

# Estimating the Cost of Capital

## A Practical Guide to Assessing Opportunity Cost

October 8, 2013

### Authors

Michael J. Mauboussin

[michael.mauboussin@credit-suisse.com](mailto:michael.mauboussin@credit-suisse.com)

Dan Callahan, CFA

[daniel.callahan@credit-suisse.com](mailto:daniel.callahan@credit-suisse.com)



- This report is a guide to estimating the weighted average cost of capital, with the goal of deriving a figure that is sensible from a business and economic standpoint.
- The cost of capital for a company is the opportunity cost for investors in the setting of a diversified portfolio.
- The cost of equity is the most difficult to estimate. We discuss limitations of various approaches and suggest a practical method.
- While we dwell on the primary sources of capital, debt and equity, we also discuss how to assess alternative sources of financing.
- The report includes a checklist to ensure that you consider the relevant issues.
- Investors who rely on multiples are not avoiding the problem of forecasting cash flows and discount rates, they are burying it.
- A thoughtful estimation of the cost of capital is a little like hygiene: There's not much upside in getting it right, but there is a lot of downside in getting it wrong.

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## Introduction

The rationale for investing is that you forgo consumption in the present, or save, in order to consume more in the future. An investment opportunity has to have a positive after-tax expected return so that you will end up with more money, after inflation, tomorrow than you have today.<sup>1</sup> Of course, there is no guarantee that the value of your investment will grow over time, but without that expectation there would be no reason to invest in the first place.

The value of a financial asset is the present value of future cash flows. In order to value a financial asset, you must have a sense of the magnitude and timing of cash flows, as well as the risk associated with receiving the cash. For instance, a company that issues a standard bond makes a legal commitment to pay interest on a timely basis and to repay the principal. Investors are left to determine the risk that the company won't be able to fulfill its obligations. As the risk increases that a company will default, the expected return that investors demand increases as well. A higher expectation of a loss requires a higher expectation of a reward.

The determinants of value are explicit in the bond market. The terms of the bond issuance specify the magnitude and timing of cash flows, and the yield on the bond is an expression of the expected return. Even if an investor disagrees with the market's assessment of a bond price, there is no question that the determinants of value are in plain view.

None of the determinants of value are explicit in the stock market. Dividends are at best a quasi-commitment to return cash to shareholders, and there is no direct way to see a stock's expected return. So equity investors need to understand the expectations for future cash flows and the risk that a stock price embeds. This makes valuation inherently trickier for equity than debt.

The cost of capital is the rate at which you need to discount future cash flows in order to determine the value today. Investors determine that rate based on their opportunity cost. Estimating the cost of debt is relatively straightforward, but estimating the cost of equity is much more challenging. This report is a practical guide for estimating the weighted average cost of capital, with the goal of deriving a figure that is sensible from a business and economic standpoint.

Estimates for the cost of equity generally rely on an asset pricing model. The most popular is the capital asset pricing model (CAPM), which has come under considerable fire in recent years. Beta, a measure of a security's financial elasticity versus the market, is the specific variable in the model that researchers and practitioners question.

We are neither strict nor enthusiastic defenders of the faith in this model. But we do believe that it can have practical utility if you take steps to reduce the error in beta and complement the input with market-priced markers such as bond yields, implied volatility in option prices, and credit default swap prices. These markers can provide guidance and context for establishing a reasonable cost of capital.

Some investors claim that the concerns surrounding the CAPM are sufficient to abandon the practice of discounting cash flows altogether. A further complaint is that modest changes in assumptions for cash flows or the cost of capital can have a meaningful impact on value. These investors often value companies using multiples, including price/earnings, enterprise value/EBITDA, and price/book.

Here's the key: Multiples are not valuation. Multiples are a proxy for the valuation process. No one should blur that distinction. Growth and return on investment, along with the discount rate, are what determine the appropriate multiple. Investors who rely on multiples are not avoiding the problem of forecasting cash flows

and discount rates, they are burying it. Our view is that it is better to make assumptions transparent and distinct than to jumble them inside a multiple under the guise of accuracy.

A thoughtful estimation of the cost of capital is a little like hygiene: There's not much upside in getting it right, but there is a lot of downside in getting it wrong. The objective here is not to hew to an academic formula mindlessly but rather to combine the economic logic of an asset pricing model, market prices, and some business sense in order to derive a solid estimate of the opportunity cost of capital.

## Cost of Capital – The Big Picture

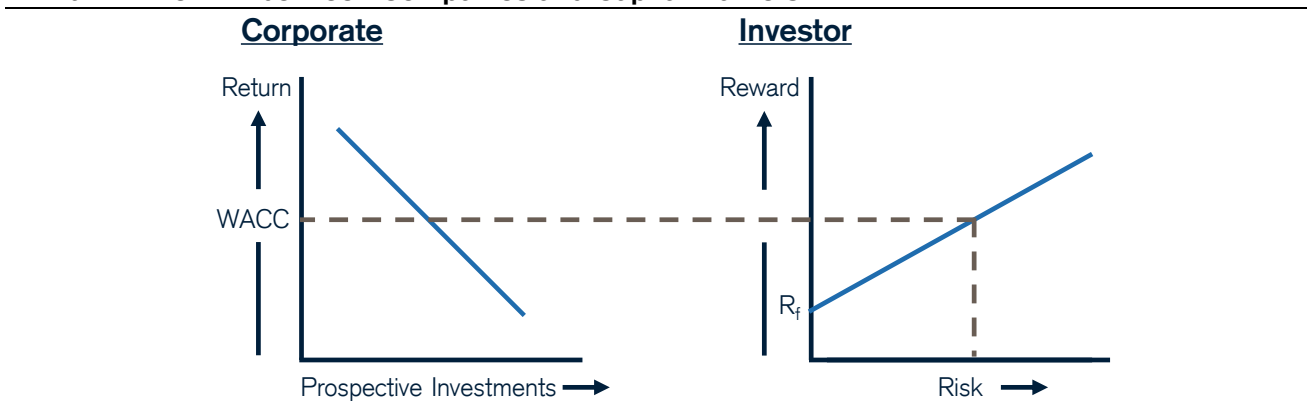
**The cost of capital for a company is the opportunity cost for investors in the setting of a diversified portfolio.**

The economic principle behind the cost of capital is that of substitution: An investor will not invest in a particular asset if there is a comparable asset that is more attractive on a risk-adjusted basis. In other words, a risk-averse investor will buy the asset with the highest return for a given level of risk or the lowest risk for a given level of return. Central to this idea is that the higher the risk, the higher the required return.

Important, too, is the idea that the risk of a particular security refers to its contribution to the risk (i.e., variance of the return) of a diversified portfolio. As a consequence, it is possible for a particular stock to have high individual risk, but low risk relative to the market. The proper focus is not on the risk of the individual security, but rather how that security affects the risk of the overall portfolio.

In order to create shareholder value, a company must be able to find projects that generate returns that exceed the cost of capital. Exhibit 1 shows the link between companies and capital markets. Just as investors must carefully consider the trade-off between risk and reward, companies must evaluate their prospective investments, including capital expenditures and mergers and acquisitions (M&A), to judge whether they will deliver appropriate returns.

**Exhibit 1: The Link between Companies and Capital Markets**



Source: G. Bennett Stewart, III, *The Quest for Value: A Guide for Senior Managers* (New York: HarperCollins, 1991), 83.

A company's balance sheet is composed of assets on the left and liabilities and equity on the right. Assets are the resources the company employs to generate cash flows. Liabilities and equity are the ways the company finances those resources. Debt and equity are the most popular forms of financial capital.

Debt is a contractual obligation between a company and its lenders, in which the company pledges to make timely payments of interest and to return principal at the end of the contractually-specified period. Debt generally has a claim to assets that is senior to that of equity.

Equity is technically a contract between a company and its shareholders that confers limited rights to shareholders. From a practical standpoint, equity represents a claim on future residual cash flows. Equity holders only have a claim to cash flows that exist after the company has paid all other stakeholders, including creditors (interest and principal), suppliers (accounts payable), the government (taxes), and employees (wages).<sup>2</sup>

From the point of view of a company's lenders and shareholders, you can think of risk as the combination of business risk and financial risk.<sup>3</sup>

Corporate risk = business risk + financial risk

- Business risk is the variability of the operating cash flows, which is often associated with operating leverage, or the ratio of fixed to variable operating costs;
- Financial risk is the amount of debt a company assumes.

To illustrate the role of financial risk, consider two companies (Bravo and Charlie) that have identical scenarios for possible operating profit in the next year:

#### Company Bravo

	<u>Operating profit</u>	<u>Interest expense</u>	<u>Pretax profit</u>
Bullish scenario	\$120	\$0	\$120
Base case scenario	100	0	100
Bearish scenario	80	0	80

Since Bravo is free of debt, the variability of pretax profits mirrors that of operating profit. As a result, the highest profit scenario (\$120) is 50 percent above the lowest (\$80).

#### Company Charlie

	<u>Operating profit</u>	<u>Interest expense</u>	<u>Pretax profit</u>
Bullish scenario	\$120	\$30	\$90
Base case scenario	100	30	70
Bearish scenario	80	30	50

Charlie has debt and hence interest expense. The variability of pretax profits for Charlie is much higher than that for Bravo. The highest profit (\$90) is 80 percent higher than the lowest profit (\$50). So the addition of debt creates more volatility in profits, which may suggest different values for Bravo and Charlie.

"Wait!" you may say, "I learned something about the Modigliani and Miller (M&M) invariance proposition—that the value of a firm is independent of its capital structure."<sup>4</sup> M&M's main point is that a change in the capital structure doesn't change risk overall. It simply transfers risk from one constituent to another. As a company adds financial leverage, risk for the remaining equity rises because the size of the senior claim on assets, debt, increases. The cost of debt also goes up because the size of the contractual obligation grows. But since debt is less costly than equity due to its seniority in the capital structure, overall risk is preserved.

Here's an example. Assume a firm has \$100 in annual operating profit. Let's consider three scenarios:

	<u>A</u>	<u>B</u>	<u>C</u>
Operating profit	\$100	\$100	\$100
Debt	0	200	400
Cost of debt	0	5%	6.25%
Cash flow for equity	100	90	75
Equity	1,000	800	600
Cost of equity	10%	11.25%	12.5%
Value of the firm	\$1,000	\$1,000	\$1,000

In scenario A, the firm is all equity financed with a cost of equity of 10 percent. The firm's value is simply \$100 divided by 10 percent, or \$1,000. In scenario B, the company issues \$200 of debt at a cost of 5 percent. Now, the cash flow left over for equity holders drops from \$100 to \$90 (interest expense of \$10 =  $\$200 \times 5$  percent), increasing its risk. To compensate, shareholders now demand a return of 11.25 percent. But note that the firm is still worth \$1,000 (\$200 debt + \$800 equity).

In scenario C, the company takes on even more debt, pushing the total to \$400. Since there's more debt, the risk for debt holders rises from 5 to 6.25 percent. The greater interest payments ( $\$25 = 6.25$  percent  $\times$  \$400) mean that there's only \$75 left over for equity holders. The risk for equity holders has risen, too, reaching 12.5 percent. So the cost of debt and the cost of equity are both higher, but the value of the firm stays the same at \$1,000 (\$400 debt + \$600 equity).

