Introduction to Financial Ratios:

Last week we learned the basics of **financial statements**—the meaning of the **numbers and accounts** that are in the main financial statements. But, by themselves, alone, these numbers don't tell us much. For example, suppose we see that a company is earning $1.3 million in net income each year, and we are asked whether we think this company is doing well or poorly, and whether or not we would invest in it. The answer to this question would clearly depend—both on who is asking the question, and what company we are assessing. For example, if the company had over $1 billion in assets—financed by equity investments of over $500 billion—this level of profitability would actually be quite poor. It would indicate that equity investors were seeing less than a .3% return on their equity investments. However, for a company with only $1 million in assets, financed by equity investments of $500,000, earning $1.3 million in net income each year would be outstanding performance. Further, **different stakeholders** may be interested in **different aspect**s of performance—equity investors might be most focused on net income, but debtholders might be more interested in the company's cash position. So a company that is highly profitable might nonetheless be risky for debtholders.

Fundamentally, **ratio analysis** is just about **combining, comparing**, and **scaling** the numbers in companies' financial statements, to allow us to **interpret** the numbers and compare different companies, which, in turn, allows us to assess performance and make decisions. The conventional ratios we examine in **financial ratio analysis** have no formal legal status—they are not determined or regulated by the SEC. They are simply tools that financial analysts have **invented** and found useful for the purpose of understanding companies and making decisions. As such, there are very many different financial ratios out there, and we could potentially invent infinitely many more. In this class, we'll cover the most common and important ones—the ones that have been found most useful by financial analysts over the decades, and the ones you're most likely to see referenced in the financial press and elsewhere.

We can bucket the different financial ratios into four different categories:

(1) **"Performance ratios":** These ratios help us answer the questions, 'How well is the company and its management performing?' and 'What are the drivers of performance?' Broadly, these ratios are centered around **return on equity**—that is, total profitability divided by equity investors' contribution to the firm's financing—because it is often assumed that companies seek to maximize returns for their investors.

(2) **"Credit and cash management ratios":** These ratios seek to measure the creditworthiness and cash position of firms. That is, they answer the question, "Will this company be able to make the interest and principal payments on its debts (as well as paying off its payables and taxes) and thus remain a 'going concern,' or is it likely to head to bankruptcy court?" As such, these ratios center on items like debt burden, interest payments, cash flows, and working capital.

(3) **"Accounting red flags":** These ratios are indicators that a company's financial statements might be fishy—in other words, that the company's managers could be "managing their accounting" (rather than the actual operations of the firm) to make things appear better than they are. While none of these measures alone are proof that a company is committing accounting fraud, if several of these measures all point in one direction, we might be extra skeptical, and examine the company's accounting extra carefully.

(4) **"Valuation Ratios":** These ratios focus on the pricing (or "valuation") of the company's securities (i.e., shares of its stock and its bonds, though we will focus on stocks). As we'll discuss in our class on finance, the question of 'Is a company performing well?' is a separate question from the question of 'Is the company's stock a good buy?' (Sometimes this is referenced as the 'good stock vs. good company' fallacy.) Sometimes companies can be performing well in terms of our performance measures, but investors could overreact to that performance, meaning that the company's stock could be *overvalued*. Conversely, statistical research in finance has shown that investors overreact when companies perform poorly in terms of some of our performance measures, leading those stocks to be *undervalued*. Broadly, valuation ratios compare the *market values* of the company's equity to various *accounting* numbers to measure whether that company is relatively 'cheap' (a good buy) or 'expensive' (a bad bet over the long run). If you don't have a background in finance, these ratios might not make perfect sense at first—we'll cover the basics of financial theory (i.e., why a stock or bond should be worth a certain amount) next class.

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Performance ratios:

Return on Equity:

Perhaps the most prominent performance measure is *Return on Equity (ROE)*. It is defined as:

$$Return\ on\ Equity = \frac{Net\ income}{Shareholders' Equity} = \frac{NI}{E}$$

Net income is, of course, the proverbial 'bottom line'—the accounting profits of the company. Shareholders' Equity here is the 'book' value of equity (as opposed to the market value of its shares), which is the total amount that shareholders have contributed to the company's financing. This means that we could interpret this ratio as "The take-home profitability available to shareholders, scaled by the total contribution the shareholders have made to the financing of the enterprise."

