is computed as:

Sustainable Growth Rate = Return on Equity × (1 – Dividend Payout Ratio).

Given its current level of profitability and dividend policy, the sustainable growth rate is the maximum rate that a firm can grow without resorting to additional external financing. If a firm's forecasted sales growth rate exceeds its sustainable growth rate, be sure you understand how the additional growth will be financed. One possibility is through increased future profitability. However, if the increased profitability is not achieved, then the growth plans may have to be curtailed. Alternatively, the additional growth may be financed externally through the issuance of debt and/or equity. This introduces uncertainty, because capital markets must be receptive to the firm's growth plans if they are going to provide financing. A final option is for the firm to cut its dividend payout ratio. However, given that the dividend payout ratio is already zero for most growth firms, this option is often not available.

Sales growth rates have very little memory; an unusually high growth rate this year rarely translates into a similarly high growth rate next year. To illustrate, Figure 5.1 takes all the firms in the US economy and computes their percentage sales growth each year, sorts them into five portfolios from low growth to high growth (labeled as year 0 on the figure), and then plots the median sales growth for each portfolio over the next five years. The fact that all the lines snap back to the middle very quickly is something you should never forget. Consider the top line. Firms in the highest portfolio have median sales growth of 55% in year 0, the year that we did the sorting.

But in the very next year the median growth for these highflyers falls to 22% and after five years, their growth rate is virtually indistinguishable from all the other firms. If all you know about a firm is that they had huge sales growth last year, don't be too impressed. Remind yourself that sales growth mean reverts very quickly.

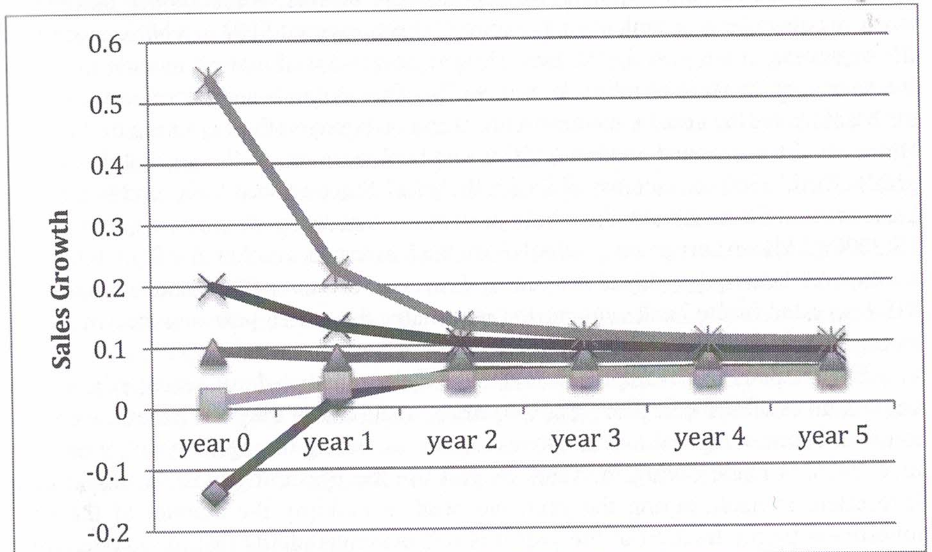


Figure 5.1 Mean-Reversion in Sales Growth

5.6 PROFITABILITY

While the analysis of growth is relatively straightforward, the analysis of profitability has endless nuance. The starting point for the analysis of profitability is our old friend from chapter 4, the return on investment. For the owners of the common equity of a business, this means the **Return on Equity**, computed as net income divided by common equity:[1]

$$\textbf{Return on Equity (ROE)} = \frac{\text{Net Income}}{\text{Common Equity}}.$$

ROE is the ultimate accounting measure of a firm's profitability and will be the focus of our financial analysis of the past and our forecasts of the future. We therefore devote most of the remainder of this chapter to the analysis of ROE.

Before proceeding, we need to discuss a nuance regarding timing conventions in

[1] Note that we use net income in the numerator and not comprehensive income. While comprehensive income is the final bottom line, the convention is to use net income because, as a practical matter, the other items included in comprehensive income are generally non-recurring.

computing the return on equity. The numerator represents the net income for the period over which we want to measure the profitability of the business, typically a year. The denominator represents the amount of common equity invested in the business. But at what point in time should we measure the amount of common equity? Back in chapter 4, we measured common equity at the beginning of the year. We motivated this choice using the example of a bank savings account. If we invested $100 in a bank account at the beginning of the year, left it there all year, and received interest income of $5 for the year, then our rate of return would be 5%. This example suggests that we divide the earnings for the year by the amount of common equity at the beginning of the year. But what if we invested another $100 in the bank account on the <u>second</u> day of the year and still received interest of $5 for the year? Since we had $200 invested in the bank account for essentially the whole year, our rate of return would be approximately $5/$200=2.5%. Alternatively, what if we had invested another $100 in the bank account on the very <u>last</u> day of the year and received interest of $5? Since we had only $100 invested in the bank account for essentially the whole year, our rate of return would be approximately $5/$100 = 5%.

The previous two examples should make it clear that we don't necessarily use the amount invested at the beginning of the year or at the end of the year. Instead, we want to use the time-weighted average investment outstanding during the year. If no new investment is made during the year, we just use the beginning balance. But if new investment is made during the year, we need to multiply the amount of the new investment by the fraction of the year it is outstanding and add that to the beginning investment. For example, if $100 is invested at the beginning of the year and another $100 is invested 9 months into the year, the time-weighted average capital invested during the year is $100 + $100*(3/12) = $125, since the additional capital is outstanding for 3 months. In practice, it can be difficult to determine exactly when new capital is issued. Therefore, a common convention is to use the simple average of the beginning and ending investment balances:

$$\textbf{Return on Equity (ROE)} = \frac{\text{Net Income}}{\text{Average Common Equity}}.$$

This convention is reasonable when the amount of new investment is a relatively small fraction of the beginning balance, and we will use this convention throughout the remainder of the text. You should remember, however, that this is a simple approximation, and if a large amount of new investment takes place during the year, it may be worth pinpointing the timing of the new investment and using the time-weighted average. This timing issue arises any time we compute a ratio that compares a flow variable (an amount generated over the course of the year – such as one on the income statement) with a stock variable (an amount existing at a point in time – such as one found on the balance sheet).

Benchmarking the Return on Equity

ROE is one of the few ratios that can be compared to a well-defined benchmark. If you

were considering investing in a fixed income investment, you would compare its interest rate to the interest rates offered by other like investments. Similarly, to evaluate firm profitability, you can compare the firm's ROE with its competitors' ROEs. Other things equal, the higher a firm's ROE, the greater the return generated per dollar of book equity invested in the firm. Moreover, to value a firm, you must estimate the firm's cost of equity capital. We will discuss the cost of capital in more detail in chapter 9, but loosely speaking, the cost of equity capital represents the expected return that an equity investment must generate to make it competitive with similar investment opportunities. So, accounting distortions aside, a firm with a ROE as high as its cost of equity capital is generating a competitive return for its equity holders. Thus, the cost of equity capital is a natural benchmark for a firm's ROE. Historically, the cost of equity capital has been estimated at about 10% for the average firm in the US economy, so this is a crude benchmark you can use to assess a firm's ROE. Unfortunately, there are two key drawbacks with such comparisons. First, as we will see in Chapter 9, the cost of equity capital varies significantly both over time and across firms. Moreover, even experts disagree on the appropriate way to compute a firm's cost of equity capital. Second, as we have mentioned before, the vagaries of GAAP accounting rarely result in measures of net income and common equity that correspond with their economic counterparts. So, to make these constructs more meaningful, you must first adjust for any major accounting distortions.

Mean Reversion in ROE

We stated earlier that many measures of financial performance tend to mean revert and ROE is no exception. Figure 5.2 shows the mean reversion in return on equity. Each year, we sort the firms into five groups from lowest to highest ROE and then we plot the median ROE for each of these groups over the next five years. As the plot shows, the highest groups move down over time and the lowest groups move up over time, consistent with the notion of mean reversion. And note that the lines are reverting toward the middle group with a ROE of about 10%, the historical long-term average ROE in the US economy.

There are a few other observations to take away from Figure 5.2. First, the drastic improvement in the lowest ROE group in year 1 is a bit misleading. If the firm goes bankrupt, it drops out of the sample, leaving only those firms who improved their performance enough to stay alive five more years and hence remain on the graph. Even with this selection bias, it takes this bottom group three years to get back to zero ROE. So they mean-revert, but slowly. Second, while the top two ROE groups decline and the bottom two groups improve, at no time do the lines completely converge. Even after five years the highest group has a ROE of about 15% and the lowest group has a ROE of about 2%. While mean reversion over 5 years has definitely brought the two groups closer together, it has not eliminated the disparity in ROE.

