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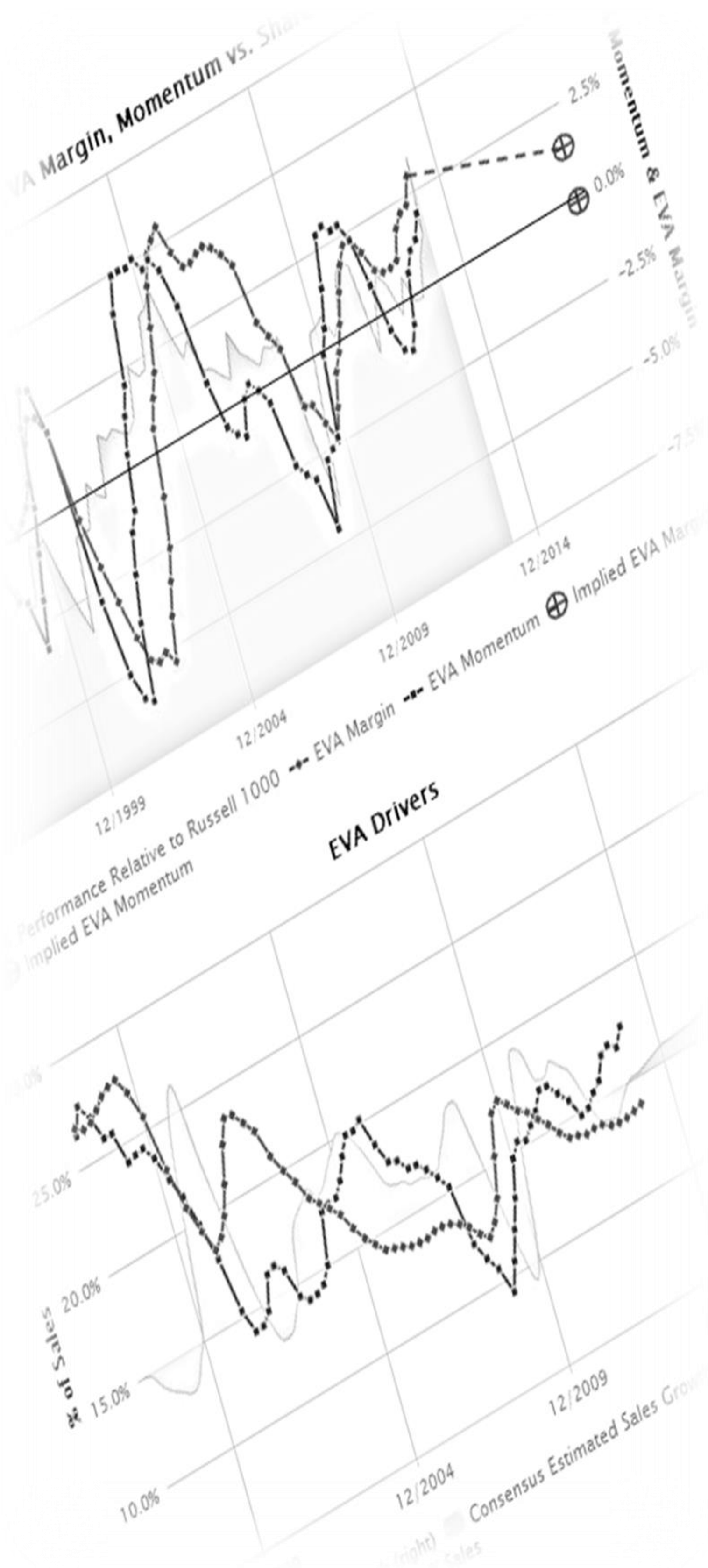

evaDimensions Cost of Capital Model

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About evaDimensions

We provide software, data and training and support services to assist our corporate clients to automate the best-practices in EVA and bring it in-house. We are also are an independent equity research provider offering investing insights through the use of our proprietary Economic Value Added (EVA) framework. Our experienced team of analysts offers both fundamental and quantitative company analysis on our 15,000-stock universe.

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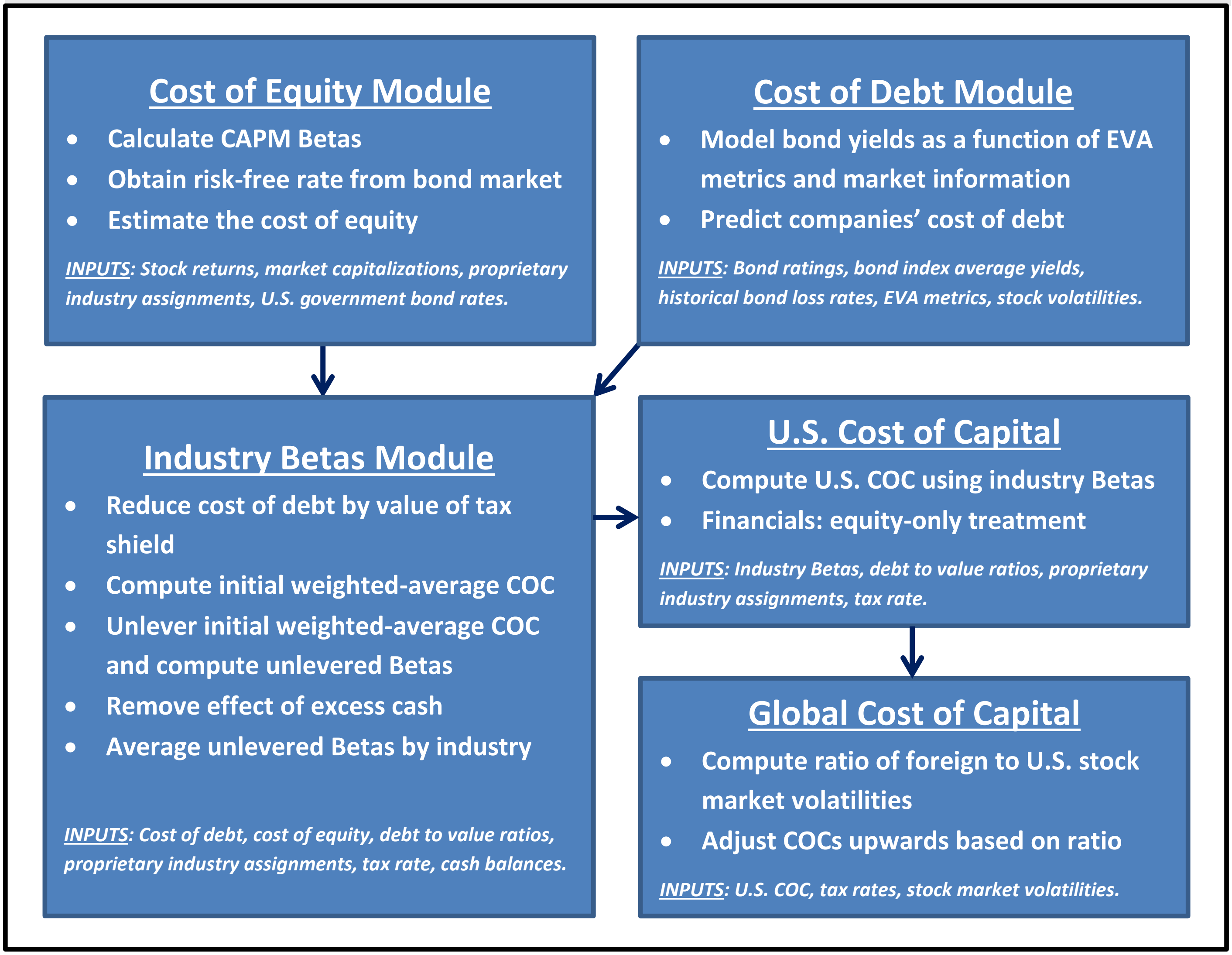
Executive Summary

Cost of Capital Calculation Overview

evaDimensions provides cost of capital calculations for over 15,000 companies globally on a historical basis. Based on our review of the literature, we have developed a composite approach that we think represents a practical, state-of-the-art method. The figure below depicts an overview of our cost of capital model. The model is divided into five main modules: the **Cost of Equity Module**, the **Cost of Debt Module**, the **Industry Beta Module**, the **U.S. Cost of Capital Module**, and the **Global Cost of Capital Module**.

