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We find that expected return differences are short term in nature and become empirically indistinguishable from zero in five years. Our analysis is based on the returns on U.S. stocks, and it thus builds on actual market prices.

When we aggregate expected returns over longer periods of time, we find that they differ much less between firms than is commonly thought. Under plausible assumptions, the standard deviation of the cost of equity per year, a key component in the cost of capital, is just 0.4% across public firms. This means, assuming a normal distribution, about 99% of the firms have their cost of equity within 1% of the market-wide average. Because equity is riskier than debt, one would expect the cost of equity to display more dispersion than the cost of debt, making differences in the weighted average cost of capital even smaller.

This amount of variation is of the order of one-fifth or perhaps only one-tenth of the variation in firms’ discount rates indicated by surveys. Yet, companies appear to think they get their numbers right. According to the Association for Financial Professionals 2013 survey, 89% of surveyed firms think their true cost of capital does not differ more than 100 basis points from their estimate.

Surveys also suggest that many firms apply remarkably different discount rates for risky and safe projects. For example, MIT Professors James Poterba and Larry Summers report that Fortune 1000 companies have on average a 11% within-firm spread in discount rates. This spread is much greater than the spread we find for firms at the opposite ends of the risk spectrum.

Our work informs practice in many ways. It suggests that high-risk firms apply much higher, and low-risk firms much lower, discount rates than they should. And when the discount rate varies within firm, it likely is too high for high-risk projects and too low for low-risk projects. This has profound effects on capital budgeting, valuation practice, and securities analysis.

In what follows, we start by presenting evidence that expected return differences on stocks converge toward zero in a few years. We also show how these differences contribute to a firm’s long-term cost of equity capital and the extent to which they depend on our model assumptions and stock characteristics. We then analyze how these results differ from conventional wisdom and market practice and the way academics teach corporate finance. We conclude by discussing how our results inform capital budgeting, valuation practice, and securities analysis.

Evidence from Market Prices
In the long term, expected stock return differences converge toward zero
We use CRSP return data from January 1963 through December 2018 to study the long-term returns on stocks listed on NYSE, Amex, and Nasdaq. Following standard practice in
empirical finance research, we remove financial firms from our sample and use CRSP delisting returns whenever a firm stops trading.

Our goal is to characterize the behavior of long-term expected stock return differences and the associated differences in the cost of equities across companies. To this end, we match the stock return data with balance sheet and income statement information to construct several return predictors proposed by the academic finance literature. An appendix lists the 55 firm-specific variables we use to rank stocks by their expected returns. We consider three alternative sets of these variables in our empirical tests. The first set contains the complete list of the 55 return predictors. The second set contains the building blocks of Eugene Fama and Ken French’s five-factor model (FF5): the market beta, firm size, book-to-market, asset growth, and operating profitability. The third set consists of the first three predictors listed in the second set, corresponding to the 1993 Fama and French three-factor model (FF3) of expected returns.

We standardize the predictors to make them comparable and sign them so that high values correspond to high average returns based on the original studies proposing these variables. A stock’s expected return score is then the average of its non-missing predictor values. Our goal is to approximate the cost of equity distribution at the firm level. However, the considerable noise contained in single-stock returns would invalidate an analysis using individual companies. To learn more of the firm-level distribution of the cost of equity, which

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we will focus on later in this paper, we sort stocks into 300 portfolios based on their expected return scores. We hold these portfolios unchanged for the next 20 years to examine how the differences in their value-weighted returns evolve over time. We repeat this procedure every sample month to obtain a time series of returns for every holding period starting from month one and ending in month 240.

We display the results from the three sets of return predictors (all predictors, FF5 and FF3). Panels A1 to A3 of Figure 1 show month-by-month average returns of the group of portfolios lying above the 95th ("high") and below the 5th ("low") percentile of the first holding-period month expected return distribution. These returns are noncumulative: the return at horizon \( k \) is an investor’s average return in month \( k \) after portfolio formation. Panels B1 to B3 plot the differences between the high and low portfolio groups’ returns and the associated 95% confidence intervals as a function of the holding month.