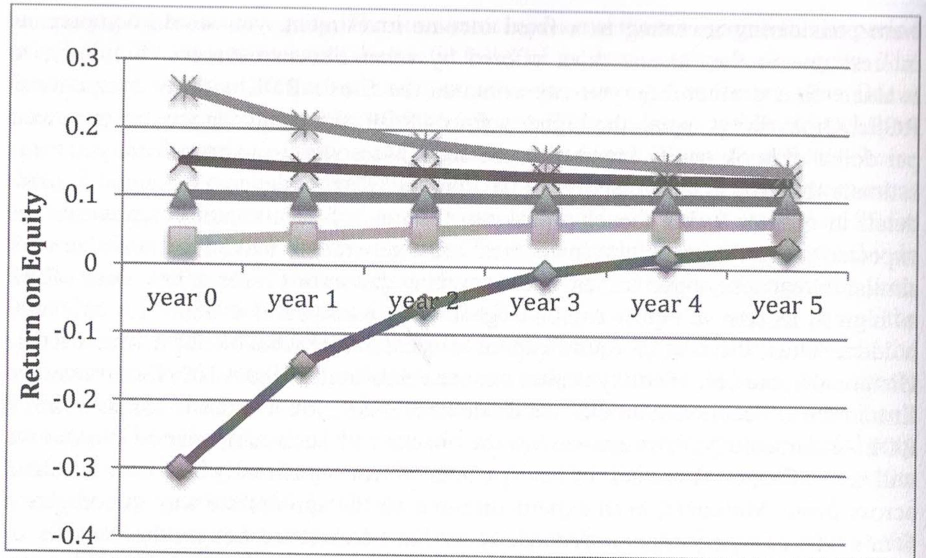


Figure 5.2 Mean-Reversion in ROE

Why does ROE tend to mean-revert? The short answer is competition. If a firm enjoys a high return on equity, this catches the attention of other firms. Existing rivals undercut the firm's prices and new firms enter the market. As the firm responds to these competitive threats with a price cut of its own, its profitability suffers, driving down the ROE. Why is the mean-reversion in ROE less than complete? For reasons we discussed in Chapter 3, many firms enjoy imperfect competition (often called competitive moats) and are therefore partially shielded from competitive forces. In addition, accounting distortions can generate long-term disparity in ROE across firms. Firms in the pharmaceutical industry report among the economy's highest ROEs, but this is partly due to the fact that their most prominent economic asset – their past R&D expenditures – are expensed immediately. Because an asset is not recorded, assets and common equity are understated, causing ROE to be overstated.

It is reasonable to expect some components of income to be more persistent than others. For this reason, we also compute **Return on Equity Before Nonrecurring Items**. The idea is to exclude from the numerator items that are likely to completely disappear in subsequent years, thus providing a better indication of a firm's long-run sustainable ROE. We expect that ROE before non-recurring items will mean-revert more slowly than regular ROE. Non-recurring items are most commonly found in the extraordinary items and discontinued operations (Ext. Items & Disc. Ops.), other income, and non-operating income line items on the income statement. You can exclude these line items from the definition of net income used to compute ROE before non-recurring items. Non-operating income is a pre-tax item on the income statement, so it must be tax-adjusted before adding it back to net income. The resulting measure is as follows:

Return on Equity Before Nonrecurring Items

$$= \frac{\text{Net Income} - \text{After Tax Nonrecurring Items}}{\text{Average Common Equity}},$$

where

After-Tax Nonrecurring Items = Ext. Items & Disc. Ops. + Other Income (Loss) + (1- Effective Tax Rate)*(Non-Operating Income (Loss)), and
Effective Tax Rate = Income Taxes/Pre-Tax Income.

You should remember that while canned ratio analyses using standardized data may produce a ratio called 'ROE Before Non-Recurring Items', it is only a first approximation and you should engage in more detailed analysis in order to classify items as recurring or non-recurring. For example, the 'Other Income' line item sometimes includes earnings from equity affiliates, which may well be recurring. Also, non-recurring items may be buried in other line items on the income statement, such as the effects of an inventory write-down, which will usually be hidden in the cost of goods sold (but can be recovered from the financial statement footnotes).

Decomposing ROE – the Basic DuPont Model

It is very useful to decompose ROE into a few fundamental drivers of profitability. The Basic DuPont Model, pioneered by management at a predecessor of the DuPont Chemical Company, factors ROE into three components, as shown below.

$$\frac{\text{Net Income}}{\text{Common Equity}} = \frac{\text{Net Income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Total Assets}} \times \frac{\text{Total Assets}}{\text{Common Equity}}, \text{or}$$

$$\text{ROE} = \mathit{Net\ Profit\ Margin} \times \mathit{Total\ Asset\ Turnover} \times \mathit{Total\ Leverage}.$$

The basic DuPont model does a good job at highlighting the three key drivers of the accounting rate of return on equity. First, the *Net Profit Margin* measures the amount of net income generated per dollar of sales. Second, the *Asset Turnover Ratio* measures the amount of sales generated per dollar of assets. Third, the *Total Leverage Ratio* measures the amount of assets that are supported by a dollar of common equity. The product of the three gives the net income generated per dollar of common equity, which is just ROE.

The DuPont breakdown provides a variety of insights. First, if a firm can't earn a positive net profit margin, then it will generate a negative return regardless of how efficiently it utilizes its assets or how much leverage it applies. The first order of business at a hotdog stand is to sell the hotdogs for more than the cost of the meat and buns. The net profit margin extends this intuition all the way to the bottom line of the income statement – how much of each sales dollar remains after all expenses are deducted. Second, assuming the firm is making a net profit, the trick is to do so with the minimum investment in assets. If selling hotdogs requires an elaborate kiosk, or a fleet of home-delivery trucks, then the profit made might not be sufficient to justify the investment. Fortunately for the hotdog business, most stands run a large volume past a relatively inexpensive investment in assets; hence, the asset turnover is high.

Figure 5.2 illustrated the mean reversion in ROE. Figure 5.3 plots the evolution of the three components of ROE. As panel A shows, most of the mean reversion in ROE is due to mean reversion in the profit margin, which makes sense if price competition is the driving force behind the mean reversion. In contrast, the total asset turnover ratio and the total leverage ratios are remarkably stable, as seen in the panels B and C. These ratios are largely determined by the structure of the industry. It takes lots of equipment and a long time to construct buildings, for example, and so the construction industry necessarily has a slow asset turnover ratio. And, as we illustrate later in the chapter, financial institutions necessarily have lots of leverage. In fact, financial institutions dominate the top group of total leverage, which stands out from the rest, with a median value of about eight.

Panel A

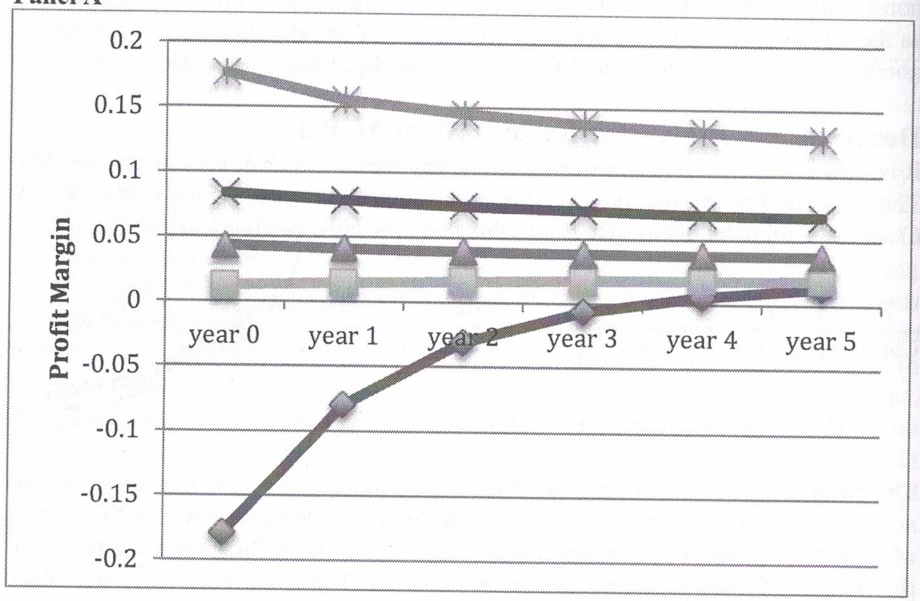
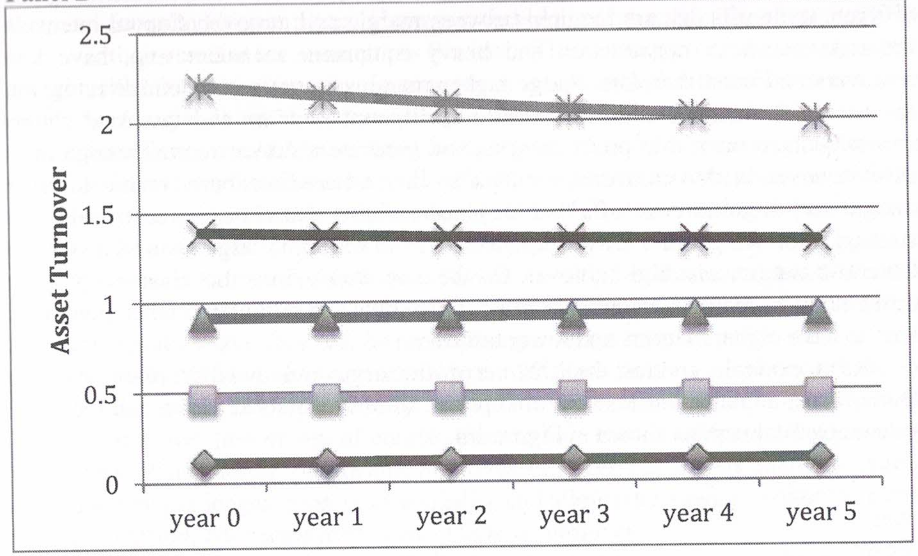


FIGURE 5.3: Mean Reversion in Net Profit Margin, Total Asset Turnover and Total Leverage (continued on next page)