In this interpretation, we can see why ROE is so common and prominent. For reasons we can discuss in more detail, the fields of finance and economics have traditionally assumed that companies are run as if for the benefit of the shareholders—the shareholders are, after all, technically the owners of the firm, and thus have the right, at least indirectly, to fire the company's management if they do not attend to the interests of shareholders. Return on equity measures, essentially, how much profitability the shareholders are accruing as a portion of their initial investments.

Students often wonder why we use the *book* value of shareholders' equity rather than the market value of the shares in this ratio. The answer is that the market value of stocks fluctuates with investors' assessments of the performance of the company and their sentiment about its future prospects. So, for example, if a company's net income kept unexpectedly improving year to year, the company's *market value of equity* would keep increasing in response. Thus, if we put the *market value of equity* in the denominator of this ratio, this company would be *punished* for its excellent performance. Since the *market value of equity* fluctuates *in response* to company's performance, it would usually be inappropriate to use it as a scaling factor in measuring the performance of companies. Instead, we use the market value of equity in *valuation ratios*, which we'll discuss

below; and we use book Shareholders' Equity—a measure of the total amount shareholders have historically contributed to the firm's financing—in various performance measures.

Return on Assets:

Return on Assets (ROA) is nearly as common as ROE as a performance measure. It is defined as:

$$Return\ on\ Assets = \frac{Net\ income}{Total\ Assets} = \frac{NI}{A}$$

As you can see, this is the same as the formula for ROE, except we replace Shareholders' Equity in the denominator with Total Assets. In words: This ratio is the total profitability of the company, scaled by the total assets the company uses to generate that profitability. In contrast to ROE, this ratio is *agnostic* about the sources of financing used to finance those assets: It doesn't care whether those assets were financed by debt or by equity. A little algebra can be helpful for understanding the difference between ROA and ROE. Note the following identity:

$$ROE = \frac{NI}{E} = \left(\frac{NI}{A}\right) \times \left(\frac{A}{E}\right) = ROA \times \left(\frac{A}{E}\right)$$

As we can see, the difference between ROE and ROA is equal to A/E, a ratio that we call ***leverage***. Recall also that, by the fundamental identity of accounting, **A = L + E**. This means that we can also write leverage as follows:

$$Leverage = \left(\frac{A}{E}\right) = \frac{L+E}{E} = \left(\frac{L}{E}\right) + 1$$

This formula shows that leverage is essentially just a measure of how much liabilities (mostly debt) a company has relative to its book equity—it is a measure of its "financing structure," what percentage is financed by debt vs. equity. This ratio is called 'leverage' because it captures how much the shareholders' equity investments are "levered up" by debt.

Now we can understand the difference between ROE and ROA: ROE is a measure of performance that is sensitive to leverage (i.e., financing structure), while ROA is not. This fact captures the advantages and disadvantages of each measure. For example, if you wanted to compare how two different companies were performing *operationally*—how well the company was using its asset to generate profits—such that you didn't want your measure to be sensitive to company's financing structure, you might prefer to use return on assets (ROA). However, if you were an equity investor, you might be most interested in how the management has performed in terms of generating profitability on your equity investments, and so you might prefer ROE as the appropriate measure. Broadly speaking, it might be fair to say that ROA is the superior measure of *operational performance*, while ROE is the superior measure of *financial performance from the perspective of the shareholders*.

The DuPont Decomposition:

The "DuPont Decomposition" is a famous and useful way breaking ROE down into three underlying components to examine different *drivers* of the company's performance. The DuPont Decomposition breaks ROE down into three underlying components: *profit margin* (sometimes called "return on sales"), *asset turnover* (sometimes called "asset efficiency" or "asset utilization), and *leverage* (discussed above). The decomposition is an algebraic identity: It just takes the definition of ROE (NI/E) and multiplies it by terms that cancel each other out:

$$ROE = \left(\frac{NI}{E}\right) = \left(\frac{NI}{S}\right) \times \left(\frac{S}{A}\right) \times \left(\frac{A}{E}\right)$$

Note how the 'S' (for sales) cancels out in the denominator and numerator of the first and second terms, respectively, and the 'A' (for Assets) cancels out in the second and third terms.