Panels A1 and B1 show that if we use all return predictors to rank stocks into groups, there are sizeable average return differences between the high and low expected return groups at the beginning of the holding period. But, over time, the average returns move rapidly toward each other, and already at year five, the return differences between the groups are statistically insignificant. After year 7, no discernible differences remain between the two groups’ performances; their average returns have converged to the common mean across all firms.\(^5\) The rest of the panels display the same pattern in return differences between the groups that are based on the predictions made by the FF5 and FF3 models. Average returns converge even faster for these smaller sets of predictive variables than for the more extensive collection. To give the cost of equity capital the best chance to vary across firms, we henceforth concentrate on the return predictions made by the complete set of variables which produces the slowest convergence in average returns.\(^6\)

In our *Journal of Financial Economics* article, we show that the convergence in average returns is proportional to the convergence in the firm characteristics that have been identified in earlier literature to predict differences in short-term expected returns. For example, due to competition in the product market, a firm that today is at the extreme tail of the profitability distribution is likely to be much closer to the middle of the distribution in five years. Suppose the relative values of the firm characteristics measure differences in either risk or mispricing. In that case, the movement of firms’ characteristics toward the mean of the distribution implies that current differences in risk or mispricing tend to converge toward zero.

As a case in point, consider the stock of Cisco Systems, Inc. In 2000, the company had the highest market capitalization in the world, but it has subsequently matured from a pronounced growth stock to a stock in the middle of the value-growth distribution. We choose six well-known firm characteristics from the complete set of 55 variables and track their behavior from 2004 to 2018.

Figure 2 displays how Cisco’s values on each characteristic have evolved compared to the evolution of these characteristics’ median values calculated across all firms. The row below each panel shows the decile rank of the value of Cisco’s characteristics for 2004, 2008, 2013, and 2018.

A typical pattern observed in Cisco’s characteristics is their tendency to revert toward the mean of the distribution. Some characteristics revert quicker, such as the P/E ratio in the early 2000s (driven by high volatility in earnings and decreasing share price), whereas some stickier characteristics, such as leverage and BE/ME-ratio, show a slower rate of convergence as Cisco over time matured and moved away from being a growth firm. Asset growth, in turn, displays a quick increase relative to other firms at the beginning of the sample, as Cisco had recently written down $2 billion in its inventory and then completed a series of aggressive acquisitions over the following years. Gradually after that, the decreasing number of acquisitions, combined with the growth in Cisco’s balance sheet, led Cisco’s asset growth to revert toward the mean of other firms. Fama and French, among others, find that firm profitability exhibits strong mean reversion.\(^7\)

Panel 3 shows that the mean reversion also applies to Cisco’s operating profitability, driven by increasing international competition and slowing sales around 2010. In their 2007 *Financial Analysts Journal* article, Fama and French report that book-to-market ratios also tend to converge from mean reversion in profitability and expected returns, the latter force experienced by Cisco by means of its lackluster stock performance.\(^8\) Finally, the convergence in market betas is what we would expect based

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4 Our results do not change if we use a smaller number of portfolios (going down to 10, as in the academic version of the paper) or an even larger number (going up to 500). However, when the number of portfolios is large, some of them become thinly populated, sometimes empty, during the longer holding periods. For consistency, we use the same number of portfolios in all analyses.

5 We compute averages of cross-sectionally demeaned returns to remove market-wide variation, which is why the mean return across stocks at each horizon is zero.

6 Although the most complete set of variables includes as many as 55 return predictors, a skeptical reader may wonder whether our return convergence result would be expected to change materially if we used an even larger number of return predictors, including ones that are yet to be discovered. Our *Journal of Financial Economics* article addresses this question by devising a characteristics-free bootstrapping procedure that measures our ability to detect persistent cross-sectional differences in expected returns. We find no evidence of such differences. This speaks against the idea of omitted return predictors changing our conclusions.


flow occurring in the first month back to the beginning of the investment period. Similarly, the average return at month 60 is the rate applied to a cash flow occurring in month 60 to discount it back one period (to month 59). Carrying on with the same logic, if we wanted to discount the cash flow occurring in month 60 back to the beginning of the investment period, the discount rate would be the product of all one-period discount rates starting from month one and ending in month 60. In symbols,

\[
(1+y_T)^T = \prod_{t=1}^{T} (1+r_t), \quad \text{(Equation 1)}
\]

We would use this rate to discount the cash flow occurring in the first month back to the beginning of the investment period. Similarly, the average return at month 60 is the rate applied to a cash flow occurring in month 60 to discount it back one period (to month 59). Carrying on with the same logic, if we wanted to discount the cash flow occurring in month 60 back to the beginning of the investment period, the discount rate would be the product of all one-period discount rates starting from month one and ending in month 60. In symbols,

\[
(1+y_T)^T = \prod_{t=1}^{T} (1+r_t), \quad \text{(Equation 1)}
\]

where \(y_T\) is the rate used to discount a cash flow occurring at time \(T\) back to the beginning of the investment period and \(r_t\) are the successive one-period rates.