Cost of Capital Overview



Coverage and Data Sources

Our U.S. universe is the union of the S&P 1500 and the Russell 3000, and our global universe is the MSCI All Country World Investible Market Index plus frontier markets (which the MSCI Index excludes), for a total of 77 countries. All calculations are done on a "point-in-time" basis. Data used in the model comes from our proprietary database of EVA metrics, MSCI, Russell, S&P, Bloomberg, Moody's, Bank of America, and KPMG.

Cost of Equity Module

Our costs of equity are based on the Capital Asset Pricing Model (CAPM), which is based on the idea that a stock that creates more risk in a diversified portfolio requires a higher return. We use the yield on 30-year U.S. government bonds as our risk-free rate as it more closely matches the estimated duration of equities. We compute equity betas with the requirement that the betas, weighted by market cap, must average 1.0 across the entire market universe; we also average each stock's beta with 1.0, assigning a weight of 2/3 to the computed beta and 1/3 to 1.0 to acknowledge that company betas tend to converge to 1.0 over time. We have chosen to use a Market Risk Premium of 4.0% rate because our experience shows that 4% leads to reasonable valuations, it is close to the average MRP estimates of various academics and practitioners, and we are unaware of any systematic technique to estimate a time-varying market premium accurately.

Cost of Debt Module

To estimate the cost of debt, we start with a model that uses an array of performance and leverage metrics sourced from our EVA model to predict a company's bond rating. Factors in the model include size, free cash flow, leverage, profitability and volatility of profitability, and several market-based measures. Then, the company is assigned a cost of debt that is consistent with its predicted rating category based on current market yields after adjusting for default losses. We skip this step for financial companies, treating them instead on an equity-only basis.

Industry Betas Module

We then combine the costs of equity and debt into a weighted-average cost of capital in order to extract an underlying cost of capital for the risk in the business (after isolating the effects of leverage and investments in marketable securities), and to compute an average unlevered beta by industry. We use the industry median beta for each company because the costs of capital estimated for any one company are measured with error. We use a proprietary set of 121 industry groupings which combine certain small GICs industries and split out others where we feel (and found) there are meaningful distinctions in the underlying business risk. We smooth these betas over time.

U.S. Cost of Capital Module

The final U.S. cost-of-capital estimates flow directly from the unlevered industry betas. In sum, a U.S. company's cost of capital is a function of three things. The first is the risk-free rate on 30-year government bonds, which is the same for all companies. The second is the unlevered beta for the business, which is shared by all the companies in the industry. The third is a discount for the tax benefit of debt financing associated with each company's running 3-year average total debt-to-capital ratio.

Global Cost of Capital Module

We have reviewed the various theses on global cost of capital and decided it makes sense to include a country risk premium. To estimate the country premiums, we compute 3-year annualized volatilities in stock market returns for each market translated into U.S. dollars as a common currency, and convert that into a country risk premium. In doing so, we use a mix of both the current and the long-term market volatilities. The final cost of capital for foreign companies is the U.S. cost of capital plus the country premium. In addition, for foreign companies, we use a country-specific corporate tax rate throughout all of the calculations.

Introduction

The cost of capital is a key ingredient in measuring performance and value

The cost of capital is an invisible dividing line between corporate success and failure, a benchmark for judging the adequacy of returns on capital, and the rate to discount projected cash flows to a present value. It is also the rate to charge for capital in the calculation of EVA and the rate to discount projected EVA to net present value.

Capital is costly because capital is scarce, limited in the aggregate to worldwide savings. Whether for an investment project or a business forecast, it is the rate of return that investors could otherwise expect to earn by investing in a stock and bond of similar risk. It is thus always an “opportunity cost” and never really a cash cost. It is a required compensation for bearing risk, where risk is assessed from the vantage point of an investor who is assumed to hold a globally diversified portfolio. Only about 25-35% of the risk in a company’s stock translates into its cost of capital. The balance of the risk is cancelled in diversified portfolios and thus does not enter into the cost of capital. For those kinds of risks, managers and investors need to attach probabilities to the value forecast for alternative scenarios.

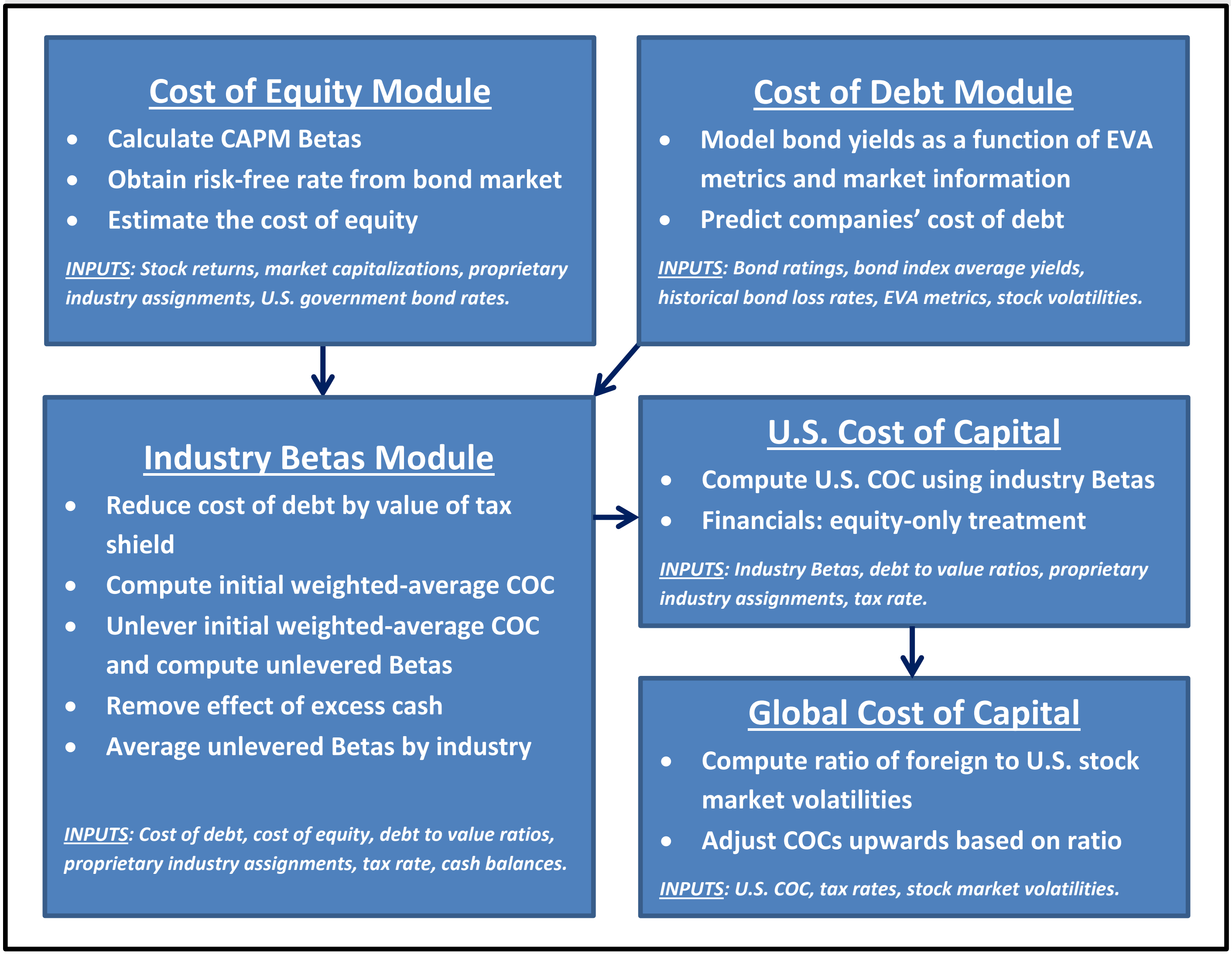
Cost of Capital Calculation Overview

The cost of capital (COC) is a formidable subject that spans the topics of corporate finance, asset pricing, market efficiency, taxation, inflation, interest rates, market segmentation, and econometrics. A review of the literature is beyond the scope of this document; for thorough reviews, consult Armitage (2005) or Pratt and Grabowski (2014). Based on our review of the literature, we have developed a new composite approach that we think represents a practical, state-of-the-art method. We applied it to U.S. companies divided into 121 custom industry groupings and have developed a method to extend the COC to global firms by adding an appropriate country risk premium. The computations have been automated and will be updated on a monthly basis.