Panel B



Panel C

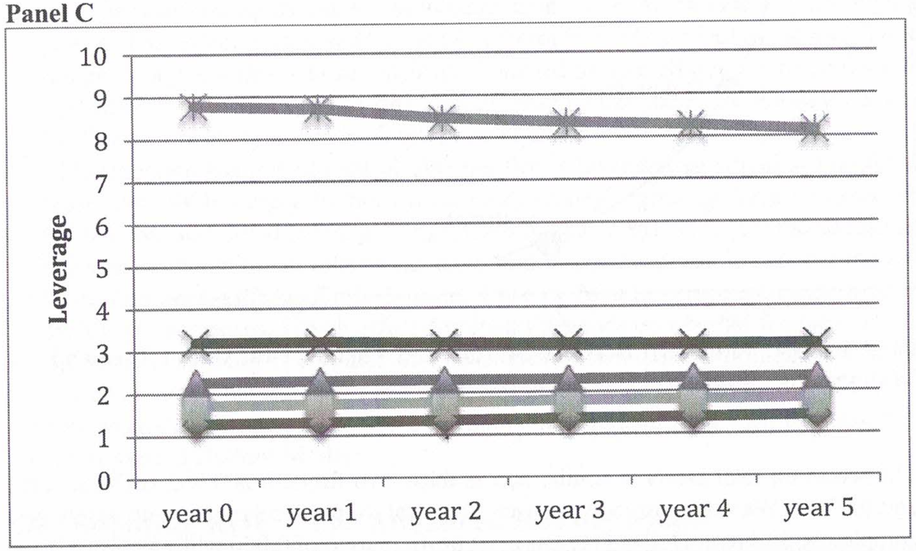


Figure 5.3 (continued): Mean Reversion in Net Profit Margin, Total Asset Turnover and Total Leverage

The first two components of the Basic DuPont model capture the operations of the business. How does the firm use its assets to make sales, and how profitably can it convert the sales into net income? These two components tend to trade off against one another; if you multiply them together, you get Net Income/Average Total Assets, labeled the *return on assets*. We can characterize different firms and industries by the different trade-offs that are required between margin and turnover. Capital-intensive industries, such as construction and heavy equipment manufacturing, have low turnovers and must therefore charge higher margins to get a competitive return on assets. On the other end of the spectrum, discount retailers and fast-food chains generally have razor thin profit margins and generate a decent return through high asset turnover. Within industries, we can also characterize firms based on the different margin and turnover trade-offs that they make. Firms that choose a cost leadership strategy, producing at the lowest possible cost and selling in large quantities, tend to have low margins and high turnover. On the other hand, firms that choose a product differentiation strategy, producing a premium product and selling in smaller quantities, tend to have higher margins and lower turnover.

As an example, contrast the 2022 net profit margin and total asset turnover of the Dollar Tree, a unique variety store that prices all of its goods at $1.00, and the retail behemoth, Walmart, as shown in Figure 5.4.

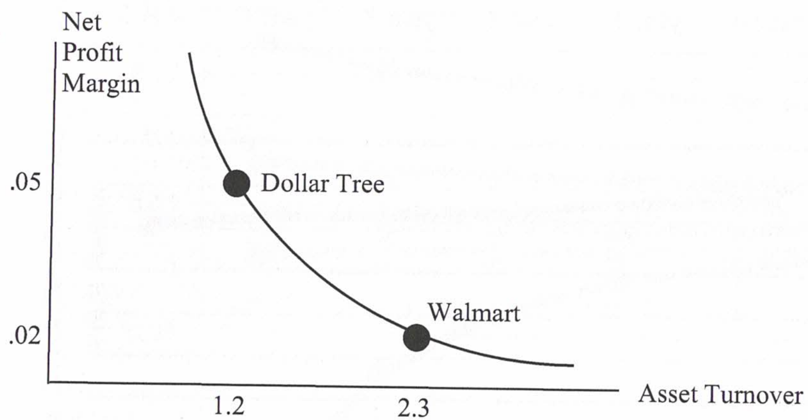


FIGURE 5.4: Trade-Off Between Margin and Turnover for Dollar Tree and Walmart

The return on total assets is similar across these two firms: it is 0.062 at Dollar Tree and 0.056 at Walmart. But how the two firms got to this similar return on assets was completely different. Dollar Tree has a net profit margin of 0.050 while Walmart's net profit margin is only half that size, at 0.024. In contrast, the total asset turnover at Dollar Tree is only 1.24 while Walmart's asset turnover is almost twice as big, at 2.30. These numbers reveal the very different strategies the two firms take. Walmart revolutionized the retail market with its focus on low costs and high sales volume. This emphasis has made Walmart a leader in supply chain management, offering non-frills stores on the edges of urban centers, and requiring suppliers to hold inventory until just before Walmart needs it. This strategy combines a low profit margin with a high asset turnover. As for the Dollar Tree, you may not think of them as being in a high-margin business, but their unique pricing strategy gives them a niche market where they can command higher prices. However, they do not have the scale or expertise to turn over their assets at the same rate as Walmart. Their strategy combines a high profit margin with a low asset turnover. In sum, as compared to Dollar Tree, Walmart makes twice the sales per dollar of asset, but keeps only half as much profit per dollar of sales. While both firms would like to have a high margin *and* a high asset turnover, in practice this is very hard to achieve. If Walmart were to raise its prices in order to improve its margin, its sales volume would probably suffer, driving down its asset turnover. And if Dollar Tree were to carry lower quantities of inventory in an effort to improve its asset turnover, its customers would probably be disappointed with the lack of selection and refuse to pay its higher margins. The very nature of each firm's strategy dictates where they will be on the margin versus turnover trade-off.

The trade-off between margins and turnover plays out in a number of different business decisions. Putting inventory on sale lowers the profit margin but improves the asset turnover (assuming, of course, that the sale causes a buying frenzy among customers). Outsourcing production improves turnover but lowers margins. Aging balsamic vinegar longer improves the quality and allows the vinegar-maker to charge a greater margin, but necessarily lowers the asset turnover.

The first two terms in the basic DuPont model determine the firm's return on total assets. The return on equity can be made larger than the return on assets by leveraging the assets. This effect is captured by the third factor in the basic DuPont model, Total Leverage. Imagine a firm whose assets are financed by a small amount of equity and a large amount of liabilities. The small equity base claims the entire return on assets and will therefore enjoy a very high return on equity.

Management has lots of control over the firm's leverage, so why don't all firms increase their ROE simply by borrowing more money? Ignoring for a moment the added risk that additional leverage brings, the more basic answer is that the additional debt comes with additional interest expense, and interest expense lowers net income and therefore lowers the Net Profit Margin. Thus, as Total Leverage increases, the Net Profit Margin decreases. Which effect dominates depends on whether the interest rate on the borrowed money is less than the pre-interest return that the firm earns with the borrowed money. This last effect is a weakness of the basic DuPont model; it doesn't cleanly separate operating decisions from financing decisions. For this, we must turn to the Advanced DuPont Model.

Decomposing ROE – The Advanced DuPont Model

The Advanced DuPont Model isolates operating performance more cleanly than the Basic DuPont Model by introducing a new measure of profitability: the *return on net operating assets* (RNOA). This core measure of operating performance is then adjusted for the effect of Leverage to arrive at the ROE. While this decomposition more cleanly separates operating and financing effects, it is also more complicated. Before we can present detailed definitions and computations, we need to associate each line item on the income statement and balance sheet with either operating or financing activities. What, exactly, are operating activities and what are financing activities? The answers will not always be clear, but as a guiding principle, financing activities relate to sources of capital, and typically come with some type of financing cost (e.g., interest expense), while operating activities relate to the provision of goods and services to customers.

Income Statement
Sales (Net)
- Cost of Goods Sold
= Gross Profit
- R&D Expense
- SG&A Expense
= EBITDA
- Depreciation & Amortization
= EBIT
- Net Interest Expense
+ Non-Operating Income (Loss)
= EBT
- Income Taxes
+ Other Income (Loss)
= Net Income Before Ext. Items
- Ext. Items & Disc. Ops.
- Noncontrolling Interest in Earnings
- Preferred Dividends
= Net Income (available to common)

Net Operating Income (NOI) =
(EBIT + Non-Operating Income)*(1-tax)
+ Other Income (Loss)
- Ext. Items & Disc. Ops.

Net Financing Expense (NFE) =
Interest Expense*(1-tax)
+ Noncontrolling Interest in Earnings
+ Preferred Dividends

where tax (the effective tax rate)
= Income Taxes/EBT.

Balance Sheet
Operating Cash and Market. Sec.
+ Receivables
+ Inventories
+ Other Current Assets
= Total Current Assets
+ PP&E (Net)
+ Investments
+ Intangibles
+ Other Assets
= Total Assets
Current Debt
+ Accounts Payable
+ Income Taxes Payable
+ Other Current Liabilities
= Total Current Liabilities
+ Long-Term Debt
+ Other Liabilities
+ Deferred Taxes
= Total Liabilities
+ Noncontrolling Interest
+ Preferred Stock
+ Paid in Common Capital (Net)
+ Retained Earnings
= Total Liabilities & Equity

Net Operating Assets (NOA) =
Total Assets
- Accounts Payable
- Income Taxes Payable
- Other Current Liabilities
- Other Liabilities
- Deferred Taxes

Net Financial Obligations (NFO) =
Current Debt
+ Long-Term Debt
+ Noncontrolling Interest
+ Preferred Stock

Common Equity = NOA - NFO

Return on Net Operating Assets

$$\textbf{(RNOA)} = \frac{\text{NOI}}{\text{NOA}}$$

$$\textbf{Net Borrowing Cost (NBC)} = \frac{\text{NFE}}{\text{NFO}}$$

FIGURE 5.5: How *eVal* uses the Advanced DuPont Model to Decompose the Financial Statements into Operating and Financing Components

The income statement items are divided into Net Operating Income (NOI) and Net Financing Expense (NFE). Both amounts are net of tax, so that Net Income = NOI – NFE. The tax rate used is not arbitrary; it is the effective tax rate for the period, defined as Income Taxes/EBT (where EBT denotes earnings before taxes). The balance sheet assets and liabilities are divided into Net Operating Assets (NOA) and Net Financial Obligations (NFO), so that Common Equity = NOA – NFO.