M&M's invariance proposition is true under certain conditions, including no taxes, no bankruptcy costs, no effects on managerial incentives, and markets being perfect and complete. The most important assumption is a world without taxes. Since interest expense is tax deductible, increasing debt adds value because stakeholders are getting value at the expense of the government. The key takeaway from M&M is that when you introduce conditions from the real world, capital structure does matter.<sup>5</sup> The changes in the cost of capital are not the result of how you slice and dice the capital structure (scenarios A, B, and C), but rather are based on the role of taxes and other factors.

Companies with low business risk as the result of predictable cash flows are in the best position to take on debt. Companies with high business risk are more likely to shun leverage. In fact, many young companies hold net cash balances which create negative financial risk and actually serve to dampen the effect of business risk.<sup>6</sup>

## Weighted Average Cost of Capital

**The weighted average cost of capital (WACC) blends the opportunity cost of the sources of capital with the relative contribution of those sources.**

For example, take a company with an after-tax cost of debt of 5 percent and a cost of equity of 10 percent that is financed with 30 percent debt and 70 percent equity. The weighted average cost of capital would be 8.5 percent, calculated as follows:

$$\begin{aligned}\text{WACC} &= (\text{cost of debt} * \text{weighting of debt}) + (\text{cost of equity} * \text{weighting of equity}) \\ &= (5\% * 30\%) + (10\% * 70\%) \\ &= 1.5\% + 7.0\% \\ &= 8.5\%\end{aligned}$$

The weighted average cost of capital is the appropriate rate to discount the future free cash flows attributable to the firm in order to determine their present value. When discounting cash flows attributable to equity holders—common for financial services firms—the correct discount rate is the cost of equity capital.

There are a few issues to keep in mind when estimating WACC. The first is that you should base the relative weighting of debt and equity on market value, not book value.<sup>7</sup> The logic behind this is straightforward: The opportunity cost an investor demands is based on the prevailing asset price, not the level at which the company recorded the debt or equity on the balance sheet.

Companies often share targets for debt-to-total capital ratios that are based on book value. In this case, you must translate that target into a ratio based on market value.

Second, the WACC is not the appropriate discount rate for all of the investments a company makes. If the company invests in a business or makes an acquisition that has greater or lesser risk than the company does, then the discount rate the company applies to that investment should be higher or lower than the WACC to reflect that difference.

Third, don't adjust your WACC based on varying risk assessments. The discount rate should be consistent. You can reflect risk by considering different scenarios for cash flows—some good, some bad. A careful examination of those cash-flow scenarios, including making sure you have considered all possible outcomes, is the essential way to capture and grasp risk.

Finally, you should use the adjusted present value (APV) method if you expect a company to have a dynamic capital structure.<sup>8</sup> This method is relevant, for example, for a company that levers up and then expects to rapidly pay down debt. A section of the appendix discusses this approach. In short, APV values the company assuming it is all equity financed, values the tax shield, and then adds the two together to come up with corporate value. It is based on the principle of additivity: You can value the pieces of the company and add them together to understand the whole.



## Calculating the Cost of Debt

**The cost of debt is the after-tax rate a company would have to pay today on its long-term debt.**

The yield-to-maturity on the company's long-term, option-free bonds is a good estimate for the cost of debt.

If the company only has short-term debt or debt that doesn't trade much (i.e., is illiquid), you can estimate the cost of debt indirectly in two steps. First, determine the credit rating on the company's unsecured long-term debt. Second, look at the average yield-to-maturity on a portfolio of bonds with a similar credit rating. Bond investors often express this as a spread over a Treasury rate, usually the 10-year note. The treasury yield is a proxy for the risk-free rate. If you are dealing with a fixed income security that includes any options, you should use an option-adjusted spread (OAS).

Some companies finance themselves mostly, or completely, with short-term debt. In this case, should you use the short-term rates as the cost of debt? The answer is no. Short-term rates do not reflect expectations about long-term inflation. The time horizon for estimating the cost of capital should be consistent with the time horizon of the cash flow forecast period. The long-term rate is a better approximation of interest costs over time even for companies that roll over their short-term debt because long-term rates capture the expected cost of repeated borrowing. If a company exclusively relies on short-term debt, use its credit rating to approximate the cost of long-term debt.

The calculation of free cash flow (more formally net operating profit after tax less investment needs) assumes that the company is financed solely with equity. This creates valuable comparability. But since interest expense is tax deductible, debt creates a valuable tax shield that free cash flow does not reflect.

To capture the value of the tax shield, you must adjust debt from a pretax rate to an after-tax rate. To do this, multiply the pre-tax cost of debt by one minus the marginal tax rate. In most cases, you can assume that the effective and marginal tax rates are equivalent. The formula is:

After-tax cost of debt = pretax cost of debt \* (1 – marginal tax rate)

For investment-grade companies, you can assume that the effective tax rate approximates the statutory rate. But for companies with tax loss carryforwards, tax loss carrybacks, or investment tax credits, the effective rate may be materially different. In your calculation of the cost of debt, you should use the statutory rate (including state and local taxes) for countries where the company earns its operating profit. For a company with a large presence outside its country of domicile, this can lead to a meaningful difference between the tax rate in a company's home country and the tax rate it actually must pay.<sup>9</sup>

Some companies have substantial tax loss carryforwards and are not expected to have to pay taxes for the foreseeable future. In this case it makes sense to value the company in two stages. First, assume the company pays normal taxes in its free cash flows. This, of course, will lead to a value that is too low. Second, calculate the present value of the tax savings. To do this, calculate the annual tax savings and discount that savings at the cost of debt. (Note that the company has to produce operating income to realize tax savings.) Add that amount back to the value of the firm assuming full tax payment. These two stages allow for comparability to profitable peers and specify the value of the tax savings.

In many cases, the book value of debt is a reasonable proxy for the market value of debt. But take note if the debt is trading at a substantial premium or discount to par, and make the adjustment in your debt-to-total capital ratio if necessary.

## Calculating the Cost of Equity

**The cost of equity is the expected total return on a company's stock.**

It stands to reason that the cost of equity is higher than the cost of debt. To begin, equity is a junior claim on the value of the firm versus debt. So if something goes wrong, debt holders get paid first and equity holders get whatever is left over. Further, interest expense on debt is tax deductible, making debt an even cheaper source of financing. Your estimate of the cost of equity should never be below the cost of debt.

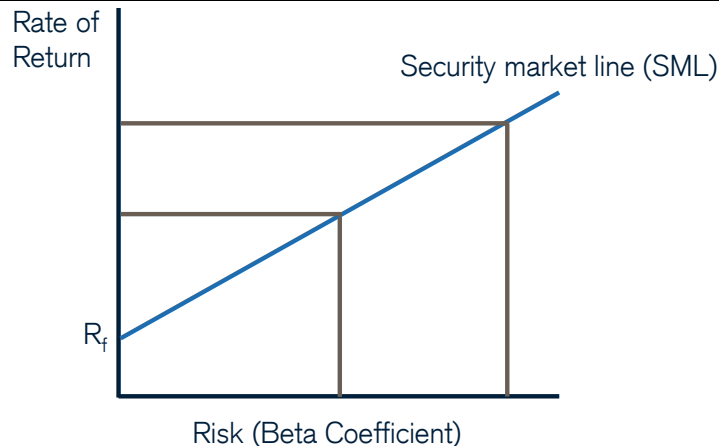
Unlike the cost of debt, which is often observable, the cost of equity is unobservable. As a result, we need to rely on an asset pricing model to estimate it. The three best known models are the capital asset pricing model (CAPM), the Fama-French Three-Factor model, and arbitrage pricing theory (APT). Because the CAPM is the most common model, we'll use it as our primary method. The appendix describes the other models.

The CAPM says that the expected return on a security is the risk-free rate plus the security's beta times the equity risk premium (i.e., the difference between the market return and the risk-free rate):

$$\text{Expected return} = \text{Risk-free rate} + \beta(\text{Market return} - \text{risk-free rate})$$

In the CAPM, the equity risk premium is the same for all companies. Only the beta is different from company to company. See Exhibit 2.

### Exhibit 2: The Security Market Line



Source: Credit Suisse.

The CAPM is better as pure theory than in practice, so putting it to work requires a number of important judgments. Three major questions emerge:

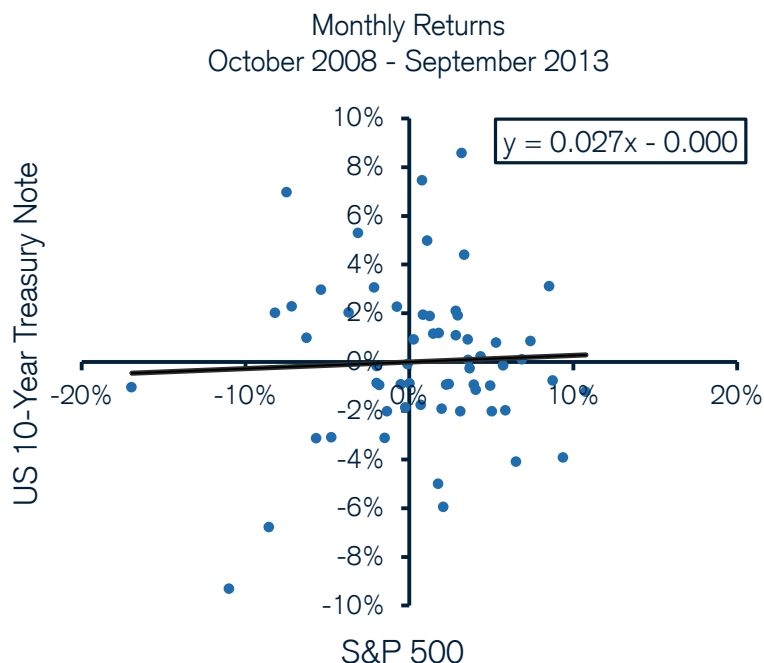
- What should I use for the risk-free rate?
- How do I estimate the difference between the market return and the risk-free rate, or the equity risk premium?
- What is the best way to estimate beta?

## Risk-Free Rate

The risk-free rate is the easiest. The best proxy for it is the yield on a long-term, default-free government fixed income security. In the United States, the 10-year Treasury note is a suitable security. This yield is easy to find, is sufficiently long-dated, and has a relatively low risk of default. Outside of the United States, you can adjust the local-currency government borrowing rate by the estimated default spread. Aswath Damodaran, a professor of finance at the Stern School of Business at New York University, shares these estimates on his website based on local currency ratings.

In theory, the risk-free rate is the return of a portfolio (or security) that has no covariance with the market—i.e., a beta of zero. While the 10-year Treasury note does not have a zero beta, Exhibit 3 shows that it is very low. Beta is the slope of the regression line.

### Exhibit 3: The Beta for the 10-Year Treasury Note Is Low



Source: FactSet and Credit Suisse.