Figure 1 depicts an overview of our cost of capital model. The model is divided into five main modules:

1. The **Cost of Equity Module** uses CAPM betas to estimate the cost of equity.
2. The **Cost of Debt Module** estimates the company-specific cost of debt using prevailing bond market rates and a proprietary model to estimate the bond rating score.
3. The **Industry Beta Module** combines costs of debt and equity to measure an underlying cost of capital for business risk, averaged by industry.
4. The **U.S. Cost of Capital Module** computes a U.S.-based COC from industry betas.
5. The **Global Cost of Capital Module** uses a volatility-based model to estimate appropriate country risk premiums which are added to the U.S. COC to determine the COC for global businesses. It also adjusts for foreign tax rates.

Figure 1: Cost of Capital Overview



In brief, our procedure is to model each firm's cost of equity and cost of debt at each historical point in time. A weighted average of the two costs is computed to get an initial weighted-average cost of capital (WACC). Generally, we average the inputs to these models (which include company fundamentals and market information) over the trailing three years. We next remove the effect of leverage and the effect of corporate investments in presumably lower-risk marketable securities to extract the unlevered beta for each firm reflecting the risk inherent solely and directly in its business activities. These unlevered betas are then aggregated by industry group. Because the betas for individual stocks are measured with significant error, and because beta is intrinsically a portfolio concept, we assume that the unlevered median beta by industry group is a more accurate indicator of the risk in the business for each firm than is the underlying unlevered beta measured for each firm on its own. We then smooth the unlevered industry betas by taking a moving average, in order to avoid abrupt blips in the cost of capital while still reflecting the directional change building up over time. Last, we use a technique to capture a country risk premium from a single variable – from the relative volatility of returns in the country stock market compared to the U.S. stock market – which produces intuitively sensible results that are sensitive to changes in perceived risk over time.

Coverage and Data Sources

Global coverage and point-in-time calculations

evaDimensions provides cost of capital calculations for over 15,000 companies globally. Our U.S. universe is the union of the S&P 1500 and the Russell 3000, and our global universe is the MSCI All Country World Investible Market Index plus frontier markets (which the MSCI Index excludes), for a total of 77 countries. We compute COC for the shaded countries in **Figure 2**. In measuring the cost of capital back in time to 1998, the universe of stocks and all calculations were constructed on a “point-in-time” basis. We included all companies in the indexes as of a given computation date, including those no longer in existence today due to bankruptcy or acquisition, and we used the financial data that were available as of those past dates. This selection of companies and data reduces survivorship and look-ahead bias.

Figure 2: Country Coverage.

Data Sources

Table 1 summarizes the inputs to our cost of capital model and the data source.

Table 1: Data Sources

Input Data	Modules	Source(s)
Historical index components	All	MSCI, Russell, S&P
Basic accounting data, e.g. market capitalizations	Cost of Equity	S&P Compustat
Stock returns	Cost of Equity, Cost of Debt, Global COC	S&P Compustat
U.S. and other countries stock index returns	Cost of Equity, Global COC	S&P Compustat, Bloomberg
EVA income statement and balance sheet metrics	Cost of Equity, Cost of Debt, Industry Betas, Global COC	EVA Dimensions
Proprietary industry assignments	All	S&P GICS, EVA Dimensions
Bond ratings	Cost of Debt	Moody's
Bond index yields	Cost of Debt	BofA / Merrill Lynch
Tax rates	Industry Betas, U.S. and Global COC	EVA Dimensions, KPMG

Cost of Equity Module

Overview

Our costs of equity are based on the Capital Asset Pricing Model (CAPM), which is based on the idea that a stock that creates more risk in a diversified portfolio requires a higher return. See Sharpe (1964), Lintner (1965), or any corporate finance textbook for a review of CAPM.

In the CAPM, a security's *expected* return is given by the following equation:

$$r_i = r_f + (r_m - r_f) * \beta_i \tag{1}$$

where r_i is the return of security *i,* r_f is the risk-free rate, r_m is the *expected* market return, and β_i is security i's "beta" with respect to the market. Beta is a measure of the degree to which the market exaggerates or dampens a stock's return. Specifically, it is the ratio of the volatility of the security divided by the volatility of the market, multiplied by the correlation of the security with the market. A stock could thus exhibit high volatility but have a low beta if its stock price movements are largely idiosyncratic and uncorrelated with the market. The term ($r_m - r_f$) is called the market risk premium, or MRP. It's the expected return on all market assets, weighted by market value, in excess of the risk-free rate. It is the expected premium return for holding stocks instead of safe bonds over time.

CAPM states that a security's expected return depends solely on its volatility and correlation with the market. Empirical evidence suggests, however, that other factors may affect returns, such as size and valuation (see Fama and French, 1992) and momentum (see Carhart, 1997). It has also long been observed that lower-beta stocks have tended to produce higher returns than would be expected from their betas alone (see Blitz, Falkenstein, and van Vliet (2014) for a recent summary of papers on this effect). However, we exclude any additional factors from our equity return model as a practical expedient because our main goal is to compute a true intrinsic value undistorted by market frictions and biases. To include a momentum factor as an effective reduction in the cost of capital, for example, would be highly cumbersome in practice; it could lead to explosive and unstable valuation estimates, and to the absurd conclusion that the more a stock goes up, the more it should continue to go up, while also missing the inevitable turning points. Rather than amplify bubbles and irrational exuberance, we want our cost of capital to expose them.

There is extensive literature surrounding the appropriate estimation and selection of the parameters in the CAPM. The next few sections discuss our methodologies.

Risk-free rate

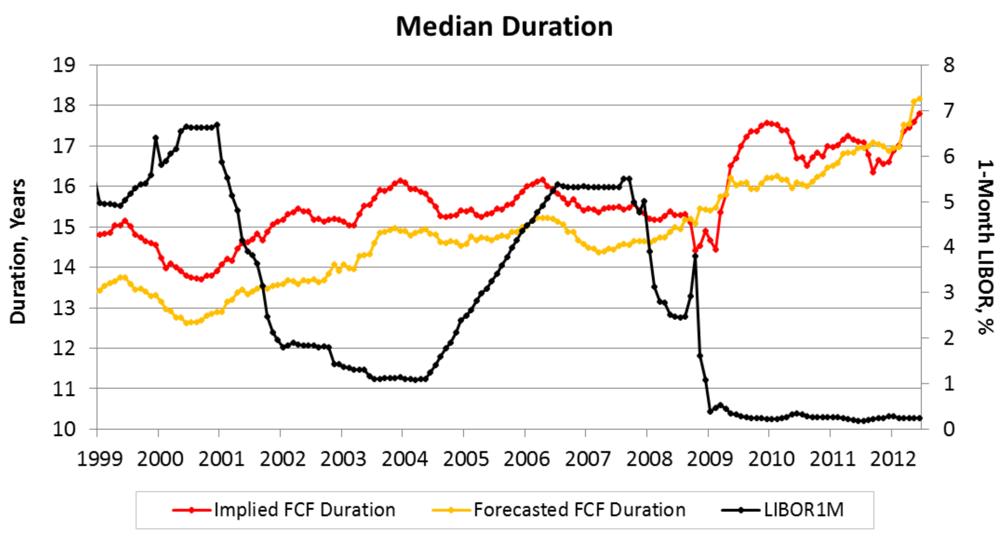
The duration of the risk-free rate should match the duration of company cash flows. We have estimated the duration of company cash flows globally in two ways:

1. We assume that market prices fairly value a company and without systematic biases. We then determine the implied free cash flows which cause the present value at a simple uniform discount rate to equal the current price. We then calculate the duration of those flows.
2. We forecast the convergence of company sales and economic profit margins, assuming that they both fade towards long-term averages. We compute the

resultant free cash flows and their duration. Details of this model are available upon request.