NI/S is referred to as **profit margin**. It is equal to net income divided by total sales (i.e., revenues). Thus it is a measure of how much of the company's gross sales it manages to keep as 'take-home' profitability, after all expenses are accounted for. It is often described as a measure of how well the company is managing the *income statement*—i.e., how well it is doing managing all of the expenses that come between the top line and the bottom line of the income statement. Profit margins famously vary across industries. For example, in highly competitive "commodity" businesses such as groceries, profit margins may be extremely low: less than 5%. In luxury-goods businesses and software, profit margins may be much higher.

S/A is referred to as **asset turnover** (sometimes also called 'asset efficiency' or just 'efficiency'). It is equal to total sales (i.e. revenues) divided by total assets. Thus we can think of it as a measure of how effectively the company is employing its assets to produce marketable goods—hence why it is sometimes referred to as 'efficiency.' It is often described as a measure of how well the company is managing the *balance sheet*—i.e. how effectively it is employing the total assets it holds on its balance sheet. Asset turnover also varies widely across industries. Grocery stores and discount retailers have thin margins (as referenced above), but high asset turnovers. In contrast, a luxury jewelry retailer or Tesla dealer likely has high margins but relatively lower turnover.

A/E is referred to as **leverage**, as we have discussed above. In general, leverage is good *on average* for equity owners, since it means that their profits are less diluted. But it also increases the *riskiness* of the company (since leverage multiplies both profits and losses) and increases the risk that the company will go *bankrupt.* Thus, on average, equity investors tend to like and to push for higher leverage levels, while debtholders tend to push for lower leverage levels.[1] Leverage ratios also tend to vary across industries and the life cycles of firms. Early-stage firms with uncertain prospects tend to be financed by more equity (that is, have lower leverage ratios), since their future cash flows are less certain and thus they would have a greater probability of

[1] You may have read in the financial press about "activist investors"—equity owners who buy up significant stakes in order to influence management to change policies in ways that they believe will increase the value of their shares. One of the major areas of focus for activist investors is leverage (which they often discuss in the press under the heading of 'capital structure). Activist investors own the company's stock, and as such, they usually prefer higher leverage levels. They often encourage companies to issue more debt and pay out more cash to shareholders in order to increase leverage. Academic research has mostly suggested that activist investors are on average good for *shareholders*. But they remain controversial because higher leverage levels increase riskiness.

bankruptcy if they were to rely heavily on debt financing. Firms in industries and stages with more stable cash flows are more likely to choose higher leverage ratios (that is, more debt and/or less equity), because they have more certainty that they will be able to service the debt and not be forced into bankruptcy. The reason for this is that debt financing imposes fixed, inflexible obligations on the company (that is, interest and principal payments), meaning that debt increases the risk that a company will go bankrupt if it has a bad year; dividend payments to equity holders are, on the other hand, 'discretionary,' meaning that a company can simply choose to cut its dividend when its cash position is poor. Historically, firms in the financial industry have had very high leverage ratios, and this became a topic of controversy and new regulation after the financial crisis, as leverage was seen to increase the systemic riskiness of the banks.

The DuPont Decomposition is perhaps most useful for comparing the performance of firms within the same industry. For example, suppose that you are managing or advising a company that has an ROE of 20%, as compared to a competitor that has an ROE of 30%. If you were to discover that the two companies had the same asset turnover, but your company's profit margin was lower, this might suggest that your company should focus on cutting out expenses such as overhead (SG&A) if feasible. In contrast, if you were to find that the two companies were matched on profit margin, but your company had a lower asset turnover, this might suggest you should work to improve your efficiency, such as by improving operations management or liquidating or spinning off poorly performing operations.

The DuPont ratios are also useful for making comparisons *within* companies *over time*. For example, if a company's profit margin were increasing over several years, this might suggest that the company's *competitive position* was improving—the company was increasingly able to command prices on its products over and above its costs. Or, if a company's asset turnover was decreasing over time, this might indicate a company was losing discipline and efficiency, that its scope was increasing too much (it had more assets than it could employ efficiently) or that its operations had become less well organized.

Inventory Turnover:

Finally, the last performance ratio I want to discuss is *inventory turnover*. This ratio is a particularly important indicator in industries where tight and effective management of inventory is vital. It is defined as:

$$Inventory\ Turnover = \frac{Cost\ of\ Goods\ Sold}{Inventory}$$

Recall that Cost of Goods Sold is the expense that is apportioned to goods that have been sold in the reporting period. Inventory is the asset account that measures the purchase price of the company's inventories. Thus, Inventory Turnover is measures what fraction of its inventory the company was able to sell during the reporting period. It is expensive for companies to hold inventories for long periods of time—inventories need to be stored in facilities that incur rent expenses, and their purchase needs to be financed. Thus, companies should prefer to improve their inventory turnover ratios. Companies with strong inventory turnovers are often colloquially said to be "running a tight ship."