## Equity Risk Premium

The equity risk premium (ERP) is the difference between the return of the market and the risk-free asset. The rationale behind a positive ERP is pretty straightforward: Investors are risk averse and demand a higher return on a riskier stream of cash flows than on a less-risky stream. The challenge is to estimate the magnitude of the premium. This is no easy task. Consider that a survey of 150 finance and valuation textbooks written over the past 30 years revealed a range of estimated ERPs from 3 to 10 percent.<sup>10</sup>

Factors that determine the ERP include collective risk aversion, the perceived level of economic risk, the degree of liquidity in markets, and tax policy. Because these factors change, the ERP tends to move around. In fact, academic research suggests that the ERP is probably a nonstationary series.<sup>11</sup> Your goal is to make an intelligent estimate of the current, forward-looking ERP.

There are three common approaches to estimating the ERP. The first is to examine historical results and assume that the future will be similar to the past. The second is to survey investors about their expectations. The third is to estimate a market-implied rate by reverse engineering the market price.

Each approach has strengths and weaknesses. Historical results are backed by lots of data but are highly sensitive to the time period you select to analyze, reflect survivorship bias, and vary based on whether you use arithmetic or geometric averages. Surveys capture investor attitudes at the moment but are imperfect because investors have a strong tendency to extrapolate their most recent experience, and the structures of the surveys are not always ideal. A market-implied ERP is based on prevailing prices but requires numerous assumptions about drivers such as future growth and return on capital.

Still, not all is lost. You can come at the problem of estimating the ERP from a number of different angles and generally arrive at a figure that is economically sound. One approach that makes sense is to start with a historical average, calibrate the result using credit spreads, and then compare it to market-implied returns.

When calculating the historical ERP, you must answer a few questions:

- What is the appropriate risk-free rate?
- Over what time period should you look at returns?
- Which average should you use, arithmetic or geometric?

Your answers to these questions can have a large influence on your estimate of the ERP. A recent paper by Aswath Damodaran showed an ERP range of 1.7 to 7.7 percent based on which combination of these choices were made.<sup>12</sup>

We have effectively answered the question about the risk-free rate. For the reasons we cited, the return on the 10-year Treasury note works well. If you choose to use Treasury bills or bonds, you must make sure that the ERP is adjusted accordingly.

The time horizon issue is trickier. Some believe that shorter time horizons are preferable because they better reflect current conditions. The problem with that argument is that short time periods come with huge standard errors. The standard deviation of S&P 500 returns since 1928 has been very close to 20 percent.

Standard error =  $\frac{\text{standard deviation}}{\text{the square root of the measured time}}$

$$= \frac{20\%}{\sqrt{\text{time}}}$$

So, for example, the standard error of an ERP based on 5 years of data is 8.9 percent. Even 25 years of data has a standard error of 4 percent. So for time periods less than 20 years, the standard errors are likely to be as large, or larger, than the ERP itself. This argues for using a longer time period. We have reliable data for the past 80 years, which gets the standard error down to about 2.2 percent.

Investors who use historical averages to estimate the ERP rarely specify whether they are using arithmetic or geometric returns. The difference between the two is material. For equity less bond returns from 1928-2012,

the arithmetic return was 5.9 percent and the geometric mean was 4.2 percent. The difference, 1.7 percentage points, is a large percentage of the value of either total.

The arithmetic average is the simple mean of the series of annual ERPs (equity market - risk-free rate). The geometric mean is the compounded return. The geometric return is always less than or equal to the arithmetic return. The difference is greater as the standard deviation of the time series increases.

If your goal is to estimate the market's risk premium over the next year, then the arithmetic average is the way to go. For multiple time periods, in contrast, a geometric average is better.

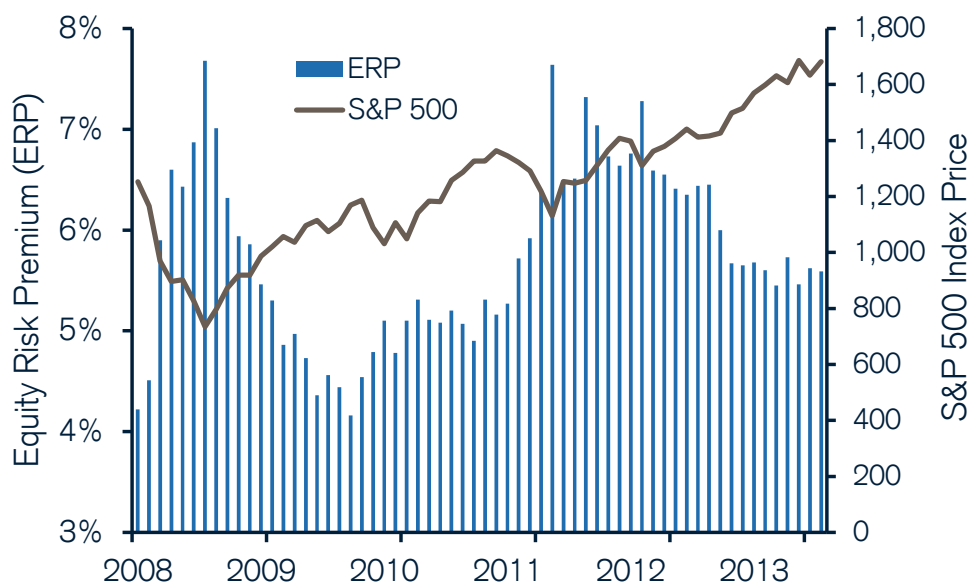
The second approach is to look at credit spreads, which reflect a bond risk premium. Because fixed income returns are observable, we can use them as a benchmark to estimate unobservable equity returns. The initial, straightforward point is that the ERP should not be below the credit spread for the simple reason that you should not expect to earn a higher return on an asset with less risk. Further, widening or narrowing credit spreads can be a useful indicator of a widening or narrowing ERP.

The final approach is an estimate of the market-implied ERP. The idea is that the key drivers of value, including earnings and dividends, follow long-term trends that are reasonably predictable. With a sense of future cash flows and knowledge of the prevailing price, we can solve for the discount rate that equates the present value of future free cash flows to today's price.

Damodaran posts this calculation on his website each month: <http://pages.stern.nyu.edu/~adamodar/>.

Exhibit 4 shows Damodaran's estimate of the ERP since September 2008. The ERP has been in a wide band of four to eight percent in the past five years. The line in the chart is the price of the S&P 500. Note that the ERP and S&P 500 tend to go in opposite directions. This means lower stock prices generally suggest higher expected returns and vice versa. As of October 1, 2013, Damodaran's estimate for the ERP was 5.7 percent, while the model developed by Credit Suisse's equity strategy group implied a warranted ERP of 4.5 percent.<sup>13</sup>

**Exhibit 4: Implied Equity Risk Premium per Aswath Damodaran**



Source: Aswath Damodaran and Credit Suisse.

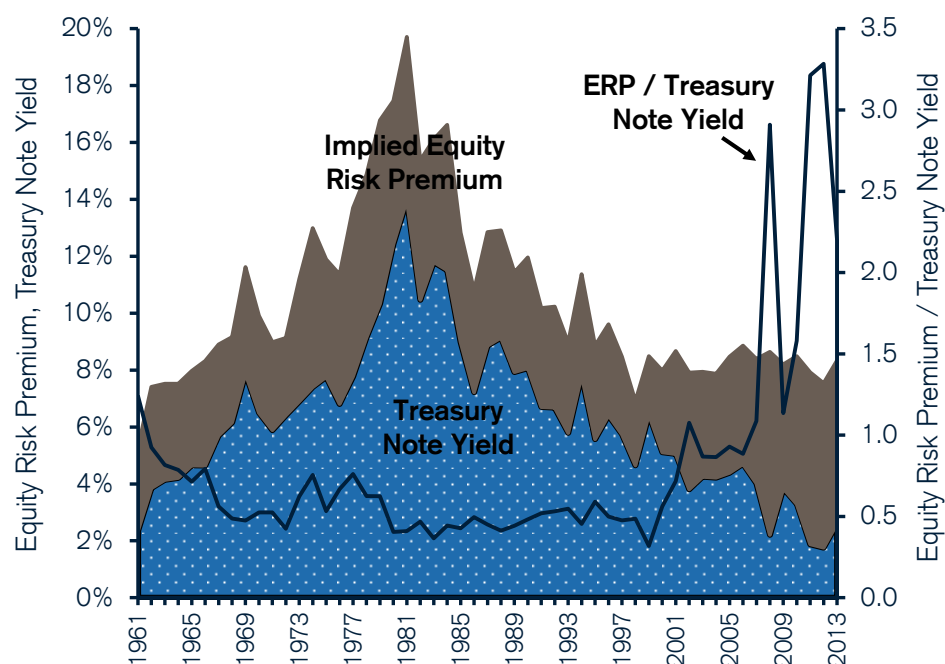
Note: 2013 data as of 09/30/13; ERP is average of prior 12 months.

Exhibit 5 shows the Treasury note yield (at the bottom in blue) and the implied ERP (on top in brown) over the past 50 years. The sum of the note yield and ERP is the expected return for the market. After peaking in the early 1980s, the bull market of the 1980s and 1990s drove down the implied return for the stock market.

The exhibit shows something even more remarkable: The ratio between the equity risk premium and the risk-free rate. That ratio has averaged 0.8 over the past five decades (roughly an average ERP of 4 percent and risk-free rate of 5 percent). But following the extraordinarily loose monetary policy adopted by central banks around the world following the financial crisis, interest rates have been pushed below the level that many consider normal. Equity returns, which have averaged 6-7 percent over time adjusted for inflation, have remained in a range consistent with historical averages.<sup>14</sup>

As a consequence, the ratio of ERP to risk-free rate has jumped from below 1.0 to in excess of 3.0. While the expected return from the market hasn't changed much, the composition relies much more on the equity risk premium and much less on the risk-free rate than in the past. Whether we will see a ratio in the future that is closer to the historical average remains a subject of debate.

#### Exhibit 5: Historical Implied Equity Risk Premium per Aswath Damodaran



Source: Aswath Damodaran and Credit Suisse.

Note: 2013 data as of 09/30/13.