We then compute the median global equity duration and find that from 1999 to 2012, the median cross-sectional duration under both methods has been between 12 and 18 years (see **Figure 3**) despite interest rates varying greatly over this time period. The duration of a 10-year, 5% coupon bond is about 8 years, while the duration of a 30-year, 5% coupon bond is 16 years. We thus choose the yield on 30-year U.S. government bonds as our risk-free rate as it more closely matches the estimated duration of equities.

Figure 3: Median implied company cash flow duration in MSCI ACWI IMI index and 1-month LIBOR.



Calculating betas

We use the following procedure to compute equity betas with the requirement that the betas, weighted by market cap, must average 1.0 across the entire market universe (as must be the case, since the market is comprised of all assets and its correlation to itself is 1.0, by definition). At each historical date, the following steps are taken:

- We compute weekly excess returns, $(r_i - r_f)$, for each stock over the prior 3 years.
- We compute the market return as the cap-weighted average of all stock returns.
- Given those assumptions, the vector of stock betas is given by this equation:

$$\beta = \Sigma w / w' \Sigma w \tag{2}$$

  where Σ is the security covariance matrix and w is a vector of market-cap based security weights in the market. This formula results in betas which will always average 1.0, cap weighted, across the entire market. This important constraint, often overlooked in practice, is necessary to ensure that the aggregate market-wide costs of capital are consistent with the overall market risk premium. It forces industries to be priced relative to one another, so that an increase in beta in one industry must be matched by an offsetting decrease in others.

- Finally, we average each stock's beta with 1.0, assigning a weight of 2/3 to the computed beta and 1/3 to 1.0. This common procedure can be interpreted as incorporating a Bayesian prior into the estimate or as acknowledging that company betas tend to converge to 1.0 over time. It is notable that we observed this in our historical data: high-tech internet betas have cooled over the years as the industry matured, and basic commodity betas have ascended with greater global demand and integration into the global economy.

Market risk premium (MRP)

There is considerable debate over how to estimate the expected stock market return premium over the risk-free rate. For a recent discussion, see the CFA Institute's *Rethinking the Equity Risk Premium* (2011).

We have chosen to set the MRP at a constant 4.0% rate because:

- Our experience shows that 4% leads to reasonable valuations.
- It is close to the average MRP estimates of various academics and practitioners, such as those in the aforementioned CFA publication, and to estimates by the CFOs included in Duke University's annual equity risk premium survey (see Graham and Harvey (2014)).
- It is consistent with the historical actual MRP recorded in global markets. The long-term historical U.S. return has been above 4%, but we believe that figure is misleading. For one thing, the U.S. is a survivor with its homeland untouched through two world wars. More important, the U.S. market over the past 90 years (since 1925) has experienced significant improvements in liquidity, transparency, disclosure, and trading costs, and at the same time national wealth has exploded, all of which suggest the MRP should now be lower than it was. Ironically, an MRP that trends lower would produce an *inflated* measure of risk premium over that time interval, as the ending discount rate is lower than it was at the beginning. Thus, the statistics for the *realized* MRP over the past 90 years are not apt to be an accurate indication of the *expected* MRP looking forward.
- Although it is unlikely that the MRP is truly constant across time, we are unaware of any systematic technique to estimate it accurately. Moreover, even if one existed, using a variable MRP could lead to poor investment decisions. An MRP computed from reverse engineering actual market prices, for instance, appeared to be very low during the internet bubble, at a time when the market was paying enormous earnings multiples across the board. We think it would be better to see the internet bubble not as a result of a vanishingly low MRP but as an intrinsic overvaluation of the market judged against a fundamental 4% MRP.

Cost of Debt Module

Overview

The cost of debt is observable for any company with publicly traded bonds – the cost is the prevailing yield to maturity on the company's bonds. There are several practical problems with using quoted bond yields, however. For one, outstanding bonds may vary in maturity. We are interested in a long-term borrowing cost, matching the aforementioned 16-18 year duration, and there is no guarantee that a given company will have a publicly traded bond of that tenure outstanding. Issue-specific covenants and security or call features also make comparison of yields across companies problematic.

We therefore chose to develop a model that would estimate each company's intrinsic long-term bond rating and estimate its borrowing cost off the credit risk curve. Bond ratings issued by agencies such as Moody's are reasonably accurate and generally accepted indicators of the relative ability of a company to repay its debt on schedule. Individual bonds are rated, and in addition, entire companies are often given a rating indicating the general ability of the issuer to repay long-term obligations. Moody's and other rating agencies publish indexes based on the long-term company ratings. The indexes aggregate all bonds with a given bond rating category and indicate the average prevailing yield to maturity.

Figure 4 depicts the overall cost of debt process from start to finish. We start with a model that uses an array of performance and leverage metrics sourced from our EVA model to predict a company's bond rating, and then the company is assigned a cost of debt that is consistent with its predicted rating category. In this way we can estimate the cost of borrowing for all companies, even those without publicly traded and rated debt. The same model, incidentally, enables us to simulate how a company's bond rating, and ultimately its overall cost of capital, would change as management selected a new capital structure target.

Figure 4: Procedure to estimate the cost of debt.

Modeling bond ratings with EVA metrics

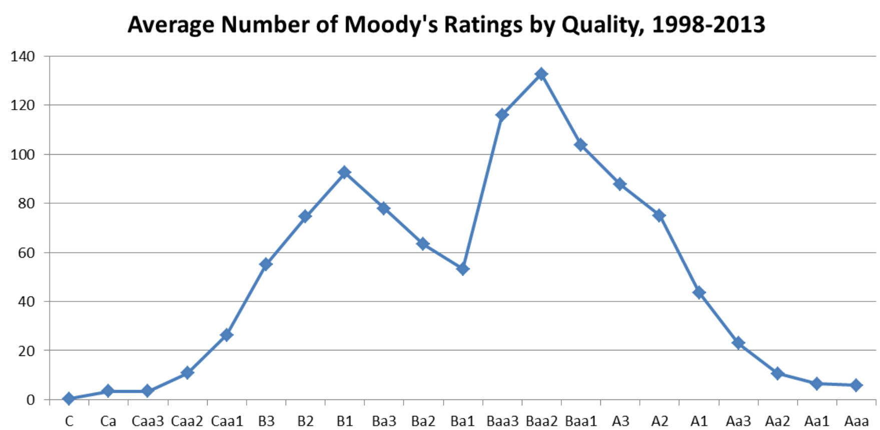
Our bond rating model is a multivariate regression of bond rating scores against various operating and leverage metrics from our EVA framework. First, we use the following table (taken from Moody's) to convert Moody's ratings to numerical scores:

Table 2: Map of Moody's rating to numeric value.