When deciding whether assets and liabilities belong to NOA or NFO, there will be some ambiguous items (e.g., operating lease liabilities). The general goal is to isolate the effects of operating activities from financing activities. The most important thing is to be consistent across classifications on the income statement and balance sheet. It would be wrong, for instance, to classify the imputed finance expense on an operating lease as an operating expense, but then classify the operating lease liability itself as a financial obligation.

Figure 5.5 illustrates how we have made these classifications using the standardized financial statement data items in our spreadsheet program, *eVal.* Remember, spreadsheet programs like *eVal* can't read and interpret the detailed financial statements, so some of the classifications are crude. You need to read the actual financial statements and adjust the data inputs accordingly.

Having allocated the line items in the income statement and balance sheet into operating and financing components, we can now conduct our ratio analysis on each activity separately, and then examine how they come together to determine ROE. The two key ratios are shown at the bottom of Figure 5.5. They are:

$$\textbf{Return on Net Operating Assets (RNOA)} = \frac{\text{Net Operating Income (NOI)}}{\text{Net Operating Assets (NOA)}}$$

and

$$\textbf{Net Borrowing Cost (NBC)} = \frac{\text{Net Financing Expense (NFE)}}{\text{Net Financial Obligation (NFO)}},$$

where

Net Financing Expense (NFE) = Net Interest Expense*(1-tax) + Preferred Dividends + Noncontrolling Interest in Earnings,
Net Operating Income (NOI) = Net Income + Net Financing Expense,
Net Financial Obligations (NFO) = Current Debt + Long-Term Debt + Noncontrolling Interest + Preferred Stock,
Net Operating Assets (NOA) = Common Equity + Net Financial Obligation, and
Effective Tax Rate (tax) = Income Taxes/Earnings Before Taxes.

Each ratio compares the income statement flows with the balance sheet items that caused them. Consider the RNOA. In the numerator, NOI represents the after-tax income earned by the operating assets; equivalently, it is net income with the after-tax financing charges added back. In the denominator, NOA represents the operating assets used to generate the NOI. Equivalently, it is common equity with the net financial obligations added back. Common equity and net financial obligations represent the sources of capital that are used to finance the net operating assets. The result is a measure of the firm's operating performance that abstracts from the manner in which these operations are financed. For instance, RNOA is not affected by the firm's level of debt, the interest rate paid, or the tax shield that the interest creates. All these effects are isolated in the net borrowing cost (NBC), which associates the after-tax income statement flows that go to debt, noncontrolling interests, and preferred stock providers with the amount of capital they provided.

The absolute interpretation of the RNOA as a profitability measure is similar to the interpretation of ROE. The key difference is that the long-term 'hurdle rate' for RNOA is the after-tax weighted average cost of capital – a blend of the cost of equity capital and debt capital that we will discuss in Chapter 9.

We offer a final word of warning about RNOA. In practice, there are many different definitions and terminologies used for RNOA. For example, it is not uncommon to use total assets in the denominator, in which case the measure is usually referred to as return on assets (ROA). Another common variant measures the numerator before taxes, in which case the measure is usually referred to as the pre-tax RNOA. Finally, the term *return on invested capital* (ROIC) is frequently used in place of the term RNOA. Invested capital is equal to the sum of Net Financial Obligations (NFO) and Common Equity. Since the balance sheet has to balance, net operating assets must equal invested capital. You can verify this in Figure 5.5 by noting that Net Operating Assets must equal Net Financial Obligations plus Common Equity. So the terms net operating assets and invested capital are often used interchangeably. The bottom line is that when you see a return on "something" you should make sure that you understand how it is computed before attempting to interpret it.

Putting all the pieces together, the Advanced DuPont Model decomposes ROE as shown below.

ROE	=	RNOA	+	Leverage	*	Spread
	=	NOI/NOA	+	(NFO/Common Equity)	*	(RNOA – NBC)
	=	NOI/NOA	+	(NFO/Common Equity)	*	(NOI/NOA – NFE/NFO).

Note that Leverage in this decomposition differs from the Total Leverage definition in the Basic DuPont Model. This measure of leverage only includes financial obligations in the numerator, whereas the Basic DuPont Model uses total assets. The Advanced DuPont Model describes ROE as RNOA plus an adjustment for the amount of Leverage the firm employs times the 'Spread' between RNOA and NBC. To interpret this relation, first recall that RNOA measures a firm's operating performance. ROE, on the other hand, measures the return to the common equity holders after satisfying the claims of all the other capital providers that are funding the firm's operations. The common equity holders are the residual claimants on any operating earnings that remain after satisfying these other capital providers. Thus, if a firm's RNOA exceeds its net borrowing costs (NBC), then the ROE will exceed the RNOA, because the common equity holders get more than a proportionate share in the net operating income. The extent to which ROE exceeds RNOA depends on the 'Spread' between

RNOA and the NBC, and the amount of Leverage the firm applies.

You may remember that we previously introduced the relation between ROE and ROI in chapter 4. The advanced DuPont model basically tells us how to compute the RNOA, which is just the ROI for the operations of a business. As a simple illustration, consider a bank that borrows funds at one rate and lends at another (hopefully higher) rate. The bank's RNOA is given by its lending rate adjusted for the other costs of operating the bank (i.e., the rate it earns on its operating assets, which largely consist of its loan portfolio). The ROE generated for the bank's owners depends on its borrowing rate relative to its adjusted lending rate (i.e. its spread) and the proportion of its lending that is funded by debt. For example, if a bank generates an RNOA of 6%, uses nine dollars of debt for each dollar of equity and pays 5% after-tax interest on its own debt, then the bank's ROE is given by

ROE = 6% + (9/1) * (6% - 5%) = 15%.

In this case the Leverage is 9 and the Spread is 1%, adding 9% to the RNOA of 6% to yield a ROE of 15%. Note that leverage does not always increase ROE relative to RNOA. If a firm has a negative spread, then additional leverage reduces ROE relative to RNOA. For example, assume that the bank in our example only generates an RNOA of 4%. In this case we have:

ROE = 4% + (9/1) * (4% - 5%) = -5%.

Thus, higher leverage increases ROE when RNOA is greater than the cost of non-equity financing and reduces ROE when RNOA is less than the cost of non-equity financing. In other words, additional leverage makes the good times better and the bad times worse. This is just another way of saying that additional leverage increases the risk of the returns to common equity holders.

The next stage of the advanced DuPont model is to decompose RNOA into net operating margin and the net operating asset turnover, much like we did in the basic DuPont model, as shown below.

NOI/NOA	= NOI/Sales	*	Sales/NOA, or
RNOA	= Net Operating Margin	*	Net Operating Asset Turnover.

Thus, RNOA is increasing in both the margin that a firm generates on its sales and the amount of sales that can be generated per unit of assets, just as in the basic DuPont model. The difference between the two models is that the margin and turnover measures are based on 'cleaner' measures of operating activities in the advanced model, and this has some important consequences. First, the net operating margin isn't polluted by interest expense, noncontrolling interest income, or preferred dividends, as it was in the basic DuPont model. Second, the treatment of operating liabilities is very different between the two models. Imagine using operating cash to pay off an extra dollar of accounts payable on the last day of the year. Clearly this has no effect on the ROE. And no terms in the advanced DuPont model would change because the definition of NOA nets the operating liabilities against the operating assets. However, in the basic DuPont model, the Asset Turnover Ratio would increase because there is a dollar less of total assets (the dollar of cash is gone) and the Total Leverage would decrease because there is a dollar less of total liabilities (because the dollar of accounts payable is gone). Again, because the basic DuPont model doesn't make a clean distinction between operating and financing, seemingly minor transactions can influence the ratios. The advanced DuPont model is relatively immune to these distortions.

Financial Assets in the Advanced DuPont Model

By default, most spreadsheet programs (including our spreadsheet program, *eVal*) classify all cash and marketable securities as part of net operating assets. Yet in many cases, these are really financial assets that are not directly tied to the operations. The firm needs to maintain some balance of cash to fund its ongoing operating activities, but this is rarely more than a few percent of sales. To pick an extreme example, at the end of September 2021 Apple had over $190 billion in cash and marketable securities. This is over 50% of their total assets and almost 5 times their balance of property, plant and equipment. Apple doesn't need to maintain this many financial assets just to run its operations. How should we deal with these financial assets in our advanced DuPont model? One option would be to net them against the Net Financial Obligations and then net the investment income they produce against Net Financing Expense. We recommend against doing this for several reasons.

First, we would be hard-pressed to specify for all firms at all times to identify the right split between operating assets and financial assets, making it almost impossible to isolate the 'true' financial assets. Second, having $190B financial assets and $190B of debt is different from having no financial assets and no debt. For example, what does the company plan to do with the financial assets? Could it be used to pay off the debt without incurring tax liabilities etc.? What rate of return is being generated on the financial assets in the meantime? Third, the whole advanced DuPont model breaks down when the financial assets exceed the financial obligations and/or the financial income exceeds the financing expense. When this happens, NFO and/or NFE become negative and the ratios can become difficult to interpret. Instead, we recommend treating the financial assets as operating assets, and analyzing them as a separate component of a firm's operating activities. What rate of return is currently being generated by the financial assets? What do you think that management will do with the financial assets? And what stream of after-tax income do you think they will generate? And remember that it is not uncommon for management to do something value destroying with the firm's financial assets, such as overpaying for an empire-building acquisition.

The Advanced DuPont Model in Three Retail Stores

Let's apply the advanced DuPont model to three department store chains; Dollar Tree (DLTR), Walmart (WMT), and Target (TGT). We have made some minor tweaks to the standardized financial statements (relative to those provided in *eVal with XBRL data*) in order to clearly delineate between operating and financing activities. If you want to see the financial statement corrections and investigate the computation of these ratios in more detail, the revised financial statements for each company are available by loading the associated Case Data available in *eVal*.