Alternative margins: Gross Margin and Operating Margin

Finally, I wanted to present substitutes for the profit margin (NI/Sales) we discussed above. For some purposes, financial analysts may be interested in different kinds of margins. The two most common alternatives are the *gross margin* and the *operating margin*. The definitions are as follows:

$$Gross\ margin = \frac{Gross\ profit}{Sales} = \frac{Sales - COGS}{Sales}$$

$$Operating\ margin = \frac{Operating\ Income}{Sales} = \frac{EBIT}{Sales}$$

Gross profit is simply equal to sales minus the cost of goods sold, which are the expenses directly involved in the production of the products the company sells. I.e., gross profit does not account for overhead or financial expenses, etc. As such, this ratio might, for example, be of interest to us if we want to compare two companies that have different advertising strategies. Suppose, for example, that Company A is an established player in the athletic apparel business, while Company B is an early-stage company newly entering the industry. We might expect that the early-stage company would have higher overhead costs, since it would have to spread its headquarters and administrative costs over a smaller revenue base, and it might also have to spend more of its revenues on advertising and development costs in order to get its name out there. As such, we might think it is not very useful to compare the two companies on net income and profit margin. In this case, we might think it more useful to compare the companies on gross margin, which deducts only direct production/input costs from revenues.

'Operating profit' is the common term for EBIT. The term is supposed to convey that it is the profit generated from the company's operations, before its pays out to financial claimants and the taxman. One reason financial analysts like to work with operating profit is that interest expenses are not included in this measure, and so it is not sensitive to companies' financing choices—i.e., how much debt vs. equity to finance themselves with. As such, operating profit (and thus operating margin) can give us more of an "apples to apples" comparison of the operational performance of two different companies that may have different financing structures and choices.

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Credit and Cash Management Ratios:

These ratios attempt to measure a company's ability to pay off its obligations. They use accounting numbers to measure the company's long-term ***solvency*** and cash ratios to measures its short-term **liquidity**. 'Solvency' means having assets that are worth more than liabilities—that is, positive net worth, over the long run. 'Liquidity' means the company's ability to convert its assets into cash necessary to make cash payments at specific times. In business, "cash is king"—debtholders can only be paid in cash, and so even highly profitable businesses have to worry about converting their economic value into cold, hard cash. Companies that cannot pay their debts can be taken to bankruptcy court and liquidated, and their shareholders may be left with nothing. Thus, a company's **solvency** and **liquidity** is of relevance to all of its stakeholders. It is perhaps of most salient concern to **debtholders**, however, since debtholders care only about the company's ability to pay off its obligations. Equity owners care both about the company's "upside" as well as its "downside," and as such they are often willing to take some risks of bankruptcy in order to yield higher potential returns. But debtholders, by

definition, have "fixed income" securities—for them, there is no "upside." From their perspective, there is only solvency vs. downside risk. As such, debtholders have their attention almost entirely focused on these measures.

Times Interest Earned:

One of the most common solvency measures is the *times interest earned ratio*, which is also sometimes called the *interest coverage ratio*. It is defined as:

$$Times\ interest\ earned = \frac{EBIT}{Interest\ expense}$$

EBIT is "Earnings Before Interest and Taxes." The name indicates that it is the company's earnings ***before*** interest and tax expenses are subtracted out—it is what the company's take-home profits would have been if it didn't have to pay the tax-man or the bank. Intuitively, this ratio captures how much "wiggle room" the company has in its profitability before it will be left unable to make its interest payments without incurring losses. It is conventional to use EBIT in the numerator, because when companies make losses they incur no taxes.

To understand why this ratio captures financial distress risk, consider the case in which this ratio equals one. In that case, by basic algebra, EBIT = Interest Expense. But that would imply that the company's EBT (that is, Earnings Before Taxes) would be equal to 0 (since EBT is defined as EBIT – Interest Expense). Since the company's EBT is 0, its tax rate would also be 0, so the company's net income would be 0. In other words, when the ratio is equal to 1, that indicates that the company can only just barely *cover* its interest expenses without incurring losses. But if the ratio goes up to 2, that indicates that the company could *cover* its interest expenses twice without incurring losses—or, put differently, that its operating profit (EBIT) could be cut in half, and it would still be able to make its interest payments.