Moody's Rating	Numeric Value
Aaa	750
Aa1	740
Aa2	730
Aa3	720
A1	710
A2	700
A3	690
Baa1	680
Baa2	670
Baa3	660
Ba1	650
Ba2	640
Ba3	630
B1	620
B2	610
B3	600
Caa1	590
Caa2	580
Caa3	570
Ca	560
C	550
WR	510
NR	500

We exclude all companies rated Caa1 (590) or lower. Those companies are in or near default, and the observed yields on their debt are typically extremely high and volatile. We also exclude financial firms. The nature of debt in a financial company is different than in industrial ones, serving as a "raw material" for intermediation as opposed to providing capital for machinery or other real assets. In the EVA framework, for financials, capital is only equity, debt is excluded, and in exchange, interest expense is deducted as an operating cost (technically, it is netted out of revenue). **Figure 5** shows the distribution of long-term company ratings after these exclusions.

Figure 5: Distribution of Moody's long-term company ratings, 1998-2013.



At each historical date, we developed a model to explain the distribution of bond rating scores with a regression against a set of factors sourced from our proprietary EVA database. **Table 3** summarizes the factors, their definitions, and the rationale for including them in the model. Unless otherwise stated, we take 3-year averages and percentile ranks of each variable to handle outliers and to be consistent with prior calculations.

The model posits that a company's bond rating should be a function of its size, as a proxy for track record, resilience, diversification, depth, and political visibility, plus its ability to generate cash to service debt at the low point of its business cycle, as indicated by its risk-adjusted return on capital, offset by its capital structure leverage from all sources, including off-balance-sheet rents, and also offset by its immediate exposure to bankruptcy risk, as indicated by its prevailing (not trailing average) rent-adjusted total liabilities to tangible net worth ratio. Market measures can also cast light on a company's outlook and its risk and improve its predictive power. One such ratio is MVA (for market value added) to capital. To simplify, MVA is the spread between a firm's aggregate market value and its aggregate invested capital. In short, it is a more accurate version of price to book. The greater the MVA, the more confidence investors have in the firm's ability to generate cash flow and sustain profitable growth. Another market measure is volatility in total shareholder return, which indicates uncertainty surrounding the generation of cash flow and profitable growth. Lastly, public utilities are a special case due to rate-of-return regulations and government granted franchise territories that offer additional credit protection.

The regression model is run quarterly at each historical date across all firms with rated debt. The model is run after first converting all the variables into percentile scores, which handles outliers and skewed distributions of the variables. Another step was required for the market measures, because they are in part a reflection of other fundamental factors already included in the model. MVA ratios, for instance, tend to be higher for firms that earn higher returns on capital. And stock price volatility is influenced by the variability in the firm's return on capital and its leverage ratios. To better isolate these effects, the variables actually used in the regression model were the *residuals* of MVA-to-capital and variability in total shareholder return that could not be explained by a regression with the fundamental factors. This eliminates double counting and increases the accuracy of the coefficients placed on the variables in the regression (which also makes the model more reliable for simulating bond ratings as the variables are altered).

Table 3: Factors in the credit rating model.

Factor	Definition	Predicted Direction	Expected Effect and Rationale
Size	Ln(Sales + Capital)	+	Large companies tend to have a long and successful track record over many cycles, possess greater scale, resilience, diversification, depth of management and political visibility. It is the single most important rating factor.
Return on Capital (ROC)	Net Operating Profit After Taxes / Capital	+	A more profitable company generates more cash flow to service debt relative to the capital that must be financed.
Volatility of Return on Capital	Standard Deviation of quarterly ROC observations	-	Companies with more volatile cash flows may be unable to service debts in business cycle troughs.
Free Cash Flow Generation	Free Cash flow / Capital	+	The more "free" cash flow a company generates from its operations, net of all capital spending, the more liquidity is available to service its debts.
Debt Leverage	Senior and Subordinated Debt / Total Capital	-	The higher the debt leverage, the more claims are exerted on corporate cash flows, which lowers the rating
Operating Lease Leverage	Present Value of Operating Rents /Total Capital	-	The present value of operating rents is another form of leverage in the capital structure competing with book debt for repayment out of operating cash flows.
Rent-Adjusted Total Liabilities to Tangible Net Worth	3x Rents + Total Liabilities/ Tangible Net Worth	-	The *prevailing* ratio of all liabilities that would factor in a bankruptcy against a protective tangible net worth cushion (net of goodwill and other intangibles).
MVA Spread	MVA (or enterprise value less capital)/capital	+	The higher the firm's price to book ratio, the more confidence the market is exhibiting in current and sustained profitability and profitable growth.
Volatility of Share Returns	One-year standard deviation of daily stock returns	-	A lower shareholder return volatility indicates the company cash flows are more predictable and the firm is more bankable.
Utilities Flag	1 if company is a utility, 0 otherwise	+	Utilities' returns are protected by regulation and make them a special case and a protected class of creditors.

The coefficient on each factor comes out with the sign posited in the table – the data confirm the intuition. Moreover, the model is highly accurate in predicting the actual ratings assigned by Moody's. Explanatory power (R^2) averages around 73%, F-statistics always indicate regression significance at the 99% level, Fama-Macbeth t-stats on the coefficients indicate significance at the 99% level, and coefficients are generally stable over time. The most significant factors are size, return on capital, and volatility of share price.

Obtaining a cost of debt from the predicted credit rating

The next step is to convert predicted bond ratings into estimated borrowing costs with the following procedure:

- We procure the "credit yield curve" of the average yields prevailing on bonds grouped by rating category, as shown in **Table 4**, and take the three-year averages of the yields to smooth the rates.
- We adjust stated bond yields for expected default losses. The cost of debt that should enter the cost of capital is the *expected* cost of debt, not the quoted yield. Investors buying a portfolio of BBB-rated bonds, for instance, will not realize the prevailing weighted-average bond yield. A portion of the apparent yield will be forfeit as some of the firms end up defaulting on their obligations. To estimate the true cost of capital, therefore, expected credit losses must be deducted from the quoted yields, which are the yields assuming the bonds are held to maturity without default. To do this, we followed a procedure suggested by Shrout (2013). We calculated the expected life of bonds based on their credit rating (higher risk bonds have a lower expected life as more of them default). Next, we computed the realized default loss rates based on life expectancy and net of loss recovery rates by rating category using historical data from 1970-2012. This produced estimates of the net losses by rating category, as shown in **Table 4**, which we deduct from the stated index yields described in the previous step to arrive at the net expected yields by rating category.
- We next create a smooth credit yield curve by interpolating between the distinct rating points using cubic splines, a common method of interpolation. As an example, the curve as of 12/31/2012 is shown in **Figure 6**.
- In the final step, we compute each company's expected long-term borrowing cost from the curve that corresponded to its predicted bond-rating score, with several exceptions. If a company's predicted bond rating is CCC or lower, we assume the cost of debt equals the firm's cost of equity. We also bound the cost of debt to be not lower than the risk-free rate or higher than the cost of equity. **Figure 7** shows predicted yield versus predicted rating for 12/31/2012.

Table 4: Ratings for which credit indexes exist and associated yield adjustments for defaults.

Rating	Adjustment
AAA	0.0080%
AA	0.0180%
A	0.0478%
BBB	0.0972%
BB	0.4340%
B	1.1151%
CCC	2.8525%

Figure 6: Adjusted yield by credit rating and spline fit, 12/31/2002.