Recall that Dollar Tree is a specialty retailer with the unique strategy of charging $1.00 for almost everything in the store. Walmart operates 'big box' discount department and grocery stores, and in 2020 was named the largest company in the world based on revenue. In the previous section, we used these two companies to illustrate how margins and turnovers typically trade off in the execution of a firm's strategy. We have added Target to the mix because they are an outlier in the retail world, with both high margins and high asset turnovers, and they leverage this superior performance to produce a remarkably high ROE.

Figure 5.6 gives the advanced DuPont model for the three companies in fiscal 2021.

Advanced Dupont Model	Dollar Tree	Walmart	Target
Net Operating Margin	0.056	0.027	0.069
x Net Operating Asset Turnover	2.432	4.494	3.950
= Return on Net Operating Assets	0.136	0.120	0.271
Net Borrowing Cost (NBC)	0.044	0.031	0.025
Spread (RNOA - NBC)	0.092	0.089	0.246
Financial Leverage (LEV)	0.443	0.711	0.968
ROE = RNOA + LEV*Spread	0.177	0.184	0.509

FIGURE 5.6: Advanced DuPont Model for Dollar Tree, Walmart, and Target

We previously noted the similar operating performance of Dollar Tree and Walmart using the basic Dupont model. We get a similar observation using the advanced Dupont model, with Dollar Tree earning a 13.6% RNOA and Walmart earning a 12.0% RNOA. And, again, we see that, relative to Walmart, Dollar Tree gets there with a higher net operating margin and lower asset turnover. Now add Target to the mix. While Target can't achieve Walmart's net operating asset turnover, they get close. And their net operating margin is 2.6 times higher than Walmart! The net result is that Target earns a spectacular RNOA of 27.1%. But this isn't why we added them to the story of ratio analysis. With such a high RNOA, Target's spread over its net borrowing cost is huge. In this case, leverage is their friend, and they deploy more leverage than either of the other two companies, with a leverage ratio of 0.968. The net result is that the leverage translates their RNOA of 27.1% into an ROE of 50.9%; almost three times as big as the other companies and easily in the top quintile of ROEs shown in Figure 5.2. Target has found the enviable sweet spot of high margins with high asset turnovers and also has the financial savvy to leverage the resulting operating performance into a remarkable ROE.

5.7 PROFIT MARGINS

The net operating margin used in the advanced DuPont model represents after-tax operating income divided by sales. In order to understand the drivers of net operating margin, we must look at each of the components of after-tax operating income as a proportion of sales. If the bottom line net operating margin is unusual, then work your way down this list of intermediate margins to identify the underlying line items that are driving this behavior.

The starting point is the **Gross Margin**, which measures the difference between sales and cost of goods sold as a proportion of sales:

$$\textbf{Gross Margin} = \frac{\text{Gross Profit}}{\text{Sales}} = \frac{(\text{Sales} - \text{Cost of Goods Sold})}{\text{Sales}}.$$

This is the first level of profitability -- the company's mark-up on the product. For each dollar of sales, how much more can the firm charge over the direct cost of making or buying the product. It is generally all downhill from here, so if a firm can't generate a decent gross margin, there is not much point in looking any further. This is also the ratio to watch if you are worried about increased competition. If the firm is lowering its prices to retain market share, you will see it here.

The next key margin we report is the **EBITDA Margin**, which gives 'earnings before interest, taxes depreciation and amortization' as a proportion of Sales. Another way to define the numerator is Sales less Cost of Goods Sold, R&D Expense, and SG&A Expense. The ratio is shown below:

$$\textbf{EBITDA Margin} = \frac{\text{EBITDA}}{\text{Sales}} = \frac{\text{Sales} - \text{CGS} - \text{R\&D Expense} - \text{SGA Expense}}{\text{Sales}}.$$

The firm may enjoy a large mark-up on its product, but it could be that the key costs aren't due to the actual production of the goods. For instance, the drug company Merck (MRK) reported a gross margin of approximately 70% for the past few years. But the real costs at a pharmaceutical company are R&D and SG&A; the actual manufacturing of the drug is a relatively minor cost. Consequently, Merck's EBITDA margin is about 20%. If you discover that the EBITDA margin is unusual, then you should go back to the detailed income statement to identify the specific line items that are responsible. Note that this ratio excludes depreciation and amortization, so it can be quite high for capital-intensive firms. Analysts often tout the EBITDA ratio, reasoning that depreciation and amortization represent non-cash charges and are therefore irrelevant. But don't be tricked into relying too heavily on this ratio (as many Telecom investors did in the late 1990s). While depreciation and amortization are accounting adjustments, they nevertheless represent the allocation of real past capital expenditures. A capital-intensive firm may look great on an EBITDA basis, but sooner or later, it will have to reinvest real cash in new assets in order to stay in business.

The **EBIT Margin** is the EBITDA margin with the 'DA' taken out. As such, it

provides a useful summary measure of operating performance. The numerator is sales less all operating expenses except interest and taxes; hence the name 'Earnings Before Interest and Taxes':

$$\textbf{EBIT Margin} = \frac{\text{EBIT}}{\text{Sales}}.$$

The after-tax operating margin can fluctuate due to changes in leverage or tax rates. The EBIT margin abstracts from these effects, providing a clean measure of underlying operating performance

As we move down the page from Gross margin to EBIT margin, the relation between sales and profits gets weaker. As sales increase, cost of goods sold will necessarily have to increase – the firm needs to pay for the goods that it is selling – so the gross margin is relatively stable over time. But an increase in sales does not necessarily mean that R&D expense will increase, as this is a much more discretionary expenditure. Similarly, administrative expenses bear no direct relation to sales. In the long run a firm needs these expenses to generate its sales, but in a given year there is no reason why they should vary in proportion to sales.

The final margin that we discuss is the **Net Operating Margin Before Nonrecurring Items**. This margin starts with net operating income but then adds back any non-recurring expenses, adjusted for their tax consequences (specifically, it adds back tax-adjusted Non-Operating Income, Other Income, and Extraordinary Items and Discontinued Operations). Unusual behavior in this margin that does not show up in the EBIT margin is attributable to taxes or costs of non-equity capital (specifically, tax-adjusted Interest Expense, Noncontrolling Interest in Earnings and Preferred Dividends).

Net Operating Margin Before Nonrecurring Items

$$= \frac{\text{Net Operating Income} + \text{After Tax Nonrecurring Items}}{\text{Sales}}.$$

Finally, any unusual behavior in the bottom line net operating margin that does not show up in the above margin should be due to non-recurring items. You should identify the nature of these items from the as-reported financial statements and ascertain that they are indeed unlikely to recur.

Economies of Scale and Operating Risk

Many young and growing firms have negative net operating margins. They all claim that this is a temporary situation and that once they grow past some critical size, they will be hugely profitable. Of course, many of them never achieve this dream and fail, but the ones that succeed do so because they experience economies of scale. A typical situation might be a firm with a positive gross margin but a negative EBITDA margin, due mainly to its SG&A expense. If the SG&A expense is composed of mostly fixed costs, then as sales grow, the SG&A expense does not increase proportionately, and eventually the EBITDA margin becomes positive. Moreover, expenditures on R&D and marketing have to be expensed immediately, but usually benefit future sales. Be on the lookout for such effects as you study a company's margins. If sales are growing and the margins are steadily improving, this is a sign that the firm is exploiting economies of scale. Alternatively, if a firm claims that it will not be profitable until it grows to some larger size, but its past sales growth has not generated any significant improvement in its margins, then you should be suspicious. The company's claims of great margins in the future may be nothing more than wishful thinking.

While a cost structure with a large fixed cost component helps achieve economies of scale, it also imposes operating risk (also referred to as operating leverage) on the company. If the sales volume is highly variable, then in periods of low volume the firm will be stuck with its fixed costs and insufficient revenue to cover them; in periods of high volume it will easily cover its fixed costs and enjoy huge margins. In other words, the good times are really good, and the bad times are really bad. As an example, consider a firm's decision to buy equipment or enter short-term rental contacts for the same equipment. Short-term rentals can be varied with sales, resulting in lower operating risk. For this reason, managers often attempt to lower their operating risk by outsourcing many aspects of production. Frequently, however, they find that there is little profit left over when they do this. No risk often means no return. For example, most oil exploration companies rent exploration equipment from dedicated oil services companies. This lowers their operating risk. But when the price of oil is high, the oil services firms jack up their rental rates, cutting into the potential profits of the oil exploration companies.

Earlier, we compared Dollar Tree, Walmart and Target to illustrate the trade-off between margins and turnovers in the DuPont model. In Figure 5.7 we show the detailed margin and Turnover analysis. There are several notable observations. First, the basic trade-off of a discount retailer like Walmart versus a specialty retailer like Dollar Tree is present: the gross margin is 29.4% at Dollar Tree, compared to 25.1% at Walmart. But more interesting is the observation that the Dollar Tree gross margin is actually higher than Target's gross margin. Target isn't beating Dollar Tree simply because it marks its goods up higher. Target wins in the end with its higher net operating margin, but how does it get there? The next line tells the story – Target's EBITDA margin is much higher than either Dollar Tree or Walmart. There are only two line items between the Gross Margin and The EBITDA Margin – R&D expense, which is zero for all three companies, and SG&A expense. Target spends only 18.6% of its sales on SG&A while Dollar Tree spends 22.5% and Walmart spends 20.5%. Further, during the pandemic of 2020-2022, Walmart and Dollar Tree sales hardly grew at all, while Target's sales grew 19.8% in fiscal 2020 and 13.3% in 2021, due largely to their innovative strategy of making sales online but offering at-store pickups. This caused the fixed component of SG&A to be spread over a larger base of sales at Target but not at the other two companies.