Restating one last time, a company with a times-interest-earned ratio of 1 is in a precarious situation—its operating profit cannot decrease at all, and its interest expenses cannot increase at all, or else it will be in the red. Companies with higher times-interest-earned ratios have more wiggle room, the higher the ratio goes.

The current ratio:

Another simple measure of a company's ability to pay off its obligations is the *current ratio*. The current ratio is defined as:

$$Current\ Ratio = \frac{Current\ Assets}{Current\ Liabilities}$$

Recall the definition of current assets and liabilities from our introduction to financial accounting: Current assets are those assets that the company expects to convert to cash within one year (including cash itself). Current liabilities are obligations that have to be paid off in one year. Thus, a current ratio equal to 1 indicates that the company will just barely be able to pay off its current liabilities. A ratio greater than 1 indicates that it has some wiggle room. A ratio less than 1 is very troubling, indicating that the value of the company's current

assets is not great enough to pay for the liabilities coming due. Such a company will either need to raise new financing, or be at risk of bankruptcy.

The "Acid Test" / "Quick Ratio":

This ratio is conceptually very similar to the current ratio, but with some minor modifications. It has the same denominator as the current ratio, but subtracts inventories and prepayments out of the numerator. Some analysts prefer this measure, called the "Acid Test" or "Quick Ratio," as being a more realistic indicator of financial health—a company cannot be certain that it can liquidate all of its inventory in order to pay off its obligations without discounting those inventories and/or disrupting its operations. Thus, these analysts argue that only Cash, Marketable Securities (stocks and bonds the company owns) and Accounts Receivable (payments owed to the company by customers) should be considered in the numerator as assets that can "cover" the current liabilities. The ratio can be defined in two ways: (1) Either adding up all of the specific components of the numerator (cash, securities, and receivables), or (2) By starting with current assets and subtracting out Inventories and Prepayments. We include both approaches in the definitions below:

$$\text{Quick } or \text{ Acid Test } ratio = \frac{(Cash+Securities+Receivables)}{Current\ Liabilities} = \frac{Current\ Assets-Inventories-Prepayments}{Current\ Liabilities}$$

Days Sales in Receivables:

As we've said in the past, under accrual accounting, companies can recognize revenue when it is "earned" even before cash is collected, and yet, in business "cash is king." Companies' abilities to convert their sales and assets into cash is just as vital as their ability to generate those sales. As such, financial analysts have come up with various different ways to measure the company's "cash conversion cycle." Some of these measures are a bit complicated, but if you are curious you can Google the term. In this class, we'll cover just one, in order to get a flavor of how they work. The Days Sales Receivables ratio is usually defined as:

$$Days\ Sales\ in\ Receivables = \frac{Accounts\ Receivable}{Sales} \times 360$$

To understand this ratio, let's think through some simple examples. Suppose that over the last few years, the company's accounts receivables were equal to its sales. This would indicate that the company was taking a full year to 'cover' its accounts receivables. So its ratio would be equal to 360 days, or approximately one year. If the company were doing a better job converting its accounts receivables into cash, its accounts receivable balance would decrease. This decrease in the accounts receivable would make the ratio less than 360 days, indicating better cash conversion—a better turnover of sales into actual cash.

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Accounting Red Flags:

Next, I want to discuss several "accounting red flag" ratios. As we learned in our section on financial accounting, accrual accounting rules permit managers some *discretion* in their reporting choices which can, in turn, allow them to *distort* their reported profitability. The most famous and egregious cases of accounting fraud involve managers and companies who attempted to make their companies look much more profitable than they actually were (e.g., Enron). But managers are also often tempted to make their companies look *less* profitable than they are for various purposes: E.g., CEOs often like to "take a big bath" after leadership changes or crises, or when they are under regulatory scrutiny. The ratios that we discuss below can be used to detect earnings manipulation in both directions.