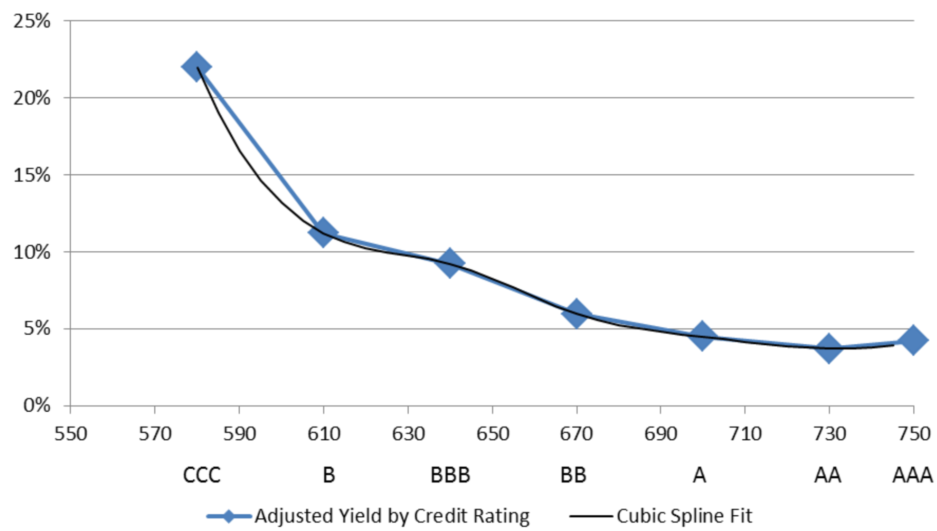
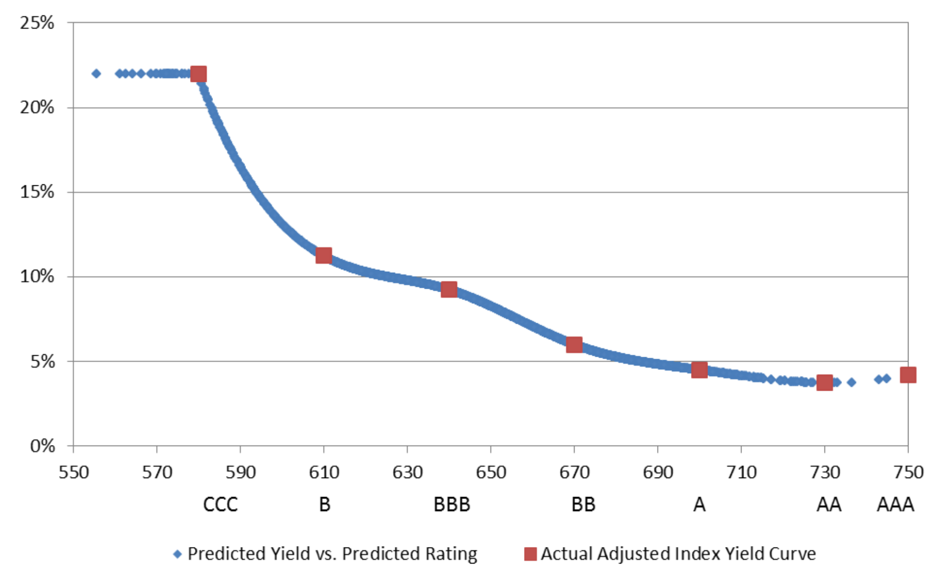


Figure 7: Predicted yield (splines) vs. predicted ratings, 12/31/2002.



Industry Betas Module

Overview

The next steps are to combine the costs of equity and debt into a weighted-average cost of capital in order to extract an underlying cost of capital for the risk in the business (after isolating the effects of leverage and investments in marketable securities), and to compute an average unlevered beta by industry. Recall that we use the industry median beta for each company because the costs of capital estimated for any one company are measured with error. Industry betas provide more stable results that are a better indication of the intrinsic risk in the industry than can be derived from any one company.

Combining costs of equity and debt

We compute each company's weighted-average cost of capital (WACC):

$$WACC_{initial} = COE * \left(1 - \frac{Total\ Debt}{Total\ Capital}\right) + COD * (1 - t) * \frac{Total\ Debt}{Total\ Capital} \tag{3}$$

where *COE* is the cost of equity, *Total Debt*/*Total Capital* is the ratio of total interest-bearing debt plus the present value of leases as a percent of total capital, *COD* is the pre-tax cost of borrowing incremental debt at prevailing rates (not embedded rates), and *t* is the marginal corporate tax rate. After extensive study, we have decided to use (3 year average) book capital leverage instead of market leverage. Book values are a better indication of management's intended target mix to finance investments, and they also eliminate the market value investors often place on risky growth options. In addition, market values can swing wildly at times, even after smoothing. In sum, book values are more appropriate to measure the risk and cost of capital appropriate for profit generating investments in the business. We used a constant 40% marginal corporate income tax rate across the board for the U.S. companies in the universe.

Computing unlevered betas from operations

As demonstrated by Miller/Modigliani, the weighted-average cost of capital is a function of the underlying risk in the business reduced by the tax shield of debt. This leads to a formula to back out the underlying cost of capital for business risk, from which an underlying unlevered beta can be derived, which is in principle the beta the firm would have in the absence of debt. That unlevered beta is in turn a function of the true underlying beta for the firm's business operations blended with, and diluted by, the presumably much lower beta associated with investments in marketable securities. This leads to another formula to back out the effect of investing excess cash in marketable securities to isolate the beta of the underlying business (referred to as beta, unlevered, ops):

$$WACC_{initial,unlevered} = WACC_{initial} \div \left(1 - t * \frac{Debt}{Total\ Capital}\right) \tag{4}$$

$$\beta_{unlevered} = \left(WACC_{initial,unlevered} - r_f\right) \div MRP \tag{5}$$

$$\beta_{unlevered,from\ ops} = \frac{\beta_{unlevered} - 0.25 * \frac{XS\ Cash}{Total\ Capital}}{\left(1 - \frac{XS\ Cash}{Total\ Capital}\right)} \tag{6}$$

In the last formula, *XS Cash*/*Total Capital* is defined as all cash balances above 2% of sales, divided by total capital. It is assumed that all excess cash is invested in marketable securities that have an average beta of 0.25. The formula thus grosses up the unlevered beta to an even higher unlevered beta for business risk. This is an extremely important adjustment for firms like Apple, whose hoards of cash mask the much higher risk in its businesses.