#### Beta

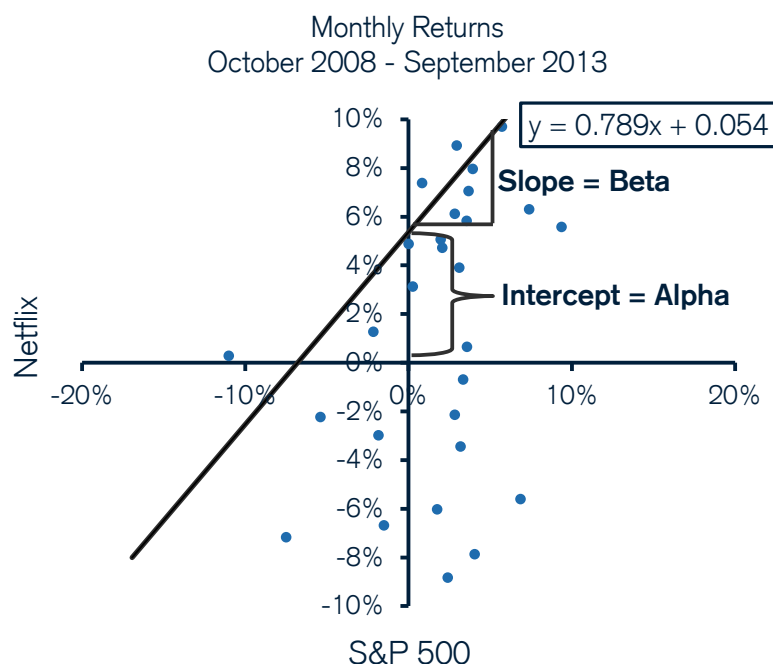
The concept of beta has come under attack in recent years but remains a reasonable starting point for thinking about risk and expected return. We will discuss methods to improve the measurement of beta and also cover alternative approaches to estimating the cost of equity. The goal, always, is to come up with a cost of equity that makes business, economic, and common sense.

Before getting into the methodology, it's important to bear in mind two points about beta. First, beta is a measure of the risk a security adds to a diversified portfolio. As a result, it is very possible for a particular company to have high individual risk but low market risk (the inverse is also true). Second, beta measures

relative risk, with an average of 1.0. Saying it differently, the market-capitalization weighted average beta of all investments must average one.

So what exactly is beta? Beta is a measure of the excess return on an individual security relative to the excess return on the market index. You can think of it as a measure of financial elasticity. In practice, you calculate a historical beta by doing a regression analysis with the market's total returns as the independent variable (x-axis) and the asset's total returns as the dependent variable (y-axis).<sup>15</sup> The slope of the best-fit line is beta. Exhibit 6 shows the beta for Netflix (NFLX) based on monthly returns over the 60 months ended September 2013.

#### Exhibit 6: Beta Is the Slope of the Best-Fit Line

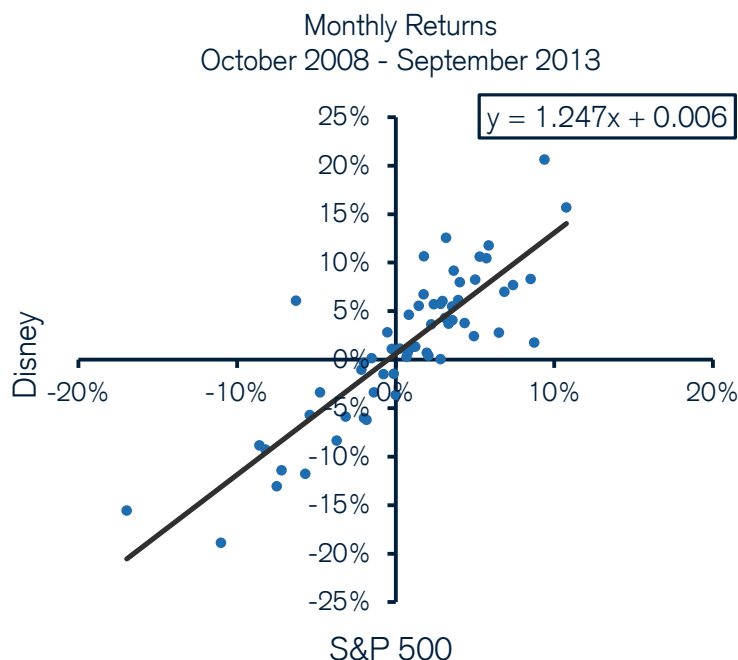


Source: FactSet and Credit Suisse.

As you may recall from a math class long ago, you can describe the slope of a line as the rise over the run. If an asset went up and down in exactly the same way as the market, the line would be at a 45 degree angle and the rise over run would equal 1.0. If the asset goes up or down at a percentage twice that of the market, the rise over run would equal 2.0, and you would consider that asset to be riskier than the market. Naturally, if the asset rises or falls at a rate that is one-half of the market's percentage, it would have a beta of 0.5 and you would deem it to be less risky than the market. (More technically, you are supposed to calculate beta using excess returns. But calculating beta using total returns makes little practical difference.) The definition of beta, then, is the covariance between the security and the market (rise) divided by the variance of the market (run).

As an additional note, the y-intercept of the best-fit line is the alpha. It is a measure of excess return relative to risk as measured by beta. In the aggregate, alpha must average to zero.

Exhibit 7 shows the calculation for beta and alpha for Disney for the 60 months ended September 2013. Beta is about 1.2 and alpha is very close to zero.

**Exhibit 7: Beta Calculation for Disney**

Source: FactSet and Credit Suisse.

Beta is supposed to be a forward-looking measure. In practice, we can't observe beta so we have to estimate it by looking at historical relationships and make adjustments where appropriate to remove some of the noise.

There are a number of judgments you have to make when determining how to calculate beta. The first is which index to compare to; the second is how far back in history you should go; and the third is the frequency of return measurement (e.g., daily, weekly, monthly, quarterly, or annually).

Of these judgments, determining the appropriate index is probably the most straightforward. One way to think about it is to identify which benchmark the marginal buyer of the security is likely to use. For most funds in the United States, the S&P 500 is the most logical candidate as more than one-half of the assets under management use it as a benchmark. But the benchmark you use will determine the beta. Exhibit 8 shows the beta for Disney (60-month, using monthly returns) calculated for four indexes. You can see a range of approximately 1.2 to 1.3.

**Exhibit 8: Disney's Beta Using Four Indexes**

Relative to:	Five-year monthly beta
S&P 500	1.22
Dow 30	1.33
Russell 3000	1.17
MSCI World	1.27

Source: FactSet and Credit Suisse.

Note: Data as of 9/30/13.

The next decision is how far back in history you should go. The benefit of going back further in time is that you get more data and hence a more reliable regression result. The drawback is that the company may have changed its business model, business mix, or levels of financial leverage. For companies that have stable



business models and capital structures, longer is better. If you suspect that the data from a few years ago no longer apply, try calculating a rolling beta. If the beta changes materially during your measurement period, you can then consider whether it makes sense to use a shorter period.

Exhibit 9 shows the betas for Disney using the S&P 500 and monthly returns over four different time horizons. The exhibit also includes the  $R^2$ 's, a measure of the strength of the correlation.

#### Exhibit 9: Disney's Beta Using Four Time Periods

<u>Measurement period</u>	<u>Monthly beta</u>	<u><math>R^2</math></u>
Three-year	1.24	56%
Five-year	1.25	73
Seven-year	1.16	69
Ten-year	1.16	58

Source: FactSet and Credit Suisse.

Note: Data as of 9/30/13.

The final decision is the frequency of the measurement period. The benefit of more frequent measurement is more data. Multiple sources, including McKinsey's book on valuation and a paper by Aswath Damodaran, suggest that there are some biases associated with daily or weekly data for beta estimation. McKinsey recommends monthly data, and Damodaran recommends using high-frequency data only with certain adjustments. Unless you have a good reason not to, you should start with 60-month, monthly returns to calculate beta.

Exhibit 10 shows Disney's beta assuming five different measurement frequencies over five years. Also included are the standard errors.

#### Exhibit 10: Disney's Beta Using Five Measurement Frequencies

<u>Return interval</u>	<u>Beta</u>	<u>Standard error</u>
Daily	1.13	0.021
Weekly	1.11	0.047
Monthly	1.25	0.099
Quarterly	1.35	0.149
Annually	1.12	0.196

Source: FactSet and Credit Suisse.

Note: Daily, weekly, monthly, and quarterly data as of 9/30/13; annual data as of 12/31/12.

Even if you make good choices in calculating historical beta, the process is imprecise. For example, Amazon.com's 60-month beta, based on monthly returns, is 0.79 with an  $R^2$  of just 17 percent and a standard error of 0.23 (as of September 30, 2013). So you can be 95 percent confident that AMZN's beta is somewhere between 0.33 and 1.25, which is not exactly the definition of precision. So there are two common ways to improve the estimate of beta.

*Adjusted beta:* The first method adjusts the beta toward 1.0 to create an adjusted beta. *Bloomberg* and *Value Line* use this technique. Here's the typical formula:

$$\text{Adjusted beta} = (\text{raw beta} * 0.67) + (1.0 * 0.33)$$

So, for example, AMZN's adjusted beta is  $0.86 = (0.79 * 0.67) + (1.0 * 0.33)$

The rationale for this adjustment is empirical evidence suggesting that betas tend toward 1.0 over time.<sup>16</sup> This makes economic and intuitive sense. The challenge to the adjustment is with respect to the weightings. It is likely that betas converge to 1.0 at different rates for different companies, and the one-size-fits all solution fails to capture that. Still, this adjustment likely improves the estimate of a forward-looking beta.

## Industry Beta

The second way to improve beta is to consider an industry beta instead of betas for individual companies. In our discussion of high-level thoughts, we discussed breaking down corporate risk into business risk and financial risk. The key premise supporting an industry beta is that business risk, or operating risk, will be similar from company to company within an industry. By considering a larger sample, an industry beta can help wring out the errors that plague the estimates for individual companies.

There is a three-step process to calculate an industry beta:

- **Unlever the beta.** Because an individual company's beta combines both business risk and financial risk, we first need to remove the effect of financial leverage by unlevering the beta. The equation to do this, which is based on M&M's invariance proposition, is as follows:

$$\beta_U = \frac{\beta_L}{[1 + (1 - T)(D/E)]}$$

Where:

$\beta_U$  = Beta unlevered

$\beta_L$  = Beta levered

T = Tax rate

D = Market value of debt (% of total capital)

E = Market value of equity (% of total capital)

Take for example Company Echo with a raw beta of 1.2, a 35 percent tax rate, 20 percent debt, and 80 percent equity:

$$\beta_U = \frac{1.2}{1 + (1 - .35)(.20/.80)}$$

$$\beta_U = \frac{1.2}{1 + (.65)(.25)}$$

$$\beta_U = \frac{1.2}{1.1625}$$

$$\beta_U = 1.03$$

- **Calculate the average beta for the industry.** The second step is to create an average of all the unlevered betas for the companies within the industry. You can define an industry as a set of companies that have similar business risk. You then take the market-capitalization-weighted average of the industry. It's often useful to also look at the median to see if it's in the same range as the mean.

- **Relever the beta for the specific company.** Unlevering the beta removed financial risk, but now you must reintroduce it based on the company's expected long-term capital structure. The formula to relever the beta is:

$$\beta_L = \beta_U [1 + (1 - T)(D/E)]$$

Take for example Company Foxtrot that has an industry beta of 0.80, a 38 percent tax rate, 25 percent debt, and 75 percent equity:

$$\beta_L = 0.8 [1 + (1 - .38)(.25/.75)]$$

$$= 0.8 [1 + .62(.333)]$$

$$= 0.8 [1.2066]$$

$$\beta_L = 0.97$$

Industry betas should provide a more accurate and stable sense of the company's relative risk. On his website, Aswath Damodaran shares his calculations of the levered and unlevered betas for many industries.<sup>17</sup>

Damodaran makes additional corrections for industries with lots of cash. When cash exceeds debt, a company has negative financial leverage. This means that the returns to shareholders are dampened, and hence risk is lower.