We now illustrate how we use the actual term structure of discount rates to estimate the implied costs of equity capital on past literature. It is well known that growth stocks tend to have higher betas than value stocks, and Cisco’s transformation reflects this pattern. Furthermore, other researchers show that, controlling for other determinants, firm age plays a significant role in driving betas toward the sample mean.\(^9\)

**Translating Expected Return Differences into Differences in Average Implied Costs of Equity**

The average return for a given group of firms depicted in Panel A1, Figure 1 at, say, holding period month 1, is an estimate of the (market-adjusted) discount rate prevailing for that group in that month.\(^10\) We would use this rate to discount the cash flow occurring in the first month back to the beginning of the investment period. Similarly, the average return at month 60 is the rate applied to a cash flow occurring in month 60 to discount it back one period (to month 59). Carrying on with the same logic, if we wanted to discount the cash flow occurring in month 60 back to the beginning of the investment period, the discount rate would be the product of all one-period discount rates starting from month one and ending in month 60. In symbols,

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(1+y_T)^T = \prod_{t=1}^{T} (1+r_t), \quad \text{(Equation 1)}
\]

where \(y_T\) is the rate used to discount a cash flow occurring at time \(T\) back to the beginning of the investment period and \(r_t\) are the successive one-period rates.

We now illustrate how we use the actual term structure of discount rates to estimate the implied costs of equity capital.

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10 This computation assumes rational expectations, that is, that the term structure of realized returns we compute equal investors’ year-0 expectations of these returns.
for firms. To make our example conservative, we pick an expected return on the market (10%) that lies at the higher end of reasonable expected market returns and a growth rate (1%) that lies at the lower end of assumed growth rates. In later analyses, we show that assuming a lower expected return and a higher growth rate only strengthens our conclusions.

Table 1 shows some inputs for the calculation. The columns labeled “Year t to year t−1” display the corresponding annual returns on the two groups of portfolios whose monthly returns we plotted in Panel A1, Figure 1.

The value of a financial asset is the sum of its discounted cash flows. The column “cash flows” presents the stream of dividends under the different growth assumptions. We assume a starting dividend of $1 and let the dividends grow annually by either 1% or 5%. The price of the low expected return group, assuming a 1% dividend growth and approximating the infinite time horizon used in equity pricing by 1,000 periods, is then given by Equation 2 below.

\[
P_0 = \frac{1}{1.014} + \frac{1.01}{1.033} + \frac{1.02}{1.046} + \cdots + \frac{2.70}{1.098^{1000}} + \cdots + \frac{20959.16}{1.10^{1000}} = 13.22.
\]  
\text{(Equation 2)}

Finally, knowing the price of the asset, the first dividend, and the dividend growth rate, we can use Gordon's growth model,

\[
P_0 = \frac{D_1}{r-g}
\]  
\text{(Equation 3)}

and solve for the implied discount rate (yield to maturity) or the cost of capital.

The lower part of Table 1 presents the prices and the implied costs of equity for the two expected return groups. When the dividend growth rate is assumed to be 1%, the 90% confidence band for the cost of equity is 2.8 percentage points (pps), i.e. the tails of the expected return distribution are about 1.4 pps from its mean. A higher dividend growth rate further decreases the cost of equity differences. This is because long-dated cash flows, which we discount back at more similar rates, carry now more weight. (As we see later, assuming a lower expected market return has a similar effect, as it too gives more weight to the more distant cash flows.) When the growth rate is 5%, the dispersion in the cost of equity around its mean is now around 0.9 pps for the low and high expected return groups.

We are interested in the cost of equity distribution across firms and how different assumptions drive the shape of the distribution. To study these issues, we apply the steps described above to each of the 300 portfolios sorted on expected returns. The results, computed using four different sets of assumptions, are illustrated in Figure 2. Panel A shows the distribution when the expected market return is set to 10%, and the dividend growth rate is 1%. We see that under these assumptions, 50% of firms have their cost of equity within approximately 0.45 pps from the common mean. Furthermore, 99% of firms have their cost of capital within 1.9 pps from the mean. The standard deviation of the cost of capital across firms is 0.71%.