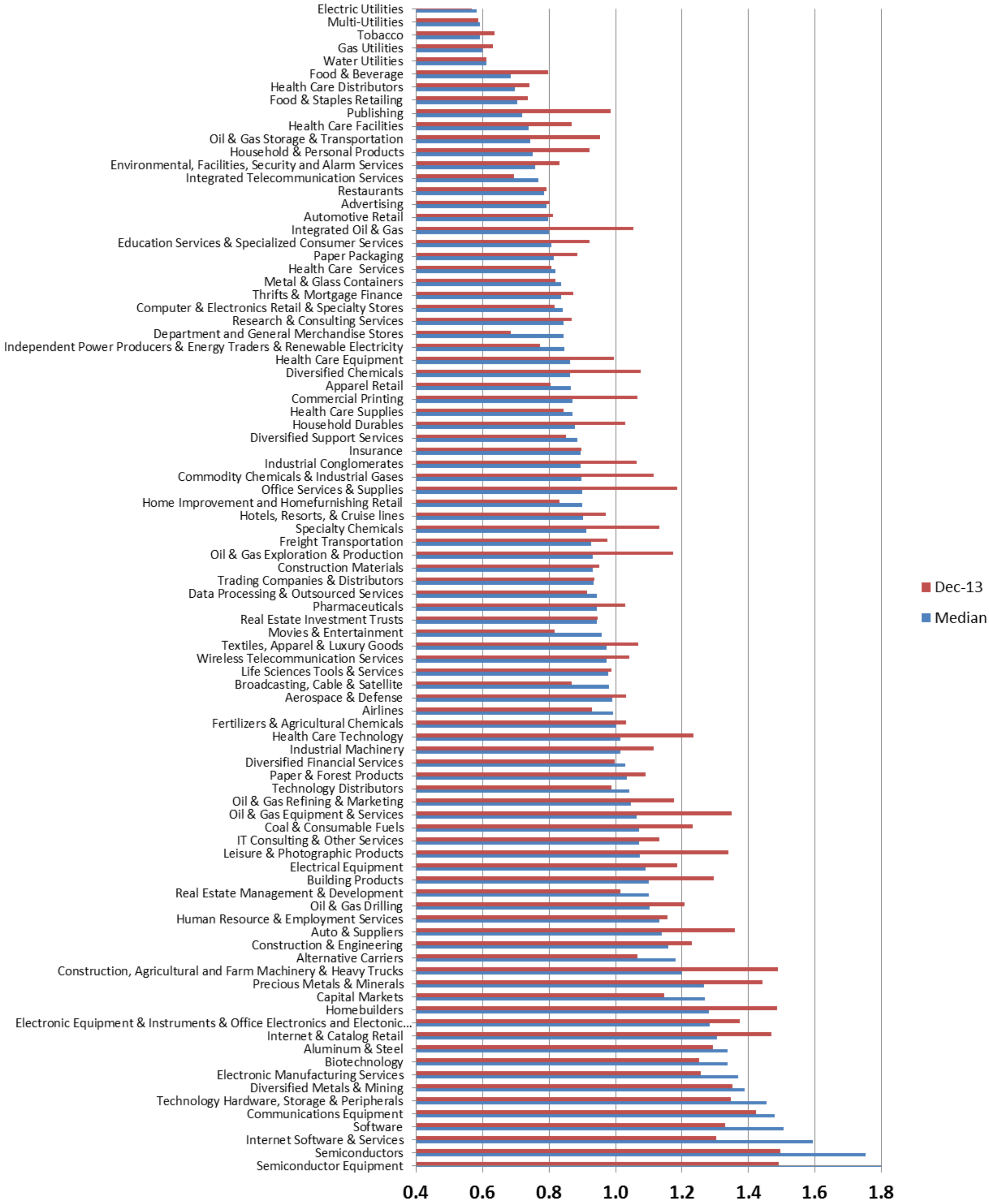
Industry median betas from operations

The next step is to compute the median unlevered beta per industry for each quarter back in time. We use a proprietary set of 121 industry groupings which combine certain small GICs industries and split out others where we feel (and found) there are meaningful distinctions in the underlying business risk. **Figure 8** presents the industry unlevered betas from operations for all non-financial industries (as of 12/31/2013). The red bar is the industry median unlevered beta as of 12/31/2013, and the blue bar is the median of the industry medians from 1999 through 2013. The results are intuitive: industries generally considered riskier and with less stable business models are assigned higher business betas.

Comparing the current betas (in red) to the long run medians (in blue), the tech firms' betas have shrunk considerably over time, and, due to the fact that the average beta must be 1.0 across the market, that necessarily pushed an increase in beta risk into other industries. The industries exhibiting the largest increases in unlevered betas include Oil & Gas, Fertilizer & Agricultural Chemicals, Paper and Forest Products, Building Products, Diversified Metals & Mining, Aluminum & Steel, and Coal and Consumable Fuels. These basic materials companies have apparently become riskier, perhaps because increased global demand has made them more integral to and integrated with the global economy. Autos, Homebuilders, and Commercial Banks have also experienced an increase in operational beta risk, no doubt due to changed perceptions of systemic risk out of the 2008-09 credit crisis.

Our next step was to use a proprietary set of 121 industry groupings which combine certain small GICs industries and split out others where we feel (and found) there are meaningful distinctions in the underlying business risk. At each quarter, we compute the average industry beta over the trailing 40 quarters, and when fewer than 40 quarters exist, we use all available data points. This smoothed unleveraged beta is the one used to compute the cost of capital.

Figure 8: Median (1999-2013) and current (12/31/2013) industry unlevered betas from operations by industry.



U.S. Cost of Capital Module

Putting it all together

The final cost-of-capital estimates flow directly from the unlevered industry betas. For industrial companies, the formula is:

$$COC_{US} = \left(r_f + \beta_{unlevered,from\ ops,industry,smoothed} * MRP\right) * \left(1 - t * \frac{Total\ Debt}{Total\ Capital}\right) \quad (7)$$

We use the term COC here to denote that this is how the actual cost of capital is determined. The weighted-average cost of capital computed before (denoted as WACC) was only an intermediate step to estimate the unlevered cost of capital by industry. Now we assume each company in an industry shares the same underlying unlevered cost of capital for operations.

In sum, a U.S. company's cost of capital is a function of three things. The first is the risk-free rate on 30-year government bonds, which is the same for all companies. Here, we use a 1-year averaging window on the risk-free rate to smooth it while ensuring it is reasonably responsive to interest rate movements. The second is the unlevered beta for the business, which is shared by all the companies in the industry. The third is a discount for the tax benefit of debt financing associated with each company's running 3-year average total debt-to-capital ratio.

Financial companies, such as banks and insurance firms, are treated on an equity-only basis in the EVA Dimensions framework, meaning that capital is restricted solely to the common equity capital, and thus interest expense is netted out of revenue and profits directly rather than through the capital charge. Accordingly, for financials, the formula above is slightly different. It becomes:

$$COC_{US,FINCO} = r_f + MRP * \beta_{financial,Industry,smoothed} \quad (8)$$

The beta is simply the smoothed median of the regular betas out of equation (2) for the companies in the various financial industries (Banks, Capital Markets, Consumer Finance, etc.), after adjusting the betas towards 1.0 and without unlevering them as with industrial companies.

Global Cost of Capital Module

Adding a country premium

The procedure above results in costs of capital for U.S. companies based on an accurate assessment of underlying business risk. Because of the depth and liquidity of the U.S. market, we believe that the business risks estimated for U.S. industries are the best indication of the fundamental risks in those businesses that would apply around the globe. A food company in France, for example, would tend to share the same low risk and underlying beta for business risk as was evident in the U.S. company sample. However, investors might feel that investing in foreign countries entails additional currency risk, inflation and interest risk, political risk, business cycle risk, etc., which would warrant an additional risk premium over and above the cost of capital for U.S. companies.

In fact, there is extensive literature and debate surrounding whether or not a country premium is warranted or exists, and if it does, how to estimate it. If global markets are "integrated," meaning that all investors have access to all global assets, investors could diversify their portfolios in terms of country exposure, and thus country risk would not be compensated. If global markets are "segmented," meaning that investors cannot or do not diversify in terms of country exposure, a country premium would be warranted. Answering the question empirically is extremely difficult due to the fact that foreign financial market data are often very limited in history and volatile. See Damodoran (2012) for a review of arguments for and against country risk premiums.

We have reviewed the various theses and decided it makes sense to include a country risk premium. This is undoubtedly the prevalent view of corporate managers and investment professionals, and it makes sense. Surely two otherwise identical companies, one in the U.S. and one in Russia, will not be viewed the same by investors, and the latter's country risk is not necessarily "diversifiable."

Potential methods of estimating country premiums include:

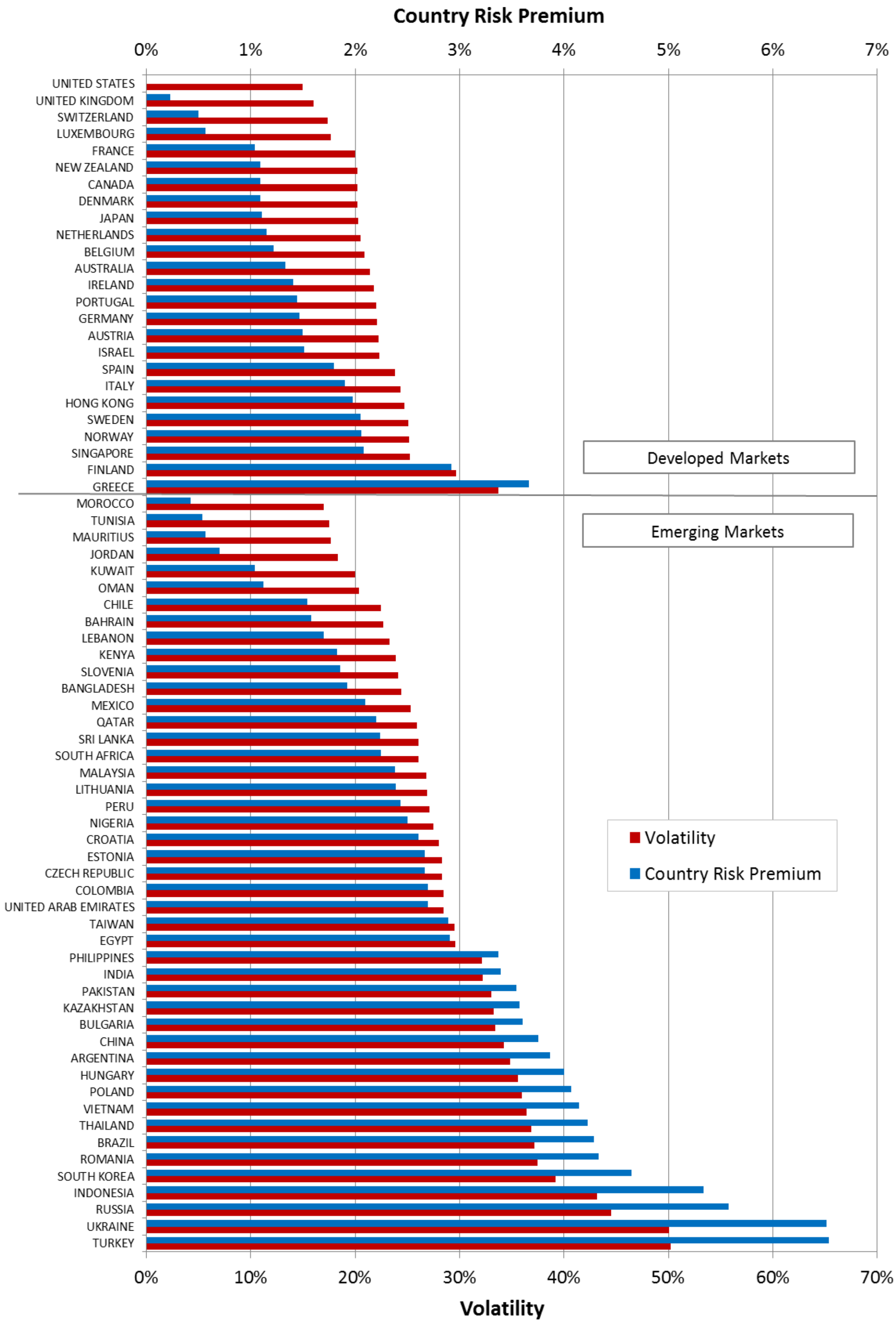
- Using default spreads from the sovereign country CDS market.
- Using sovereign country credit ratings.
- Using sovereign country risk ratings, which are scores designed to capture the risk of countries along dimensions such as political, economic, and financial stability and freedom.
- Using equity market volatilities.

Without elaborating on the pitfalls of the other methods, we decided to use equity market volatilities as a simple, available, and intuitive means of reading country risk. We first define stock market indexes for each foreign country we cover by working down this priority schedule, taking the first with sufficient data as of a given calculation date:

1. The MSCI country index for the given country.
2. The most well-known index corresponding to the given country's main stock exchange. An example is the Kuwait Stock Exchange Price Index for Kuwait.
3. An MSCI regional index which includes the given country and whose other members seem to be of similar risk as the given country. An example is the MSCI Europe for Luxembourg.

To estimate the country premiums (denoted as *CRP* in **Formula (**9)), we compute 3-year annualized volatilities in stock market returns for each market translated into U.S. dollars as a common currency, and convert that into a country risk premium. **Figure 9** shows the average country volatility and the corresponding country risk premiums from 1996 to 2014 for all covered countries. The results are intuitive and generally consistent with how fundamental investors view the risk of investments in foreign countries.

Figure 9: Average volatility of foreign stock markets and country COC adjustment, 1997-2014.



We translate volatilities into the country risk premiums with the following formula:

$$CRP = \left(\left[\frac{.30 * \sigma_{f,avg} + .70 * \sigma_{f,cur}}{.30\ \sigma_{US,avg} +\ .70 * \sigma_{US,cur}}\right]^{0.7} - 1\right) * MRP \tag{9}$$

In the formula, σ_f is foreign stock market volatility and σ_{US} is U.S. market volatility. The subscript *avg* refers to the average volatility since 12/31/1996 and *cur* to the volatility measured as of the date the calculation is being run. The two are blended 30/70, so that the "volatility" used is 30% based on the long run value and 70% on the most recent reading. The fraction in the equation is thus the ratio of foreign market volatility to the U.S. market volatility. It equals 1.0 for the U.S. market or any market with the same volatility (so that the country risk premium is defined to be zero for the U.S. market once 1.0 is netted from the fraction), and the fraction is above 1.0 for markets that exhibit greater volatility than the U.S. market, which in turn translates into a positive country risk premium. As a practical matter, we chose to "dampen" the ratio by raising it to the exponent of 0.7 because we found the raw ratio took on extreme values in certain countries during crisis periods. Finally, the dampened volatility ratio, less 1.0, is multiplied by the 4% market risk premium to measure the country risk premium. We truncate the CRPs to fall between 0% and 8%.

With all ingredients in hand, the final equation for the cost of capital is:

$$COC = \left(r_f + \beta_{unlevered,from\ ops,industry,smoothed} * MRP\right) * \left(1 - t_C * \frac{Total\ Debt}{Total\ Capital}\right) + CRP \tag{10}$$

Global tax rates

In **Equation 10**, the tax rate *t* is subscripted by country (*c*) to stipulate using the local marginal tax rate. We use the corporate tax rate reported per country by KPMG, which can be found at http://www.kpmg.com/global/en/services/tax/tax-tools-and-resources/pages/corporate-tax-rates-table.aspx. In 2014, these rates range from 0% to 55%, although most major countries have rates between 15% and 40%. All else equal, a higher tax rate would increase the value of the tax shield from debt, increasing the value of debt financing and lowering the cost of capital by a greater amount to the extent a firm is leveraged.

Risk-free rate

In **Equation 10**, we use the same 30-year U.S. Treasury rate as the risk-free rate for all companies because we are measuring company results and determining values after translating local currency results into U.S. dollars so as to have a single common currency for comparisons and relative ratings. Moreover, so long as interest-rate parity and purchasing-power parity apply, which means interest rate differentials and exchange rate differentials offset over time, the analysis and valuations should be the same in local currency or in dollars.

Examples

Table 5 shows a cost-of-capital calculation for six companies as an example, computing **Equation 10** for three food companies and three semiconductor companies. All inputs and outputs are in U.S. dollars.

Table 5: Cost of capital inputs example as of 3/31/2014.

Company	Ticker	Country	Industry	RFR	MRP	Smoothed, Unlevered Industry Beta from Operations	Total Debt / Total Capital	Tax Rate	CRP	Cost of Capital
HORMEL	HRL	U.S.	Packaged Foods & Meats	3.6%	4.0%	0.71	3%	40.0%	0.0%	5.9%
DANONE	BN FP	France	Packaged Foods & Meats	3.6%	4.0%	0.71	55%	33.3%	1.5%	6.3%
RUCHI SOYA	RSI IS	India	Packaged Foods & Meats	3.6%	4.0%	0.71	72%	34.0%	2.6%	6.4%
INTEL	INTC	U.S.	Semiconductors	3.6%	4.0%	1.70	12%	40.0%	0.0%	9.8%
ARM HOLDINGS	ARM LN	U.K.	Semiconductors	3.6%	4.0%	1.70	13%	21.0%	0.5%	10.4%
TAIWAN SEMI	2330 TT	Taiwan	Semiconductors	3.6%	4.0%	1.70	18%	17.0%	1.3%	11.1%

Looking Ahead

EVA Dimensions has automated the cost-of-capital analysis procedures outlined above and will use it to update the cost-of-capital *parameters* each quarter. The actual costs of capital used in our rating and valuation models, and to compute EVA, however, will be updated monthly to reflect changes in the underlying risk-free rate on U.S. 30-year bonds and changes in the companies' leverage ratios. We are also committed to staying abreast of conceptual and practical innovations to enhance the model, and welcome feedback from our clients.

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