The reasons you adjust betas are to reflect that they tend toward 1.0 over time and to reduce measurement error. The first goal leads to another important analytical consideration. If you have a company with a beta that is meaningfully above or below 1.0, you should adjust the weighted average cost of capital calculation for the residual value to reflect a beta closer to 1.0. This adjustment is particularly important for young companies that will look a lot more mature as they reach the point at which you apply the residual value.

To summarize, as a default, you should determine the cost of equity by:

- Using the 10-year Treasury note as your risk-free rate;
- Applying a reasonable equity risk premium;
- Calculating a 60-month, monthly beta that you adjust as appropriate (industry betas are best).

## Other Forms of Financing

**If relevant, you have to know how to determine the cost of other sources of capital.**

Debt and equity are by far the largest sources of capital. But there are other means to finance assets as well. One example is operating leases. For instance, a retailer can choose to either buy or lease a new store. Given the transparency of interest rates and taxes, these two financing sources are generally nearly equivalent. But their effects on the income statement and balance sheet are very different. We want to normalize the two methods for the purpose of comparing companies and estimating the cost of capital. You will find this most relevant for industries with heavy investment needs, including transportation (e.g., airlines) and retail.

**Operating leases.** Companies that choose to acquire stores through operating leases have lower operating income and lower levels of debt than companies that choose to buy their stores. In order to make the two choices comparable, for companies that lease you need to add the implied principal amount of the lease to assets and the equivalent amount of debt to the right side of the balance sheet. This increases the ratio of debt to total capital. For companies that lease you also need to adjust earnings before interest and amortization by reclassifying the implied interest expense portion of the lease payments from an operating expense to a financing cost.

As a consequence of these adjustments, corporate value increases as you are discounting a higher cash flow number by a lower discount rate. But the equity value is theoretically unchanged as the increase in corporate value is offset by a higher level of debt. For more on operating lease adjustments, Aswath Damodaran has a spreadsheet that guides your calculations.<sup>18</sup>

**Preferred stock.** Preferred stock is an equity instrument that blends the features of debt and equity. The total value of preferred stock outstanding in the U.S. is around \$165 billion, a small fraction of the equity and bond markets. Like debt, preferred stock typically provides its holder a stream of cash flows—in this case, in the form of a dividend. Also like debt, preferred stock generally has no voting rights. However, preferred stock resembles equity in that the company is not contractually obligated to pay a dividend (interest payments and the repayment of principal are contracts), and decisions about the dividend are left to the discretion of the board of directors. Because preferred stock is junior to debt but senior to common equity in the capital structure, the cost of preferred stock is typically somewhere in between the two.

Cost of preferred = preferred dividend per share/market price per share

Further, unlike interest payments on debt, the dividends on preferred stock are not tax deductible. This deters a lot of companies from issuing preferred stock, with the largest issuers being financial institutions, REITs, and public utilities. Preferred stock is attractive to other companies because tax laws allow companies to exclude 70 percent of dividend income from their taxable income, which is especially valuable here because preferred stock tends to have a higher yield than common stock. Financial companies may use preferred stock to improve capital ratios at a lower cost than straight equity.

Many preferred issues include some provision for retirement, and frequently the preferred offers an option to retire the issue, to convert it into common stock, or to repurchase it at a specific time and price. You must read the details about a preferred issue to understand if there's an embedded option. If so, you must include that option in your valuation.

**Convertible bonds.** Convertible bonds are another source of financing. Convertible bonds combine a straight debt issue with a warrant. You should value them accordingly. Convertible bonds typically have yields below straight debt because of the value of the embedded warrant. They are often junior to other issued debt as well. There are three broad regimes in valuing converts. The first is when the stock price is well above the exercise price. Here, these instruments act more like straight equity. Second, when the stock price is near the exercise price, both the bond value and the warrant are important sources of value. Third, when the stock price sinks well below the exercise price, the convert is “busted” and trades more like straight debt.

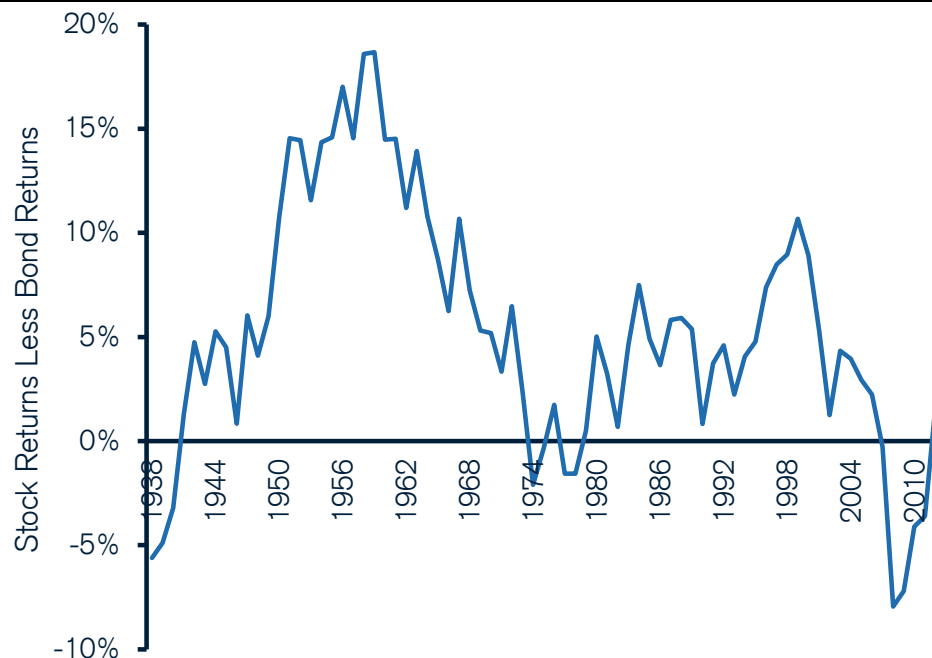
It's also important to note that convertible bonds embed warrants, not options. Warrants are for the issuance of new shares, which means that current shareholders will be diluted upon conversion.

## Normalizing

**During times when implied returns are far from historical norms, you may have to provide a normalized cost of capital. Further, it's important to consider a company's need to access capital markets when evaluating the capital structure.**

Over the past 85 years, the average geometric return for the stock market has been 9.0 percent, the arithmetic return 11.1 percent, and the standard deviation about 20.1 percent. Said differently, the stock market's real return (i.e., inflation-adjusted) has been 6-7 percent and, as we noted earlier, the equity risk premium has been 4-5 percent. But those long-run figures belie the instability of the time series. Exhibit 11 shows the rolling 10-year equity risk premium, which makes clear that the results often deviate substantially from the historical average. Collective risk aversion changes dramatically from period-to-period.

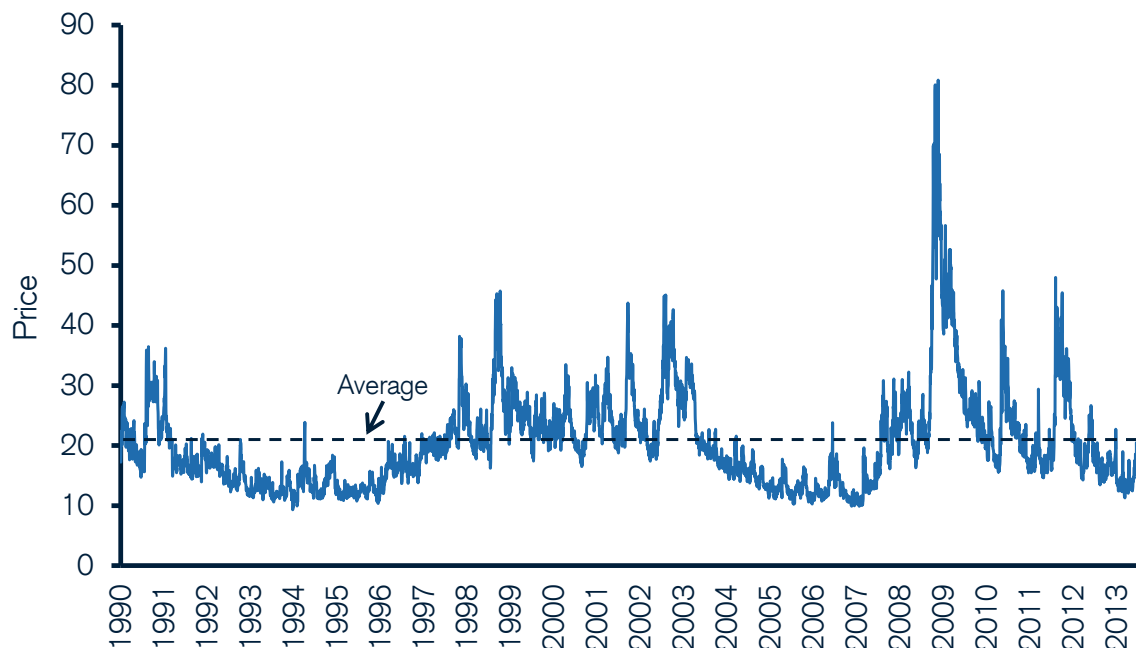
**Exhibit 11: Rolling 10-Year Realized Equity Risk Premium (1938-2012)**



Source: Aswath Damodaran and Credit Suisse.

Note: Stocks represented by S&P 500 Index or proxy; bonds represented by US 10-Year Treasury security.

One crude way to gauge collective risk aversion is to monitor the Chicago Board Exchange Volatility Index, or VIX, which is a measure of the implied annual volatility of options on the S&P 500 Index. (More technically, the VIX measures the implied volatility of the next 30 days and is expressed as annualized volatility.) Exhibit 12 shows the time series for the VIX over the past 20 years. The exhibit shows that the implied volatility can be very different than the S&P 500's average standard deviation over the past 85 years. The spike in late 2008 was the largest sustained period of perceived risk since the 1930s.

**Exhibit 12: The Chicago Board Options Exchange Volatility Index (1990-September 2013)**

Source: FactSet and Credit Suisse.

We can also gauge systemic risk by aggregating market-based measures of default risk for corporations or nations.<sup>19</sup> Two examples that analysts follow widely include bond spreads and credit default swap (CDS) spreads. The bond yield spread is the yield on a bond in excess of the risk-free rate, and the CDS spread is the cost of insuring against default. When viewed together, the VIX, credit spreads, and CDS spreads give a reasonable sense of collective risk aversion. Low volatility and low credit and default risk spreads imply a greater risk appetite, and high readings indicate fear of risky assets.

Credit Suisse's Global Risk Appetite Index (CS GRAI) is a useful tool for tracking fluctuations in risk preference.<sup>20</sup> The CS GRAI gauges risk tolerance by comparing the performance of safe assets such as government bonds to more volatile assets such as equities. Typically, the risk appetite is high following a period when risky assets have generated very high returns and the risk appetite is low following a period of low returns for risky assets.