Margin Analysis	Dollar Tree	Walmart	Target
Gross Margin	0.294	0.251	0.293
EBITDA Margin	0.069	0.046	0.107
EBIT Margin	0.069	0.045	0.084
Net Operating Margin (b4 non-rec.)	0.056	0.034	0.066
Net Operating Margin	0.056	0.027	0.069
Turnover Analysis	**Dollar Tree**	**Walmart**	**Target**
Net Operating Asset Turnover	2.432	4.494	3.950
Net Working Capital Turnover	19.121	(490.582)	119.644
Avge Days to Collect Receivables	0.000	4.715	0.000
Avge Inventory Holding Period	76.496	43.162	59.780
Avge Days to Pay Payables	31.433	43.248	66.122
PP&E Turnover	6.126	6.135	3.851

FIGURE 5.7: Margin and Turnover Analysis for Dollar Tree, Walmart, and Target

5.8 TURNOVER RATIOS

We now turn our attention to ratios measuring the amount of assets that the firm requires to generate its sales, known as turnover ratios. These ratios are also referred to as efficiency ratios, because they tell us how efficiently management is employing the firm's assets. A net operating asset turnover ratio of 2 indicates that \$.50 of net operating assets are required to generate \$1.00 of sales. We use turnover analysis to examine how the underlying operating asset and liability line items on the balance sheet contribute to the overall net operating asset turnover ratio. The basic approach is to compute a turnover ratio for specific groups of operating assets and operating liabilities. A common turnover ratio is the **Net Working Capital Turnover Ratio**, computed as

Net Working Capital Turnover Ratio

$$= \frac{\text{Sales}}{\text{Current Operating Assets} - \text{Current Operating Liabilities}}$$

Typically, all the current assets are classified as operating and all the current liabilities except current debt are classified as (negative) operating. The net working capital turnover ratio measures how efficiently a firm is managing its working capital accounts. Ideally, a firm would like to generate sales with a minimum investment in working capital. Obviously, this presents the firm with trade-offs. It is difficult to minimize the investment in inventory while still presenting the customers with a wide variety of choices and fast delivery. And all firms would like to collect on their sales immediately and pay their accounts payable very slowly, but customers often prefer to delay payments and suppliers often give incentives to pay early.

It is common to compute individual turnover ratios for the three most important components of working capital – receivables, inventories, and payables – and there are a number of common modifications that are made in the computation of these ratios. First, they are often stated in the form of the average number of days that a dollar sits in the account. The relation between an annual turnover ratio and the **Average Days Outstanding** metric is simply:

$$\textbf{Average Days Outstanding} = \frac{365}{\text{Annual Turnover Ratio}}.$$

For example, if we turn over our receivables 12 times per year, then the average receivable must have a life of approximately 365/12 = 30 days. Using this approach, the **Average Days to Collect Receivables** is given by:

$$\textbf{Average Days to Collect Receivables} = \frac{365}{(\text{Sales/Average Receivables})}.$$

Similarly, the **Average Days to Sell Inventory** is given by:

Average Days to Sell Inventory

$$= \frac{365}{\text{Cost of Goods Sold}/\text{Average Inventory}}.$$

Note that we made an additional modification in computing the average inventory holding period; we replaced sales with cost of goods sold. This is because inventories are carried at cost, and so we want a flow variable that measures the cost of inventories consumed during the period. Lastly, the **Average Days to Pay Payables** is computed as:

Average Days to Pay Payables

$$= \frac{365}{\text{Purchases}/\text{Average Accounts Payable}}$$

where Purchases = Cost of Goods Sold + Ending Inventory – Beginning Inventory.

Note here that the denominator is measured using purchases. This represents the dollars of payables that were added during the period, and so is directly comparable with the average balance in accounts payable.

The final turnover ratio that we report is **Property, Plant and Equipment (PP&E) Turnover**, computed as:

$$\textbf{\textit{PP\&E Turnover}} = \frac{Sales}{Average\ Net\ PP\&E}.$$

PP&E isn't literally consumed in the sale the same way that inventory is. Nonetheless, it is an asset that is necessary in the production of sales, albeit indirectly at times. In the very short run, a company's corporate headquarters and distribution centers could probably be destroyed and sales in the department stores wouldn't be affected, but in the longer run, headquarters and distribution centers are necessary. We want to know if the firm is using its PP&E efficiently. Does it have idle capacity? Does it invest too heavily in non-producing assets, such as lavish headquarters and Lear jets? Comparing the PP&E ratio of the firm with a few of its close competitors can frequently shed light on these questions.

Note that there are additional accounts, such as intangibles, that may cause an unusual net operating asset turnover ratio. You should identify and understand these accounts too. For example, if a firm has engaged in an acquisition involving significant goodwill, this will typically drive the net operating asset turnover down relative to the company's competitors. However, this is not necessarily a bad sign, and competitors may have similar amounts of internally generated goodwill that is not recognized on their balance sheets.

Continuing our retail example, in the bottom panel of Figure 5.7 we compare Dollar Tree's turnover ratios with the corresponding ratios for Walmart and Target. As we noted earlier, Dollar Tree's net operating asset turnover is noticeably lower than at Walmart or Target. The most obvious reason is that it takes them 76 days to turn over their inventory, on average, while it takes Walmart only 43 days and it takes Target 59 days. Dollar Tree has to fill its store with a wide variety of goods, and holds them longer until they sell, relative to the other two more efficient stores. The second cause of Dollar Tree's slow operating asset turnover is due to the accounts payable to their suppliers. Think of payables to your suppliers as interest-free loans. As such, payables are negative amounts of net operating asset – so the slower you pay off your payables, the better. Dollar Tree pays off its accounts payable balance in 31 days, on average. In contrast, Walmart (famously) stretches its suppliers by not paying them for 43 days. But Target is the stingiest of all, taking 66 days on average to pay its bills. The last operating asset we need to consider is arguably the biggest – the stores themselves. The PP&E Turnover ratio measures the sales generated per dollar of PP&E investment. Based on the data in Figure 5.7, it would appear that the Dollar Tree and Walmart are much better at managing their investment in stores, earning just over \$6 in sales per dollar of PP&E investment, compared to only \$3.8 at Target. But this is misleading. Target owns most of its stores – this is the bulk of their PP&E balance. In contrast, Dollar Tree and Walmart lease many of their stores, and the investment in leases isn't in PP&E (in *eVal*, leases are typically part of Other Assets). If we add PP&E and Other Assets together and measure the turnover of these two asset groups, we would get a turnover of 2.4 at Dollar Tree, 3.5 at Target, and 4.6 at Walmart. Once again, Dollar Tree is the least efficient in its use of assets while Walmart is the most efficient.

5.9 LEVERAGE

In both the basic and advanced DuPont decompositions financial leverage makes the good times better and the bad times worse. As we analyze the firm's past, we can see how much leverage the firm employed, and whether it amplified superior or inferior operating performance. But leverage has a forward-looking feature that the previous ratios lacked. Leverage increases the riskiness of the expected future cash flows. Levered firms commit themselves to making fixed payments to creditors, and the common equity holders must ultimately surrender control of the firm to the creditors if these payments cannot be met. The more financial leverage a firm has, the greater the chance that unexpected poor performance will be amplified to the point that the firm cannot pay its creditors. The likelihood of defaulting on amounts owed to creditors is known as *credit risk*. Many of the ratios we discuss in this section form the basis for the debt covenants between the firm and its creditors. A firm may have great long-term potential, but if it runs into short-term liquidity problems, it may not live to see the long-term. For this reason, the analysis of credit risk also includes a detailed examination of the firm's ability to meet its obligations in the next year or two. Our DuPont decompositions examined how financial leverage contributes to the level and variability of ROE; now we want to assess the amount of credit risk that the leverage imposes on the equity holders.

In this section we first discuss some summary measures of a firm's capital structure and short-term liquidity. We then discuss how these and other variables can be combined to make an explicit prediction of how likely it is that the firm will default on its debt.

Long-Term Capital Structure

A firm's capital structure – its mix of debt and equity – is the primary long-term driver of credit risk. The most common way to represent a firm's capital structure is the **Debt to Equity Ratio**:

$$\textbf{Debt to Equity Ratio} = \frac{\text{End}-\text{of}-\text{Year Current and LongTerm Debt}}{\text{End}-\text{of}-\text{Year Common Equity}}.$$

This ratio is similar to the definition of financial leverage used in the advanced DuPont model. It differs in that we exclude preferred stock and noncontrolling interests from the numerator, because these capital providers typically have fewer rights than debt holders in the case of a missed payment. Because we want to assess risk at the most recent point in time, we also compute the debt-to-equity ratio based on the ending balances, rather than the average balances, as in the advanced DuPont model.

In the context of credit analysis, this ratio provides an overall indication of the extent of a firm's long-term credit commitments. Other things equal, higher debt-to-equity implies a higher probability of financial distress. The weakness of this ratio is that it fails to consider the firm's ability to pay off its creditors. For example, firms with very stable and predictable cash flows, such as utilities and banks, frequently run very high debt-to-equity ratios. This is because they have a stable flow of cash flows from their customers (utility bills and interest payments) reducing the risk that they won't be able to meet their debt payments, and so a high debt-to-equity ratio is not necessarily an indication of financial distress for firms with strong and stable cash flows.

Our next ratio is **Funds from Operations to Debt**, computed as:

Funds from Operations to Debt

$$= \frac{\text{Funds from Operations}}{\text{Average Total Debt}}\text{, where}$$

Funds from Operations = Net Income + Depreciation & Amortization + Increase in Deferred Taxes + Increase in Other Liabilities + Noncontrolling Interest in Earnings + Preferred Dividends.