Scaled Accruals:

As we learned in our class on accounting, modern accounting is based around *accrual accounting*, which is different from *cash accounting*. Accrual accounting has various advantages, but it is less objective, and more subject to manipulation, than simple cash accounting. In any given period, a company's net income and cash flows may differ—but over the long run, they should look similar on average. Thus, one simple measure of possible accounting manipulation is to simply take *accruals* (defined as net income minus cash flows from operations) and *scale* it by an appropriate denominator, such as sales or assets. Each denominator is equally good, so I'll present both ratios:

$$Accruals\ over\ assets = \frac{Net\ income - Cash\ flows\ from\ operations}{Assets}$$

$$Accruals\ over\ sales = \frac{Net\ income - Cash\ flows\ from\ operations}{Sales}$$

As always, this ratio has to be considered in the appropriate context. For any particular company, in any particular period, there may be a good reason why accounting net income is diverging from cash flows. We can only determine if it is alarming by looking in more detail at the company's accounting choices over time. Still, *on average*, high accruals can be an alarming signal. As we'll discuss in the finance section, these accruals ratios have been used in successful "portfolio strategies"—i.e. rules for selecting stocks that yield abnormal risk-adjusted returns on average. If investors buy stocks that have low accruals and short-sell stocks that have high accruals, they tend to earn abnormal positive risk-adjusted returns. This suggests that the market is undervaluing companies that have low accruals and overvaluing companies that have high accruals—in other words, it appear that the financial markets get "tricked" or overly fixated on net income, and don't account for when it diverges from cash flows.

The Beneish M-Score ratios:

Next, I want to present a series of ratios that have been used by a financial scholar, Messod Beneish, to predict financial fraud. Each ratio is interesting and important in its own right; and when Beneish took these

measures and a few others and combined them in a regression model, he was able to predict financial fraud with some accuracy. Notably, these ratios are in fact *ratios of ratios* over time—that is, they compare the value of a particular ratio in *this year* relative to the value of that ratio *last year*. They thus capture *changes* in companies' accounting reporting choices *over time*, which is more informative than simply looking at a single value of the ratio out of context.

Asset Quality Index:

This index is a ratio of a company's *asset quality* in this year compared to last year. *Asset quality* is defined as (Total Assets – Current Assets – PPE)/(Total Assets). Think back to our accounting class and a basic example of a balance sheet: Total Assets, by definition, consists of Current Assets and Non-Current Assets. Non-Current Assets consists mostly of PP&E and intangible investments such as goodwill, trade names, and intellectual property. Thus, this ratio is essentially equal to these intangible assets divided by total assets. These assets are relatively "soft" compared to assets like cash and factories, and more easily manipulated by management. Thus, an increase in this ratio could indicate that managers are aggressively capitalizing and overvaluing these types of "soft" investments in order to make their balance sheets appear stronger. The ratio is defined below. Note that I use the years "2017" and "2016" as subscripts to make clear that this ratio divides the current year's asset quality by the previous year's value, but, of course, you could calculate this ratio on any pair of years.

$$Asset\ Quality\ Index = \left(\frac{Total\ Assets - Current\ Assets - PPE}{(Total\ Assets)}\right)_{2017} / \left(\frac{Total\ Assets - Current\ Assets - PPE}{(Total\ Assets)}\right)_{2016}$$

The Depreciation Index:

As we learned in our class on accounting, companies have discretion over the rate at which they depreciate their assets (e.g., they can choose among straight-line depreciation and accelerated depreciation, and change their assumptions about the salvage value of the assets they are depreciating, etc.). Changes in depreciation rates over time *might* indicate that a company is attempting to manipulate its reported profitability. We define the *depreciation rate* as

$$\text{Depreciation rate} = \frac{\text{Depreciation}}{\text{PPE} + \text{Depreciation}}$$

The denominator is equal to PP&E plus the amount that has been depreciated over the period—thus it essentially captures the value of PP&E at the beginning of the period, before it was depreciated. Thus, the ratio captures the rate of depreciation of the firm's hard assets.

Depreciation rates naturally *should* and in fact *do* vary between firms and industries. As such, this measure is only useful in context: We should be most alarmed by sudden *changes* in firms' depreciation policies and rates across time. The depreciation index is thus defined as:

$$Depreciation\ index = Depreciation\ Rate_{2016} / Depreciation\ Rate_{2017}$$

Note that if this ratio is *greater than 1*, that indicates that the company was depreciating its hard assets more slowly in 2017 than it was in 2016. That could indicate that the company is changing its depreciation policies to increase its reported net income.