Low risk aversion often comes with high asset prices, but high asset prices imply less upside and more downside. And so asset prices are often vulnerable to decline when investors perceive risk to be low—think of the spring of 2000 and the summer of 2007. Conversely, when investors perceive risk to be high, asset prices are often very attractive—think spring of 2009.

When collective perceived risk is well above or below historical standards, analysts face a challenge. On the one hand, the cost of capital represents the opportunity cost of investors, so the prevailing rates and risk levels should be useful and indicative. On the other hand, we know that credit spreads and the equity risk premium are series that revert to the mean, which implies that extremely high or low readings are likely to be followed by readings closer to the historical average.

So should an analyst simply go with the current levels or should he or she normalize the cost of capital estimate to reflect long-run averages?

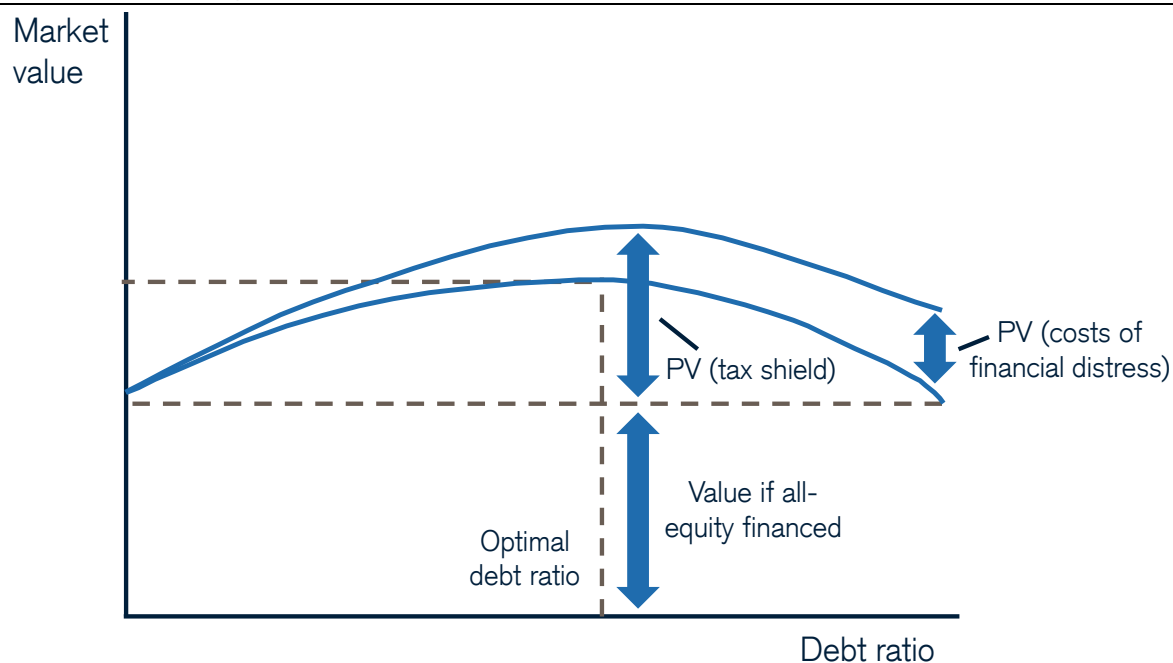
The best approach, if not altogether satisfying, is to calculate the cost of capital twice: once for prevailing conditions and a second time for “normal” conditions. The two calculations should be explicit in your commentary and analysis. When perceived risk is high, the calculation using normal rates will boost your values. When risk perception is low, normal rates will lower your values.

Harley Davidson’s issuance of senior unsecured notes in February 2009 is a good case for when to use this two-step approach. The \$600 million offering, which carried a 15 percent yield, was snapped up by Berkshire Hathaway and Davis Selected Advisors. With the company issuing senior unsecured debt at a 15 percent yield, one could only conclude that the cost of equity was quite a bit higher, probably in the high teens. So it made sense to use the market-determined rates to discount future cash flows, even if those rates were exorbitantly high by historical standards.

At the same time, it would have been reasonable to assume that collective risk aversion would not remain elevated and that more normal rates would prevail at some point in the future. So a separate calculation of Harley Davidson’s value, using a discount rate representative of long-term averages, would have been appropriate. Again, the key is making sure that you label your analysis clearly.

An assumption of finance theory that doesn’t always hold in the real world is that capital is always available, if at a price. In reality, there are times when external financing is either exorbitantly expensive or simply unavailable. For companies with negative free cash flow (i.e., companies that invest more than they earn) or knowledge-based companies that rely on steady investments, windows of capital inaccessibility can be crippling and, in some cases, a mortal blow. Some researchers have argued that future investments are tantamount to liabilities and that executives must take those liabilities into consideration in setting the capital structure.

### Exhibit 13: Determining the Optimal Capital Structure



Source: Credit Suisse based on Tim Koller, Marc Goedhart, and David Wessels, *Valuation: Measuring and Managing the Value of Companies*, 5<sup>th</sup> Edition (Hoboken, NJ: John Wiley & Sons, 2010).



Here's one way to think about it. In standard finance theory, a company should take on as much debt as it can without incurring too much risk of distress. So a company's optimal capital structure assumes as much debt as possible to reduce the cost of capital without taking on so much debt as to incur the risk of distress. Exhibit 13 shows this tradeoff.<sup>21</sup>

In contrast, companies that need to fund future investments need some assurance that they will be able to invest irrespective of the conditions in capital markets. In effect, the insurance value of cash on the balance sheet exceeds the value of the tax shield of debt. So these companies tend to have greater cash reserves.

When modeling, consider carefully future investment requirements and the company's need to access external capital. If the company is insufficiently capitalized, make sure that you have a distinct node to reflect the risk of distress. This not an issue about the cost of capital but rather a modeling consideration.

**Checklist**

- ☐ Determine all sources of financing

**Debt**

- ☐ Calculate the yield to maturity on the company's long-term debt
  - If observable, use that yield
  - If illiquid, use credit spread
  - If the security contains an option, use the implied option-adjusted spread
- ☐ Reflect the tax shield
- ☐ Consider other tax issues, including tax-loss carryforwards and tax credits
- ☐ If the company has substantial operating leases, convert them to look like debt

**Equity**

- ☐ Determine the current risk-free rate (U.S. 10-year Treasury note)
- ☐ Use current equity risk premium estimate (see <http://pages.stern.nyu.edu/~adamodar/>)
- ☐ Calculate the industry beta
- ☐ Relever the industry beta to calculate the stock's beta
- ☐ Check your cost of equity versus the cost of debt and implied volatility
- ☐ For the residual value, use beta weighted toward 1.0 if the beta is substantially different than 1.0 currently

**Other sources of financing**

- ☐ Calculate return required on preferred stock or convertible bond

**Capital Structure**

- ☐ Determine the company's target debt-to-capital ratio (use market values)
- ☐ In the case of a dynamic capital structure, use adjusted present value (see appendix)

**Normalize**

- ☐ If the current expected returns are much higher or lower than historical norms because of collective increases or decreases in risk aversion, show both the prevailing cost of capital and a normalized cost of capital. Make sure you label each clearly.

## Appendix

### a. Real versus Nominal Cash Flows

**It does not matter if you use real (adjusted for inflation) or nominal (unadjusted for inflation) numbers provided your analysis is consistent throughout.**

Here are the two main points:

- Valuation doesn't change in the face of rising or falling rates unless the real (inflation-adjusted) discount rate and/or the real growth rate change. There is substantial evidence that these rates are very sticky over time and in the aggregate. But judgment is required for individual companies.
- Investors tend to be very poor at adjusting their earnings growth rates to reflect inflation. Generally, investors take recent inflation rates and extrapolate them. Modigliani and Cohn forcefully argued this point over 30 years ago, and Campbell and Vuolteenaho reiterated the point in a more recent paper.

A logical starting point is to show that you get the same value if you model a financial asset on a real or nominal basis.

Assume a firm and the following conditions:

Distributable earnings	= \$100
Growth next 3 years (real)	= 5%
Growth beyond 3 years (real)	= 3%
Ten-year note yield	= 3%
Equity risk premium	= 5.75%
Beta	= 1.0
Expected inflation	= 3%

#### What are the growth rates?

	<u>Real</u>	<u>Nominal</u>
First 3 years	5%	$(1.05)*(1.03) - 1 = 8.2\%$
3 years +	3%	$(1.03)*(1.03) - 1 = 6.1\%$

#### What are the discount rates?

<u>Real</u>	<u>Nominal</u>
$(1.0875/1.03) - 1 = 5.58\%$	$3\% + 1*(5.75\%) = 8.75\%$

#### What are the cash flows?

<u>Year</u>	<u>Real Cash flow</u>	<u>Nominal Cash flow</u>
1	105	108.2
2	110.3	117.0
3	115.8	126.5

#### What are the terminal values?

<u>Real</u>	<u>Nominal</u>
$115.8*(1.03)/(0.0558 - 0.03) = \$4,617$	$126.5*(1.061)/(.0875 - .0609) = \$5,045$

**What are the present values?**Real

$$105/1.0558 + \\ 110.3/(1.0558)^2 + \\ (115.8 + 4,617)/(1.0558)^3$$

$$= \underline{\underline{\$4,219}}$$

Nominal

$$108.2/1.0875 + \\ 117.0/(1.0875)^2 + \\ (126.5 + 5,045)/(1.0875)^3$$

$$= \underline{\underline{\$4,219}}$$

The main message is that it's important to always be consistent in matching cash flows with discount rates when you model. Provided you feel real growth rates haven't changed (i.e., the company can price its goods or services at the rate of inflation), a change in nominal discount rates due to inflation will not change value.

## b. Adjusted Present Value

**Adjusted present value (APV) adds some important flexibility to a discounted-cash-flow analysis that is particularly useful for companies that have dynamic capital structures.**

The assumption of a steady debt-to-total capital ratio—a crucial assumption in the WACC calculation—often makes sense. But changing capital structures require another layer of analysis.

You do an APV analysis in four steps:

1. Prepare a cash flow forecast for the business
2. Discount the cash flows and residual value to the present value using the cost of equity
3. Value the costs or benefits of financing
4. Add the pieces together

The best way to illustrate this concept is to provide a simple numerical example. Note that the company's total debt drops during the forecast period. Here's an example:

Step 1 is to create the cash flow forecasts.