Funds from operations represent the amount of 'funds' or working capital created or destroyed by the firm's operations. This measure directly compares the amount of debt with the flow of funds that will be used to service the debt. Thus, this measure overcomes the shortcoming described above for the debt-to-equity ratio. One benchmark for this ratio is the interest rate that the company pays on its debt. Unless funds from operations can comfortably cover interest payments, the probability of default is high. A potential shortcoming of this ratio is that working capital can be tied up in illiquid current asset accounts, such as prepayments and inventories. In reality, it will be difficult to pay creditors with these assets. Thus, a common variant of this ratio is the **Cash from Operations (CFO) to Debt Ratio**. This ratio backs out the non-cash working capital accounts from the numerator of FFO to get to CFO:

$$\textbf{CFO to Debt} = \frac{\text{Cash from Operations}}{\text{Average Total Debt}}.$$

This ratio is a useful check, but you should not interpret it too literally. Growth firms frequently run negative cash from operations as they invest in working capital to generate sales growth. This growth is not necessarily a bad thing, but we need to make sure that the firm has the necessary plans in place to finance this growth.

Short-Term Liquidity

The above ratios focus on the firm's capital structure to assess the credit risk created by the firm's long-run financial obligations. The next set of ratios focus on short-term liquidity. These ratios provide an indication of the firm's ability to meet its short-term cash commitments as they come due. The first ratio is the **Current Ratio**, measured as the ratio of current assets to current liabilities:

$$\textbf{Current Ratio} = \frac{\text{End} - \text{of} - \text{Year Current Assets}}{\text{End} - \text{of} - \text{Year Current Liabilities}}.$$

Current assets represent the assets that the firm expects to convert to cash over the next 12 months. Current liabilities represent the obligations that the firm must satisfy over the next 12 months. A current ratio greater than one indicates that the company has enough current assets to meet its current liabilities. Note that if a firm can delay paying its suppliers longer than it takes to sell the inventory, they can have more current liabilities than current assets. But this doesn't mean they are going bankrupt; as long as they keep growing, they will generate the cash to pay the payables when they eventually come due. In addition, an obvious shortcoming of the current ratio is that, in the event of financial distress, some of the current assets may not be readily converted into cash at their book values. If no one is buying the company's inventory then it might not be worth its book value, and you can imagine the difficulty in converting prepaid rent back into cash. An alternative measure of the ability to meet current liabilities is the **Quick Ratio**:

Quick Ratio

$$= \frac{\text{End} - \text{of} - \text{year Operating Cash and Marketable Securities} + \text{Receivables}}{\text{End} - \text{of} - \text{year Current Liabilities}}.$$

This ratio restricts the numerator to cash, marketable securities and receivables, which are all likely to be converted into cash on short notice at close to their book values.

The next two ratios are called **interest coverage ratios**. These ratios provide an indication of the ability of a firm to cover its interest charges based on its ongoing operating profits. The first ratio uses **EBIT** (earnings before interest and taxes) in the numerator and interest expense in the denominator, while the second ratio replaces the numerator with **EBITDA** (earnings before interest, taxes, depreciation and amortization):

$$\textbf{EBIT Interest Coverage Ratio} = \frac{\text{EBIT}}{\text{Interest Expense}}, \text{and}$$

$$\textbf{EBITDA Interest Coverage Ratio} = \frac{\text{EBITDA}}{\text{Interest Expense}}.$$

The key difference between the ratios is the exclusion of depreciation and amortization expense from the numerator of the second ratio. The rationale for excluding depreciation and amortization is that they represent non-cash charges, and therefore do not reduce the amount of cash available to meet interest payments. On the other hand, a firm must ultimately replace its depreciable assets in order to stay in business, and so it can also be argued that inclusion of these charges provides a more meaningful indicator of long-term solvency.

Continuing our comparison of retail firms, Figure 5.8 gives the analysis of Leverage for Dollar Tree, Walmart, and Target.

Analysis of Leverage			
- Long-Term Capital Structure	**Dollar Tree**	**Walmart**	**Target**
Debt to Equity Ratio	0.443	0.567	1.070
FFO to Total Debt	0.386	0.347	0.745
CFO to Total Debt	0.225	0.367	0.683
Analysis of Leverage			
- Short-Term Liquidity			
Current Ratio	1.343	0.928	0.992
Quick Ratio	0.249	0.265	0.272
EBIT Interest Coverage	10.125	14.130	21.249
EBITDA Interest Coverage	10.125	14.437	26.817

FIGURE 5.8: Analysis of Leverage for Dollar Tree, Walmart, and Target

Dollar Tree's debt-to-equity ratio is 0.443, while Target is more than double that at 1.070, and Walmart falls in the middle with 0.567. These are all very conservative capital structures, so it is unlikely that a few unexpected bad events could force any of these companies into bankruptcy. And, while the higher debt to equity ratio at Target might suggest they are the riskiest, they are also the most able to make their interest payments, with an EBITDA Interest Coverage ratio of 26. This means they generate enough EBITDA to pay their interest bill 26 times over. This is much more liquid than Dollar Tree's ratio of 10, although 10 is still a very healthy coverage ratio.

5.10 MODELING CREDIT RISK

The analysis of leverage in the previous section gives us some interesting ratios, but it doesn't directly quantify the probability of default. Predicting the likelihood that a company will default on its debt is one of the most common uses of financial statement analysis. Every junior loan officer at every local bank requires financial statements from a commercial loan applicant and, if the loan is granted, then requires that financial statements be submitted on a regular basis in order to monitor the financial health of the company. The loan contract contains covenants that limit subsequent borrowing or equity distributions by the company and establishes periodic tests of financial health. If the company fails a health test, then the loan is declared to be in technical default and it becomes immediately due and payable in full. The idea is that, if the company starts to look sufficiently sick, the bank can rush back in and grab assets before they are all gone.

Being in technical default on a loan doesn't necessarily mean the firm will fail, or seek bankruptcy protection, but these events are highly correlated. In any case, defaulting on a loan has enormous consequences; legal fees skyrocket, vendors stop granting credit, and customers stop buying goods and services. For example, when General Motors entered bankruptcy proceedings in 2009, the United States government pledged to honor new car warranties just to keep sales from plummeting. Interestingly, they did not pledge to honor existing warranties. Regardless of whether the firm can work out the default with its lenders or is forced into liquidation, default is a situation all parties wish to avoid.

Clearly lenders and company management want to avoid default, but who beyond this cares about estimating the likelihood of default? Investors in corporate bonds also care about the probability of default. Bond rating agencies specialize in issuing credit ratings for corporate debt to help bond investors assess credit risk. More surprisingly, in certain contexts the default probability can be an important input in pricing a firm's equity. If the firm defaults, the value of the equity is approximately zero, so the expected value of the equity is really the probability that it won't default times the value of the equity given that it continues as a going concern. For most firms the probability of default is so low that we ignore it when valuing the equity. But for a firm with a high probability of default, default risk should not be ignored. You can think of an equity investment in a troubled firm as purchasing an option – the default probability is the likelihood that the option ends up out of the money, in which case the equity holders can abandon their claim of the firm. We refer to this option as the abandonment option, and we discuss it in more detail in chapter 12.

Estimating the Likelihood of Default

Broadly speaking, you should approach default forecasting in the same way as any other financial statement analysis topic: use the past financial statements to get a clear understanding of the company's past financial performance and current financial position, and then forecast how you believe the firm will evolve in the future. But there are a few twists. First, for the purposes of assessing the risk of default, we don't really care how successful a firm is beyond the point where we are confident that it will avoid default. The difference between good financial performance and great financial performance matters when forecasting the cash distributions to equity holders but makes little difference to the cash distributions to creditors. The maximum that creditors get is the agreed upon interest and principal payments. Second, we have a very specific notion of what unsuccessful is – failure to make contractual interest and principal payments or a violation of debt covenants.

The long-term capital structure and short-term liquidity ratios discussed earlier give you a qualitative feel for the firm's credit risk. In this section we attempt to attach specific probabilities of default to different levels of these and other ratios. Specifically, we introduce six ratios that have been shown to be predictive of future default. We compute these ratios in the Credit Analysis sheet in *eVal*. Below each ratio we report the historical frequency that firms with a ratio near this value defaulted on their debt during the subsequent five years. As a benchmark, averaging over economic expansions and contractions, the probability that an industrial firm will default during a five-year period is about five percent, although this rate doubled in 2008-2009 due

to the financial crisis.

Before proceeding with our model of default probability, we want to issue a word of warning. The actual covenants found in a typical loan contract are extremely detailed. They spell out exactly how each ratio will be measured, what line items will be included and excluded over what time periods, and what the consequences are for violating different hurdle rates for each ratio. By comparison, the ratios below are simple and standardized. You should consider the ratios below as a general guide for the types of ratios found in actual debt covenants, knowing that in practice the ratios are highly customized to each specific firm.

Figure 5.9 graphs each of the six ratios we use to build our model of default probability. The distribution of each ratio is computed for the entire sample of public firms between 1980 and 1999, excluding banks, insurance companies and real estate companies (because their financial characteristics are so different from the majority of firms). For each ratio, we sort this data into ten equal-sized groups, called deciles, and then plot the frequency that firms in each decile defaulted over the next five years.[2] Each graph also shows the cutoffs for each decile just above the axis; for instance, the value shown above deciles 5 and 6 is the median value of the ratio for the entire sample.

Profitability

For the purposes of predicting default, we measure profitability as the return on total assets before extraordinary items: (net income – extraordinary items)/total assets. Regardless of the firm's other financial characteristics, if it is sufficiently profitable then it will generate enough cash each year to pay its creditors. But how much more likely is it for a firm to default on its debt when its profitability for the year is in the top 10 percent of all firms than if this ratio is in the bottom 10 percent? To get a feel for this, consider the top left graph in Figure 5.9. As expected, the graph slopes down – firms with higher levels of profitability are less likely to default on their debt. To quantify this, the graph shows that the median firm has a return on total assets of 2%, and an implied default probability of about 4%. However, the bottom decile of firms have return on total assets of less than –45% and the odds that they will default in the next five years jumps to over 8%, while the top decile of firms have a return on total assets of more than 12% and a default probability is only 2%. In other words, it is over four times more likely that a firm in the bottom decile will default than a firm in the top decile.