The distribution of the cost of capital becomes narrower when we increase the assumed dividend growth rate or decrease the market expected return. Increasing the dividend growth rate to 5% (Panel B) lowers the standard deviation to 0.437%, with 99% of firms now having their cost of equity within 1.37% from the mean. The lowest cost of capital variation case we present is based on an expected market return of 6% and dividend growth of 5% (Panel D). Under these assumptions, the standard deviation is 0.10%, and 99% of firms have their cost of capital within 0.37 pps from the mean. The results also imply that for 99% of the firms, the distance between the largest and smallest discount rates within this group is 0.59 pps, indicating almost no variation in the cost of equity.

The results, computed using four different sets of assumptions, are illustrated in Figure 2. Panel A shows the distribution when the expected market return is set to 10%, and the dividend growth rate is 1%. We see that under these assumptions, 50% of firms have their cost of equity within approximately 0.45 pps from the common mean. Furthermore, 99% of firms have their cost of capital within 1.9 pps from the mean. The standard deviation of the cost of capital across firms is 0.71%.

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Table 2 further displays how the standard deviation of the cost of capital behaves when we vary the dividend growth rate and the expected return on the market. We consider situations where the expected return varies from 2% to 10%, and the growth rate varies between 1% and 5%, leaving out unmeaningful pairs in which the growth rate is at least as large as the expected market return. The standard deviation is of the order of 0.4% when the expected market return is 6% and the dividend growth rate is 1% or 2%; when the expected market

11 During the sample period, the annual value-weighted nominal return for U.S. stocks was 11.3% and the risk-free rate was 4.8% (source: Kenneth French's data library). Using Robert Shiller’s data for the U.S. stock market, we calculate that the annual mean dividend growth rate was 6.1% during the same period. Given that the expected market return is the sum of the risk-free rate (which is currently close to zero) and risk premium, we consider 10% a realistic upper bound for the expected market return.

12 Recall that our analysis of the convergence speed of monthly returns was based on demeaned returns. Since we now estimate the cost of equity, we add the expected return on the market of 10% to the annual returns (implying that the mean return and discount rate across stocks is now 10%). In light of the empirical evidence presented earlier, we also assume that the two groups' rates of returns after year 20 have converged to the market-wide mean of 10%. The columns labeled “year t to year 0” show the discount rates that we use to calculate the present value of a cash flow occurring in year t. We obtain these rates by compounding the successive discount rates from year one to year t (see eq. 1).


14 The distribution is not exactly symmetric because the right tail tends to be longer than the left tail for all the cases we study. To be conservative, we refer in the text to the upper limits of the distribution for a given fraction of firms when discussing their discount rates’ maximum distance to the mean.
Table 1
Calculation of the Implied Cost of Equity

We assume that the spreads in low- and high-discount rate firms’ discount rates are those shown in Figure 1 Panel B1. The expected return on the market is 10% per year at all maturities. The discount rates in columns “Year t – 1 to year t” are the per-year rates used to discount cash flows from year t to year t – 1; the rates in columns “Year t to year 0” are the per-year rates used to discount cash flows from year t to year 0. Both firms pay a dividend of $1 next year and these dividends grow at a rate of 1% or 5% per year until year t + 1000. We compute the prices of the low- and high-discount rate firms by discounting the expected dividends back using the term structures of discount rates. A firm’s implied discount rate is\[r = \frac{P}{D} + g,\] where \(P\) is computed using the actual term structure of discount rates.