### Income statement

	0	1	2	3	4	5
EBIT		22.7	29.8	37.1	40.1	42.1
Interest expense		21.6	19.1	17.8	16.7	15.8
Pretax income		1.1	10.7	19.3	23.4	26.3
Taxes @ 34%		0.4	3.6	6.6	8.0	8.9
Net income		0.7	7.1	12.7	15.4	17.4
Depreciation		21.5	13.5	11.5	12.1	12.7
Capital expenditures		10.7	10.1	10.4	11.5	13.1
Change net working capital		(12.3)	1.9	4.2	5.2	6.1
Change other assets		9.0	6.9	3.4	0.0	0.0

### Balance Sheet

	0	1	2	3	4	5
Assets						
Net working capital	60.0	47.7	49.6	53.7	59.0	65.1
Net fixed assets	221.0	210.3	206.9	205.7	205.1	205.5
Other assets	26.0	17.0	10.1	6.7	6.7	6.7
Total assets	307.0	275.0	266.6	266.1	270.8	277.3

Liabilities + Equity						
Revolver	13.0	0.2	4.8	11.7	20.9	20.0
Bank loan	80.0	60.0	40.0	20.0	0.0	0.0
Subordinated debt	150.0	150.0	150.0	150.0	150.0	0.0
Long-term debt	0.0	0.0	0.0	0.0	0.0	140.0
Total debt	243.0	210.2	194.8	181.7	170.9	160.0
Equity	64.0	64.8	71.8	84.4	99.9	117.3
Total Liabilities + Equity	307.0	275.0	266.6	266.1	270.8	277.3

Interest paid	21.6	19.1	17.8	16.7	15.8	
Principal repaid	32.8	15.4	13.1	10.8	10.9	

**Free Cash Flow**

EBIT	22.7	29.8	37.1	40.1	42.1	
Taxes @ 34%	7.7	10.1	12.6	13.6	14.3	
NOPAT	15.0	19.7	24.5	26.5	27.8	

Change in working capital	(12.3)	1.9	4.1	5.3	6.1	
Capital spending (net)	(10.8)	(3.4)	(1.1)	(0.6)	0.4	
Other	(9.0)	(6.9)	(3.4)	0.0	0.0	
Investment	(32.1)	(8.4)	(0.4)	4.7	6.5	

Free cash flow	47.1	28.1	24.9	21.8	21.3	22.4
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Step 2 is to discount the cash flows and residual value at the cost of equity in order to determine the present value. This is the value of the company's operations.

	0	1	2	3	4	5	6+
Free cash flow		47.1	28.1	24.9	21.8	21.3	194.7
Discount factor	1.0	0.9	0.8	0.7	0.7	0.6	
PV		42.4	22.8	18.2	14.3	12.6	115.5

Value FCF	225.9		Discount	11.0%
			Growth	2.0%

Step 3 is to value the tax shield. This is discounted at the cost of debt. This values the company's financing.

	0	1	2	3	4	5	
Interest tax shield		7.4	6.5	6.1	5.7	5.4	
Terminal value of shield							122.4
Discount factor	1.0000	0.9132	0.8340	0.7617	0.6956	0.6352	
PV		6.7	5.4	4.6	3.9	3.4	77.8

Value Tax Shield	101.9		Discount	9.5%
			Growth	2.0%

Step 4 adds the results of steps 2 and 3 to determine the company's value.

Operations	225.9
Financing	101.9

Adjusted Present Value	327.8
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### c. Arbitrage Pricing Theory

**Arbitrage pricing theory (APT) is a multivariate model that considers a variety of economic factors that shape an investment's required rate of return.**

The CAPM is a univariate model that considers only risk versus the market. APT acknowledges the fact that some stocks may be more sensitive to a particular factor than other stocks. For example, ExxonMobil is likely to be more sensitive to the price of oil than Coca-Cola is, whereas Coca-Cola may be more sensitive to the price of sweetener than ExxonMobil is.

The returns in APT are specified by this equation:

$$\text{Return} = \alpha + \beta_1(F_1) + \beta_2(F_2) + \beta_3(F_3) + \dots + \varepsilon$$

Common factors include yield spreads, interest rate risk, business outlook risk, and inflation risk.

The practical problem with APT is that it does not specify what the factors are and adds substantial complexity to the problem of estimating the cost of equity. As a result, it has been more popular in the classroom than in practical applications.



#### d. Fama-French Three-Factor Model

**The Fama-French model estimates returns by considering a correlation with three factors, including the equity risk premium, the excess returns of small stocks versus large stocks, and the excess returns of cheap stocks versus expensive stocks.**

In 1992, Eugene Fama and Kenneth French published a bombshell paper that suggested that their tests did not support the CAPM.<sup>22</sup> Rather than settling for that criticism, they looked at past returns and tried to determine what explains returns. Their analysis led them to two variables beyond the market risk premium: small capitalization and low valuation. They found that small capitalization companies deliver higher returns than large capitalization companies (small minus big, or SMB) and that cheap, high book-to-price stocks deliver higher returns than expensive, low book-to-price stocks (high minus low, or HML).

$$\text{Return} = \alpha + \beta_1(R_m - r_f) + \beta_2(R_S - R_B) + \beta_3(R_H - R_L) + \varepsilon$$

Fama and French imposed a rational asset-pricing framework in the tests of their model. They assumed that observed returns are associated with risk and hence are proxies for risk. In other words, they conclude that small stocks must be riskier than large stocks and that cheap stocks are riskier than expensive stocks even though there is no clear case for either conclusion based on first principles.

In Exhibit 14, we calculate the cost of equity for Disney using the Fama-French model. We use monthly returns versus the S&P 500 over the past five years for the CAPM beta and the U.S. 10-year note for the risk-free rate.

#### Exhibit 14: Fama-French Cost of Equity Calculation for Disney

Factor	Average annual premium	Regression beta	Contribution to expected return
Market risk premium	5.6%	1.09	6.1%
SMB premium	3.1%	0.10	0.3%
HML premium	4.8%	0.43	2.1%
Premium over risk-free rate			8.5%
		Risk-free rate	2.8%
		<b>Cost of equity</b>	<b>11.2%</b>

Source: Eugene F. Fama and Kenneth R. French, Aswath Damodaran, Dimensional Fund Advisors, Credit Suisse.

Note: Risk-free rate, ERP, and data used in regression as of 8/30/13.

A couple of issues are worth mentioning here. First, the CAPM beta (the regression versus the market) is the most significant factor determining the premium to the risk-free rate. Second, the key is not whether a stock itself is small or cheap but rather how it behaves relative to small and cheap stocks. You should not assume automatically that small and cheap stocks have a risk premium above and beyond the market risk premium.

That this multi-factor model outperforms the CAPM should not come as a surprise because Fama and French selected risk proxies precisely because they better explained returns. Taken to its logical extension, *any* factor can be considered a risk factor if it better predicts returns. The challenge is to find risk factors that are causal and not simply correlated.

The main practical impediments to using the Fama-French Three-Factor model are the same as for the basic CAPM: choice of time horizon and frequency of measurement period. Over very long time periods small stocks have delivered higher returns than large stocks, and cheap stocks have outperformed expensive ones. But

there are long stretches where these relationships do not hold. Aswath Damodaran recommends going with the Fama-French Three-Factor Model for looking at the past records of mutual funds, but prefers the CAPM, with appropriately adjusted betas, for corporate finance and valuation.

## e. Calculation of Credit Suisse HOLT Discount Rate

**The CFROI® discount rate is a real, market-implied cost of capital consistent with the CFROI “Total Valuation System” approach.**

The model calculates the discount rate directly from, and in accordance with, the rest of the CFROI valuation framework. The discount rate depends on the CFROI fade rate and normalized growth rate assumptions in the Net Cash Receipt (NCR) forecasts that drive valuation. It is the cost of capital that equates the NCR forecasts with the current market price. This methodology allows users to compare discount rates to CFROIs in order to assess whether management teams are creating or destroying wealth. The CFROI valuation model permits CFROI and discount rate comparisons throughout time and across countries.<sup>23</sup>

CFROI and discount rate comparison across markets and throughout time is achieved through: 1.) Real (inflation-adjusted) NCR's that eliminates the distortion of changes and differences of purchasing power around the world and 2.) The Global Standard Firm (GSF) is used as a point of reference to measure company-specific risk characteristics and allow for global comparisons. The GSF (also referred to as the market discount rate or base rate) is a hypothetical company in 1999 of USD \$5 billion market cap and 25 percent leverage. It is scaled in time to the movement of the MSCI World Index to prevent size bias and is currency converted for every country at each point in time. The GSF, described as the “country rate” in HOLT Lens, is the focal point from which company-specific risk differentials are calculated.

Company-specific discount rates are assigned a premium (penalty) or discount (benefit) risk differential relative to the GSF discount rate. These risk characteristics are measured in terms of size and leverage differentials. These risk variables, also employed in credit analysis, are used as proxies for liquidity and financial risk. Investors require a higher rate of return to compensate them for the additional risk. CS HOLT has empirically verified these risk characteristics to be the most statistically relevant to date. The discount rate uses equity market capitalization as a proxy for liquidity and leverage at market as a measure of financial risk. Greater financial leverage suggests a higher discount rate, while greater liquidity of traded shares (lower trading costs), suggests a lower discount rate. Corporations must accept a higher weighted average cost of capital for having less stock liquidity and for taking on additional debt. In summary, the more risk the investor accepts (less liquidity and high leverage) the higher the required rate of return.

The CFROI model puts the tax deductibility of interest directly into the NCR stream through higher CFROIs resulting from lower taxes paid. From the owners' perspective (external to the firm), the cost of debt (or equity) capital is properly viewed as the return that bondholders (or common stock owners) expect to achieve in the future. Bondholders receive full interest and principal payments and their anticipated return is understated when the cost of debt capital is reduced by impounding the benefit of the tax deductibility of interest payments as done in EVA models. This process allows a direct link between the investors' discount rate and the firms' cost of capital.

## Measuring Market-Derived Discount Rates

- **Screen.** CFROI discount rates are calculated by country/region. For each country/region, screen all the companies to develop an acceptable sample of well-behaved companies. The country/region groupings are based on a set of requirements, including a sufficient number of observations, adequate reported market and financial data, and sufficient model fit.
- **Calculate market-implied discount rates.** The CFROI market-derived discount rate is the rate at which CFROI NCR forecasts are discounted to equal the current market price for each stock. Since each

company has a known equity market value and a known stream of NCR forecasts, market-derived discount rates can be calculated for each company. CFROI discount rates are calculated using forecasted CFROI's, reinvestment rates and fade rates that drive NCR forecasts. These market-derived discount rates are integral to the rest of the CFROI valuation model and inherently dependent on fade rate and normalized growth rate assumptions. For each company, calculate market-implied discount rates using NCR forecasts and market prices.

- **Run regression.** Run multi-linear regression to measure the quantitative relationship between market-implied discount rates and the risk characteristics of size (liquidity risk) and leverage (financial risk). A regression equation is produced using each company's market-implied discount rate as the dependent variable regressed against leverage at market and the natural log (ln) of equity market cap (3 month rolling average) as the independent variables. The regression equation consists of an alpha (intercept), a size coefficient and a leverage coefficient. This equation is calculated for every country/region and changes weekly as stock prices change and forecasts are updated.

$$\text{Discount Rate} = \alpha + \beta_1 (\ln(\text{Size})) + \beta_2 (\text{Lev})$$

- **Calculate Global Standard Firm discount rates and company-specific risk differentials and discount rates.** A company-specific discount rate can be determined by inserting the company's size and leverage forecast into the regression equation. However, for comparability and analysis reasons we calculate a GSF (country, market or base) discount rate. The GSF is a hypothetical company based in 1999 of US \$5 billion size and 25 percent leverage. The GSF size is currency converted for each country and is scaled through time to the MSCI index. The correlated movement with the global market removes market growth (size) bias allowing comparison through time and selection of a consistent size and leverage all over the world permits analysis across countries. We use the GSF as a focal point to measure relative company-specific size and leverage differentials. The GSF is presented as a base, country or market rate but is actually just a reference point and theoretically can be any point on the regression line. The use of the GSF allows for comparable company-specific liquidity and financial risk within a market.