Leverage

The greater a firm's financial leverage the less the cushion that is available if profits fail to generate the necessary cash flow to pay creditors. Because some firms have negative equity (and this would mess up our graph), Figure 5.9 plots total liabilities/total assets rather than debt/equity, which is the more traditional measure of leverage. As a firm's leverage increases, the default rate increases steadily,

[2] The default probabilities associated with different levels of each ratio are sourced from Falkenstein, Boral and Carty (2000).

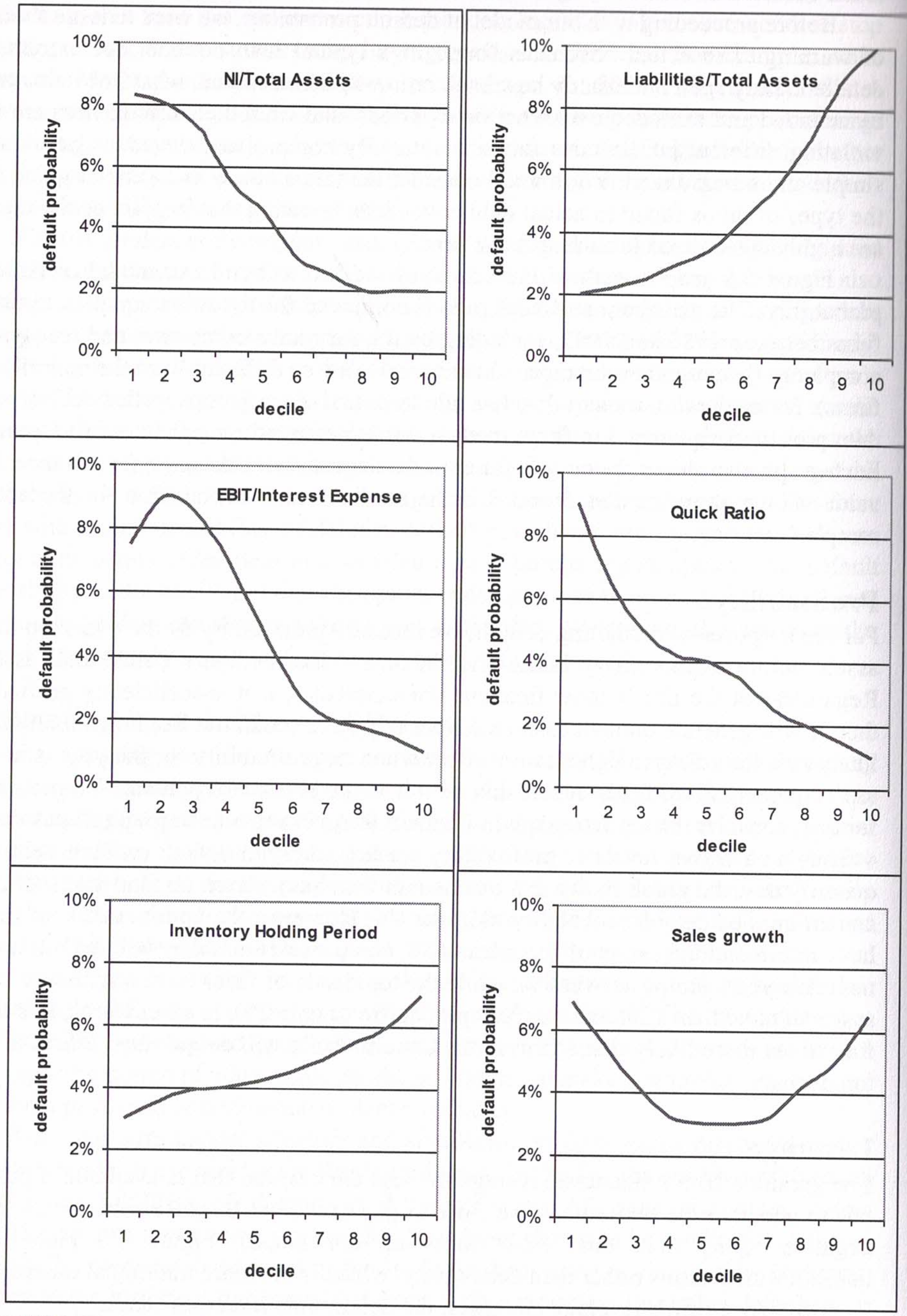


FIGURE 5.9: Implied 5-Year Default Probabilities by Decile of the Ratio Profitability

starting at 2% for the firms in the lowest decile and increasing to 10% for firms in the highest decile.

Liquidity

If you have enough cash, or assets that will soon become cash, you can surely pay your bills, hence the importance of liquidity ratios in credit analysis. As we discussed earlier, it is difficult to pay debt holders with inventory and certain other current assets, so the Quick Ratio (cash, marketable securities and receivables divided by current liabilities) is the ratio we use to predict default. As Figure 5.9 shows, the Quick Ratio is predictive across the entire distribution, but the slope is steepest for the worst firms, those in the first two deciles. The default probability is 9% for firms with a Quick Ratio less than 0.38 but drops to 5% in the third decile, where firms have Quick Ratios between 0.52 and 0.81.

Interest Coverage

Interest coverage is typically computed in a very precise and complicated way in most debt covenants. But for our purpose, we simply graph EBIT/interest expense. Between the second and sixth decile, the slope of the interest coverage graph is very steep, showing that this ratio does a good job of discriminating winners from losers inside this region. The graph flattens out on the high end because it doesn't really make much difference if you are covering your interest eight times or ten times. On the low end the graph actually slopes up, which seems counter-intuitive. But for firms with negative EBIT, an increase in interest expense lowers the EBIT/interest ratio, which probably explains the unusual shape of the curve in the low region. As a crude benchmark, the median EBIT/interest ratio is 2.2.

Inventory

The inventory holding period is less predictive than the previous measures, as seen by its modest slope in Figure 5.9. We include it nonetheless because it captures information that is very different from the previous default predictors. Previously we described the inventory holding period as a measure of how efficiently the company manages its inventory. All else equal, a shorter holding period is better. In the context of default prediction, if the holding period is very long then, besides suggesting inefficient inventory management, it may indicate an even more serious problem. It could be that the firm is having trouble selling its inventory and, consequently, may suffer financial distress in the future. Firms in the lowest decile of this ratio are probably service firms that have little or no inventory, so the ratio doesn't really apply to them; as a benchmark, the median inventory holding period is about 50 days.

Sales Growth

Unlike the previous graphs, sales growth has a U-shaped relation with default probability, as seen in the bottom right graph in Figure 5.9. While this makes it more difficult to interpret, we include it because it captures information that is very different from the more traditional ratios. In the lowest deciles, sales are declining (i.e., negative sales growth), which is clearly a bad sign. But more curiously, the odds of default are high for firms with the highest sales growth. The intuition is that the set of firms with rapidly growing sales includes a greater proportion of firms with unprofitable sales. Further, such rapid sales growth is more likely to be financed by additional borrowing, further increasing the risk of default. As a benchmark, the median annual sales growth for the sample is 10%, and this corresponds to the lowest default risk. Sales declines of more than 20% or sales growth of more than 80% imply twice as high a probability of default.

Final Thoughts on Credit Risk

We stress once again that the ratios given here capture the spirit, but not the actual details, of the financial health tests specified in an actual debt contract. Further, if your forecasts imply that a poorly performing firm will turn around and be wildly profitable in the future, then the implied default probabilities based on its historical performance don't really mean much.

5.11 CONCLUSION

Ratio analysis is an indispensable part of equity valuation and analysis. Ratios are the tools that you will use to evaluate financial performance. If you make a career in financial analysis, then you'll soon be reeling off the financial jargon we've introduced in this chapter with reckless abandon. But you should always remember the important caveats of ratio analysis. First, you should make sure you know how a ratio is computed before you start interpreting it. Second, ratios don't provide answers, they only guide you in your search for answers. Unusual ratios tell you which part of a firm's Form 10-K you need to delve into to get your answers. Finally, management knows that you'll be computing all these ratios, and they'll go to great lengths to make sure these ratios look nice. Be particularly skeptical of ratios that management flaunt in their press releases and be vigilant in your search for evidence of creative accounting.

5.12 QUIZZES, CASES, LINKS AND REFERENCES

Quizzes

- Chipotle Mexican Grill (Problem 3)
- Pandora (Problem 3 (i), (ii) and (iii))
- LinkedIn (Problem 3)
- Salesforce (Problem 3)
- Take-Two (Problem 3)
- Netflix (Problem 3)
- Dropbox (Problem 3)

Cases

- Analyzing Apple (Questions 7-12)
- Big Five Sporting Goods
- Charles Schwab and the End of Trading Commissions
- Interpreting Margin and Turnover Ratios
- Royal Caribbean Cruises in 2010 (Part A)
- Sirius Satellite Radio (Questions 10-14)
- High Yields at Annaly Capital (Questions 5-7)
- Has Zynga Lost Its Zing? (Questions 8-11)
- A Tale of Two Movie Theatres
- Is Tesla's Stock Price in Ludicrous Mode? (Questions 7-10)
- Building *eVal* (Part C)

Links

- Video for Chapter 5-Part 1: https://www.screencast.com/t/AgfHMJvcLmnl
- Video for Chapter 5-Part 2: https://www.screencast.com/t/YLra5NPm
- Video for Chapter 5-Part 3: https://www.screencast.com/t/tdcCdvjmuZdn
- *eVal* software: http://www.lundholmandsloan.com/software

References

Falkenstein, E., Boral, A. and Carty, L., (2000), "RiskCalc for Private Companies: Moody's Default Model", *Moody's Investor Service Global Credit Research*. Available online at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=236011