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Valuation Ratios:

Valuation ratios attempt to measure whether a company's stock is overpriced or underpriced in financial markets. They do this by comparing the value of the market price to the company's "fundamentals"—cash flows and accounting numbers. The logic behind many of these valuation ratios may not make perfect sense until we've done our financial theory class. But let's do our best to work through these for now.

Market to Book:

This ratio, usually denoted as M/B, simply compares the market price of the company's shares to the accounting or "book" value of equity. It is defined as:

$$\frac{M}{B} = \frac{Total\ market\ value\ of\ shares}{Total\ Shareholders' Equity}$$

The total market value of the shares of the company can be calculated by multiplying the number of shares by the current market price.

There are two major reasons why a company's market value of equity and its book value of equity may differ. First, recall that the "book" value of equity is the difference between the accounting value of the company's assets and its liabilities. Thus, it is like a measure of the "liquidation value" of the firm—how much would be left over if the company sold off all of its assets to pay down all of its liabilities. But accounting is *conservative*: many assets are not "written up" to their current market value, and are instead "carried on the books" at their historical costs. As such, the book value of equity usually understates a company's true liquidation value. Second, investors value companies not just for the current value of their assets, but also for the future economic profitability they will generate via their operations. Thus, for most healthy companies that are operating profitably on an ongoing basis, the market value of the company should be greater than its book value.

In other words, there are good reasons for a company's market value of equity to be greater than its book value of equity, and for this ratio to diverge across companies. Nonetheless, *on average*, statistical financial research has found that stocks of companies with low market-to-book ratios (often called "value" stocks) tend to outperform those of companies with high market-to-book ratios. This suggests that investors get over-enthusiastic about certain stocks, and lose track of accounting fundamentals, and trade them at overly high M/B ratios; and get overly pessimistic about other stocks and trade them at overly low M/B ratios.

Dividend yield:

Perhaps the most fundamental valuation ratio is the *dividend yield*. The fundamental financial benefit of owning equity/shares in a company is that you are then entitled to the dividends the company distributes. (You can also expect that the shares will appreciate in value, but this capital appreciation must eventually, at some point, be driven by investors' expectations for dividends in the future—stock market prices can't be supported by "turtles all the way down.") Thus, it is natural to compare the market price of shares to the dividends being paid out. The dividend yield can be defined in two equivalent ways, in terms of *per share* values, or in terms of total market values:

$$Dividend\ Yield = \frac{Total\ Dividends\ Paid}{Total\ Market\ Value} = \frac{Dividends\ per\ share}{Market\ price\ per\ share}$$

Often, we flip this ratio to make it easier to interpret. The flipped ratio is called the "price to dividend ratio," often denoted simply as P/D:

$$P/D = \frac{Total\ Market\ Value}{Total\ Dividends\ Paid} = \frac{Market\ price\ per\ share}{Dividends\ paid\ per\ share}$$

A high P/D ratio (which is equivalent to a low Dividend Yield) means that investors are willing to pay relatively more for the dividends they are receiving. Thus a high P/D ratio is taken as an indicator that a company has a high valuation.

As always, in any particular company, in any particular year, the dividend yield is not definitive. Some companies are justified in having higher P/D ratios—for example, investors may have *good reasons* to anticipate that these companies' dividends will *increase* in the future, and thus they may be justified in paying a higher price for these shares in terms of their current dividend payouts. Nonetheless, statistical research in finance has shown that *on average*, the P/D ratio is a somewhat informative signal of over- vs. under-valuation. In general, the shares of companies with low P/D ratios (that is, high dividend yields—sometimes called "value stocks") tend to outperform the shares of companies with high P/D ratios (that is, low dividend yields—sometimes called "growth stocks"). Moreover, when the market as a whole has an unusually high P/D ratio (that is, high prices relative to dividends), future returns for the market as a whole tend to be low.