<table>
<thead>
<tr>
<th>Year t</th>
<th>Discount rates</th>
<th>Year t to year t-1</th>
<th>Year t to year 0 (annualized)</th>
<th>Cash flows</th>
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<tr>
<td></td>
<td>Below 5th percentile</td>
<td>Above 95th percentile</td>
<td>Below 5th percentile</td>
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<tr>
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<tr>
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<td>9.8 %</td>
<td>10.2 %</td>
</tr>
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<td>10.0 %</td>
<td>10.0 %</td>
<td>10.0 %</td>
<td>10.0 %</td>
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</table>

Firm valuations and implied discount rates

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<th>Growth rate</th>
<th>Firm</th>
<th>Price</th>
<th>Implied discount rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 %</td>
<td>Below 5th percentile</td>
<td>13.22</td>
<td>8.56 %</td>
</tr>
<tr>
<td></td>
<td>Above 95th percentile</td>
<td>9.61</td>
<td>11.40 %</td>
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<td>5 %</td>
<td>Below 5th percentile</td>
<td>23.80</td>
<td>9.20 %</td>
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<td></td>
<td>Above 95th percentile</td>
<td>16.99</td>
<td>10.89 %</td>
</tr>
</tbody>
</table>
Figure 3
Distribution of the Implied Cost of Equity

This figure reports the distribution of the implied annual cost of equity under various assumptions. The four panels vary either the expected market return (which is 10% in Panels A and B and 6% in Panels C and D) or the dividend growth rate (which is 1% in Panels A and C and 5% in Panels B and D). The distributions are based on computations similar to those in Table 1.

Panel A
\( rm=10\%, \; g=1\% \)

Panel B
\( rm=10, \; g=5\% \)

Panel C
\( rm=6\%, \; g=1\% \)

Panel D
\( rm=6\%, \; g=5\% \)
Most valuations made by investment banks are proprietary, but we can get a glimpse of the assumptions behind them by studying the filings of publicly traded companies with the Securities and Exchange Commission (SEC). To avoid time varying cost of capital to affect the estimates of its variation, we focus on Form S-4 filings over a recent three-month window. Firms need to file S-4 forms with the SEC to disclose any material information related to a merger or acquisition. Table 3 summarizes these data.

The results suggest the discount rates vary a lot across firms. For public firms, the standard deviation of the average cost of capital is 2.1%, that is, about five times the standard deviation we estimate for the cost of equity. The standard deviations of the high and low estimates are 2.7% and 1.7%, indicating that the discount rates are skewed to the right. The average difference between the high and low estimate is 1.7%. Thus, investment banks build in a lot of uncertainty in their cost of capital estimates.

Private firms exhibit even greater variation in the company cost of capital than public firms, and their average cost of capital is also much higher. The standard deviation is 7.7%, that is, about 20 times the standard deviation we estimate for the expected return on stocks. Although most of the observations in the Balakrishnan et al. study come from the 2015-2017 period, the long sample period necessarily reflects varying cost of equity. As a result, any comparison between their and our study must be interpreted with caution.

**Table 2**

### Standard Deviation of Implied Cost of Equity

This table reports the standard deviation of the implied annual cost of equity under various assumptions. The table shows the standard deviation when the expected market return varies from 2% to 10% (rows), and the dividend growth rate ranges from 1% to 5% (columns). The inputs to computing the standard deviations come from an application of the calculations illustrated in Table 1. In the table, “Not meaningful” parameter pairs refer to those in which the dividend growth rate is at least as large as the expected market return.

<table>
<thead>
<tr>
<th>Expected market return, $r_m$</th>
<th>1%</th>
<th>2%</th>
<th>3%</th>
<th>4%</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>0.10%</td>
<td>Not meaningful</td>
<td>Not meaningful</td>
<td>Not meaningful</td>
<td>Not meaningful</td>
</tr>
<tr>
<td>4%</td>
<td>0.29%</td>
<td>0.20%</td>
<td>0.10%</td>
<td>Not meaningful</td>
<td>Not meaningful</td>
</tr>
<tr>
<td>6%</td>
<td>0.45%</td>
<td>0.37%</td>
<td>0.28%</td>
<td>0.19%</td>
<td>0.10%</td>
</tr>
<tr>
<td>8%</td>
<td>0.58%</td>
<td>0.51%</td>
<td>0.44%</td>
<td>0.36%</td>
<td>0.28%</td>
</tr>
<tr>
<td>10%</td>
<td>0.71%</td>
<td>0.64%</td>
<td>0.58%</td>
<td>0.51%</td>
<td>0.43%</td>
</tr>
</tbody>
</table>

**Investment Banks**

Most valuations made by investment banks are proprietary, but we can get a glimpse of the assumptions behind them by studying the filings of publicly traded companies with the Securities and Exchange Commission (SEC). To avoid time varying cost of capital to affect the estimates of its variation, we focus on Form S-4 filings over a recent three-month window. Firms need to file S-4 forms with the SEC to disclose any material information related to a merger or acquisition. Table 3 summarizes these data.