## Endnotes

<sup>1</sup> Christophe Faugère and Julian Van Erlach, "A Required Yield Theory of Stock Market Valuation and Treasury Yield Determination," *Financial Markets, Institutions, & Instruments*, Vol. 18, No. 1, February 2009, 27-88.

<sup>2</sup> Lynn Stout, a professor of law at Cornell University, argues against the "principal-agent approach," which assumes that shareholders own corporations, that shareholders are residual claimants, and that shareholders are principals who hire (and fire) directors to act as agents. She says the first assumption is wrong and owning a share provides shareholders a contract with very limited rights. The second assumption is false as well, she suggests, as it is based on bankruptcy law and does not apply to ongoing entities. Finally, she suggests that the right of shareholders to vote is of little practical value in matters of governance. See Lynn Stout, *The Shareholder Value Myth: How Putting Shareholders First Harms Investors, Corporations, and the Public* (San Francisco, CA: Berrett-Koehler Publishers, 2012), 36-44.

<sup>3</sup> George Foster, *Financial Statement Analysis* (Englewood Cliffs, NJ: Prentice-Hall, 1978), 268-271.

<sup>4</sup> Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporate Finance and the Theory of Investment," *American Economic Review*, Vol. 48, June 1958, 261-297.

<sup>5</sup> Merton H. Miller, "The Modigliani-Miller Propositions After Thirty Years," *Journal of Economic Perspectives*, Vol. 2, No. 4, Autumn 1998, 99-120. Also, John R. Graham, "How Big Are the Tax Benefits of Debt?" *The Journal of Finance*, Vol. 55, No. 5, October 2000, 1901-1941.

<sup>6</sup> Richard Passov, "How Much Cash Does Your Company Need?" *Harvard Business Review*, November 2003, 119-128.

<sup>7</sup> Richard A. Brealey, Stewart C. Myers, and Franklin Allen, *Principles of Corporate Finance, 11<sup>th</sup> Edition* (New York: McGraw Hill, 2013), 221.

<sup>8</sup> Steven N. Kaplan and Richard S. Ruback, "The Valuation of Cash Flow Forecasts: An Empirical Analysis," *Journal of Finance*, Vol. 50, No. 4, September 1995, 1059-1093; Timothy A. Luehrman, "Using APV: A Better Tool for Valuing Operations," *Harvard Business Review*, Vol. 75, May-June 1997, 145-154.

<sup>9</sup> Charles Duhigg and David Kocieniewski, "How Apple Sidesteps Billions in Taxes," *New York Times*, April 28, 2012.

<sup>10</sup> Pablo Fernandez, "The Magnitude and Concept of the Equity Premium in 150 Textbooks," *Social Science Research Network*, July 16, 2011.

<sup>11</sup> Bradford Cornell, *The Equity Risk Premium: The Long-Run Future of the Stock Market* (New York: John Wiley & Sons, 1999), 59-60.

<sup>12</sup> Aswath Damodaran, "Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2013 Edition," *Working Paper*, March, 2013.

[http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2238064?xyzallow](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2238064?xyzallow)

<sup>13</sup> Andrew Garthwaite, *Credit Suisse Macro Call*, September 30, 2013.

<sup>14</sup> Jeremy J. Siegel, *Stocks for the Long Run: The Definitive Guide to Financial Market Returns & Long-Term Investment Strategies, 4<sup>th</sup> Edition* (New York: McGraw Hill, 2008), 13.

<sup>15</sup> Technically, you should calculate beta using total returns (price appreciation plus dividends). Some services, including Bloomberg, simply use price appreciation and ignore dividends. This has little practical relevance for companies with yields similar to that of the market, but can make a difference for companies that either pay no dividend or pay a dividend well above the market level. For convenience, we have used price appreciation in our examples. See Aswath Damodaran, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset, 3<sup>rd</sup> Edition* (Hoboken, NJ: John Wiley & Sons, 2012), 187.

<sup>16</sup> Marshall E. Blume, "Betas and Their Regression Tendencies," *Journal of Finance*, Vol. 30, No. 3, June 1975, 785-795. For a discussion of how to model the rate of reversion to the mean, see: Michael J. Mauboussin and Dan Callahan, "How to Model Reversion to the Mean," *Credit Suisse Global Financial Strategies*, September 17, 2013.

<sup>17</sup> Damodaran's industry betas are here:

[http://pages.stern.nyu.edu/~adamodar/New\\_Home\\_Page/datafile/Betas.html](http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/Betas.html).

<sup>18</sup> Go to <http://tinyurl.com/drc88> and select "oplease.xls."

<sup>19</sup> Stefano Giglio, "Credit Default Swap Spreads and Systemic Financial Risk," *University of Chicago, Booth School of Business*, November 2011. <http://www.hhs.se/DF/Seminars/Documents/Giglio.pdf>.

<sup>20</sup> Jonathan Wilmot, Paul Mielczarski, and James Sweeney, "Global Risk Appetite Index," *Credit Suisse First Boston Global Strategy Research*, February 24, 2004.

<sup>21</sup> Jules H. Van Binsbergen, John R. Graham, and Jie Yang, "The Cost of Debt," *Journal of Finance*, Vol. 65, No. 6, December 2010, 2089-2136.

<sup>22</sup> Eugene F. Fama and Kenneth R. French, "The Cross-Section of Expected Stock Returns," *Journal of Finance*, Vol. 47, No. 2, June 1992, 427-465.

<sup>23</sup> This section follows (nearly verbatim) Katie Davis, Robb Stone, and Pratyasha Rath, "The HOLT CFROI® Valuation Model Market-Derived Discount Rate," *Credit Suisse HOLT*, 2012; "Credit Suisse Global Investment Returns Yearbook 2011," *Credit Suisse Research Institute*, February 2011, 25-29.

## References

Blume, Marshall E., "Betas and Their Regression Tendencies," *Journal of Finance*, Vol. 30, No. 3, June 1975, 785-795.

Brealey, Richard A., Stewart C. Myers, and Franklin Allen, *Principles of Corporate Finance*, 11<sup>th</sup> Edition (New York: McGraw Hill, 2013).

Campbell, John Y., and Tuomo Vuolteenaho, "Inflation Illusion and Stock Prices," *American Economic Review*, Vol. 94, No. 2, May 2004, 19-23.

Cornell, Bradford, *The Equity Risk Premium: The Long-Run Future of the Stock Market* (New York: John Wiley & Sons, 1999).

Credit Suisse Global Returns Yearbook 2011, *Credit Suisse Research Institute*, February 2011.

Damodaran, Aswath, *Damodaran on Valuation: Security Analysis for Investment and Corporate Finance* (Hoboken, NJ: John Wiley & Sons, 2006).

— — —, *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset*, 3<sup>rd</sup> Edition (Hoboken, NJ: John Wiley & Sons, 2012), 187.

— — —, "Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2013 Edition," *Working Paper*, March 2013.

Fama, Eugene F., and Kenneth R. French, "The Cross-Section of Expected Stock Returns," *Journal of Finance*, Vol. 47, No. 2, June 1992, 427-465.

Faugère, Christophe, and Julian Van Erlach, "A Required Yield Theory of Stock Market Valuation and Treasury Yield Determination," *Financial Markets, Institutions, & Instruments*, Vol. 18, No. 1, February 2009, 27-88.

Fernandez, Pablo, "The Magnitude and Concept of the Equity Premium in 150 Textbooks," *Social Science Research Network*, July 16, 2011. Available at SSRN: [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1898167](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1898167).

Foster, George, *Financial Statement Analysis* (Englewood Cliffs, NJ: Prentice-Hall, 1978).

Giglio, Stefano, "Credit Default Swap Spreads and Systemic Financial Risk," *University of Chicago, Booth School of Business*, November 2011.

Goetzmann, William N., and Roger G. Ibbotson, *The Equity Risk Premium: Essays and Explorations* (Oxford: Oxford University Press, 2006).

Graham, John R., "How Big Are the Tax Benefits of Debt?" *Journal of Finance*, Vol. 55, No. 5, October 2000, 1901-1941.

Hammond, P. Brett, Jr., Martin L. Leibowitz, and Laurence B. Siegel, *Rethinking the Equity Risk Premium* (Charlottesville, VA: Research Foundation of CFA Institute, 2011).

Kaplan, Steven N., and Richard S. Ruback, "The Valuation of Cash Flow Forecasts: An Empirical Analysis," *Journal of Finance*, Vol. 50, No. 4, September 1995, 1059-1093.

Koller, Tim, Marc Goedhart, and David Wessels, *Valuation: Measuring and Managing the Value of Companies*, 5<sup>th</sup> Edition (Hoboken, NJ: John Wiley & Sons, 2010).

Luehrman, Timothy A., "Using AVP: A Better Tool for Valuing Operations," *Harvard Business Review*, May-June 1997, 145-154.

Miller, Merton H., "The Modigliani-Miller Propositions After Thirty Years," *Journal of Economic Perspectives*, Vol. 2, No. 4, Autumn 1998, 99-120.

Modigliani, Franco, and Merton H. Miller, "The Cost of Capital, Corporate Finance and the Theory of Investment," *The American Economic Review*, Vol. 48, June 1958, 261-297.

Modigliani, Franco, and Richard Cohn, "Inflation, Rational Valuation, and the Market," *Financial Analysts Journal*, March-April 1979, 24-44.

Passov, Richard, "How Much Cash Does Your Company Need?" *Harvard Business Review*, November 2003, 119-128.

Pratt, Shannon P., *The Cost of Capital: Estimation and Applications* (New York: John Wiley & Sons, 1998).

Rappaport, Alfred, *Creating Shareholder Value: A Guide for Managers and Investors, Revised and Updated* (New York: Free Press, 1998).

Rappaport, Alfred, and Michael J. Mauboussin, *Expectations Investing: Reading Stock Prices for Better Returns* (Boston, MA: Harvard Business School Press, 2001).

Siegel, Jeremy J., *Stocks for the Long Run: The Definitive Guide to Financial Market Returns & Long-Term Investment Strategies*, 4<sup>th</sup> Edition (New York: McGraw Hill, 2008).

Stout, Lynn, *The Shareholder Value Myth: How Putting Shareholders First Harms Investors, Corporations, and the Public* (San Francisco, CA: Berrett-Koehler Publishers, 2012).

Van Binsbergen, Jules H., John R. Graham, and Jie Yang, "The Cost of Debt," *Journal of Finance*, Vol. 65, No. 6, December 2010, 2089-2136.

Wilmot, Jonathan, Paul Mielczarski, and James Sweeney, "Global Risk Appetite Index," *Credit Suisse First Boston Global Strategy Research*, February 24, 2004.



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