Price to earnings ratio:

As we discussed in our accounting class, when companies generate profits, they have the choice of whether to pay those profits out to shareholders as dividends, or whether to *reinvest* those profits *internally*. If a company has good *investment opportunities*, it may be a good idea, and in the interest of the shareholders, for the company to reinvest profits. As such, some companies think that looking at the price-to-dividends ratio may unfairly "punish" companies that are choosing to reinvest their profits rather than pay them out immediately. In other words, they think that the P/D ratio is overly sensitive to the companies' financing/investment choices. They argue that when companies reinvest their profits, that will increase the dividends they can pay in the future. Many of these analysts prefer to look at the *price-to-earnings* ratio instead. Indeed, the price-to-earnings

("P/E") ratio may well be the single most common valuation metric used by practitioners, the press, and managers—sometimes, they refer to it simply as the company's "multiple." It is defined as:

$$\frac{P}{E} = \frac{Price\ per\ share}{Earnings\ per\ share} = \frac{Total\ market\ value}{Total\ earnings}$$

As always, there could be good reasons for companies' P/E ratios to differ. For example, if one company has a higher P/E ratio than another, this may indicate that it has higher growth prospects. But on average, statistical research in finance has found that companies that look "cheap" on this metric—i.e, that have low P/E ratios—tend to outperform those with high P/E ratios. This may indicate that investors sometimes get overly excited about certain firms and trade them at valuations that become untethered from their accounting profitability.

Connecting P/E and P/D:

The two ratios are closely connected by another ratio which we often hear discussed in the financial press, the so-called "**payout ratio**." By basic algebra, we can show:

$$\frac{P}{E} = \frac{P}{D} \times \frac{D}{E}$$

The second term on the right-hand side of the equation, D/E, is the ratio of the company's dividend payouts to its earnings (net income). Thus, it is a measure of how much of its profitability the company is paying out versus how much it is reinvesting internally. Early-stage companies that are still growing may have low payout ratios, as they invest in new opportunities. "Mature" companies tend to have higher payout ratios, sometimes even greater than 1, as they focus on "harvesting" the returns on their earlier investments.

Price to Sales:

Finally, in recent years, it has become increasingly common to hear talk of companies' *price-to-sales* ratios. This focus is largely driven by the recent tech boom and rise of startups. Many of these companies have aggressive "market entry" strategies, in which they are willing to sell their products at a break-even, or even at a loss, right now, in the hopes of gaining a market share and customer base that will allow them to profit later. Companies that have zero or negative net income can obviously not be valued using price-to-earnings ratios. As such, many analysts compare the valuations of these companies using their *price to sales* ratios. The implicit assumption is that, eventually, the companies will be able to "flip a switch" and become profitable, and that these companies' margins should be relatively similar at that point, so that similar companies should have relatively similar price-to-sales ratios. The price to sales ratio is defined as:

$$\frac{P}{S} = \frac{Price\ per\ share}{Revenues\ per\ share} = \frac{Total\ market\ value}{Total\ revenues}$$

Note that, by basic algebra, we can show the following:

$$\frac{P}{S} = \frac{P}{E} * \frac{E}{S}$$

The second term, E/S, is net income over sales, which is the company's profit margin. As such, the company's P/S ratio is a function of its P/E ratio and its margins.

Enterprise Value Ratios:

You may have read articles that discuss companies' valuations in terms of their *enterprise value*. A company's *enterprise value* is simply a fancy term for the total value of its stock and the value of its debt—or in other words, it differs from what we discussed above only in that it adds in the market value of debt. I have decided to put less emphasis on these valuation ratios, because they are less relevant to investors picking stocks. I will only lay out the concepts and ratios, just so that you are familiar with them when you read about them in the press. Broadly speaking, the ratios we discussed above all attempt to capture the *value of shares* **relative** to the value of cash flows and profits that *shareholders* are entitled to. *Enterprise value ratios*, in parallel, focus on the *total value of shares and debt* and so they compare this value to the total cash flows that all financial claimants—shareholders and debtholders—are entitled to.

The most common ratio in this category is the *Enterprise Value to EBITDA ratio*. The logic here is simply that a company's EBITDA is approximately equal to its cash flows *after* it has engaged in all of its operations, but *before* it has paid off its financial obligations (such as in interest expenses and taxes; and in depreciation and amortization which allocate the cost of previous investments). As such, it is a measure of the total cash flows available to all of the company's financial claimants, whether debt holders or equity investors. Once again, the assumption is that, on average, a company's total Enterprise Value should be a reasonable multiple of those cash flows. The ratio is defined as follows:

$$\frac{EV}{EBITDA} = \frac{Total\ market\ value\ of\ shares + total\ market\ value\ of\ debt}{EBITDA}$$