The results suggest the discount rates vary a lot across firms. For public firms, the standard deviation of the average cost of capital is 2.1%, that is, about five times the standard deviation we estimate for the cost of equity. The standard deviations of the high and low estimates are 2.7% and 1.7%, indicating that the discount rates are skewed to the right. The average difference between the high and low estimate is 1.7%. Thus, investment banks build in a lot of uncertainty in their cost of capital estimates.

For example, the high discount rate applied by an investment bank to Mullen Technologies, an electronic vehicle company, is 8% and the dividend growth rate is 3% or 4%; or when the expected market return is 10% and the dividend growth rate is 5%. We consider these parameter pairings as reasonable assumptions and use the resulting standard deviation of 0.4% of the implied cost of equity as base case in our subsequent analysis.

**Conventional Wisdom on Cost of Capital Differences**

Conventional wisdom suggests that cost of capital differences are much larger than the ones implied by our evidence. Below, we review conventional wisdom on cost of equity and cost of capital from different angles.

**Analyst Reports**

One can learn of analysts’ views on firms’ cost of equity directly from their reports. Using textual analysis on over 31,000 analyst reports from the 2001-2017 period, accounting scholars Karthik Balakrishnan, Lakshmanan Shivakumar, and Peeyush Taori find a mean cost of equity of 10.11% with a range from 5.00% to 19.85%. The standard deviation of the cost of equity is 2.35%, that is, about six times the standard deviation we estimate for the expected return on stocks. Although most of the observations in the Balakrishnan et al. study come from the 2015-2017 period, the long sample period necessarily reflects varying cost of equity. As a result, any comparison between their and our study must be interpreted with caution.

Although the observations on actual discount rates are case-based by necessity, they shed light on the range of discount rates courts deem plausible. Delaware courts have adopted the discounted cash flow (DCF) method as their preferred method of valuation for operating companies. Experts in most Delaware appraisal cases use the CAPM to calculate the weighted average cost of capital (WACC) for their DCF analyses. This has the potential of generating large variation in discount rates. For example, in the case of Cell Tech, the court accepted a 30% discount rate calculated using the CAPM. In another case, the court accepted a beta of 3.35 for a thinly traded limited partnership unit. Alternative approaches to determining the cost of capital can generate even larger discount rates. In one case appraising a small biotech company, the court used a venture capital discount rate of 50%.

Delaware courts have also accepted the evidence from the academic finance literature that small stocks command higher expected returns than large ones. The size premium for the cost of equity can be sizeable: in the Emerging Communications case, for example, the court accepted a premium of 1.7%. This premium is about four times the standard deviation of the expected return on stocks in our analyses.

Firms
Surveys give an idea how firms compute their cost of capital and how accurate they think their estimates are. The Association of Finance Professionals (AFP) 2013 survey finds that 85% of the surveyed firms use the CAPM to calculate their

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**Table 3**

<table>
<thead>
<tr>
<th>Cost of Capital in Fairness Opinions</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>The sample is on Form S-4 filings of publicly traded firms registered with the Securities and Exchange Commission in the period from April to June 2021. Firms are required to file these forms to register any material information related to a merger or acquisition. We require the fairness opinion on a firm to include information on its company cost of capital. The sample includes 53 fairness opinions on 27 publicly traded non-financial firms. In addition, 20 of the fairness opinions refer to a listed company’s acquisition or merger with a company that is not publicly traded on the NYSE, AMEX, or Nasdaq. Such fairness opinions exist for 17 private non-financial firms. When a firm has more than one fairness opinion, either because more than one bank has evaluated the firm or because its units have been evaluated separately, we take the equally weighted average of the cost of capital. All fairness opinions include both a high and low estimate.</td>
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<tr>
<th>Cost of capital</th>
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</thead>
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<tr>
<td></td>
<td>Mean (Std. dev.)</td>
<td>N</td>
</tr>
<tr>
<td>High estimate</td>
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<td>Low estimate</td>
<td>8.3% (1.7%)</td>
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</tr>
<tr>
<td>Average estimate</td>
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</tr>
<tr>
<td>High-Low difference</td>
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Courts
Many valuation disputes end up being litigated in the courts, which have to take a stand on the plausibility of the assumptions behind the valuations, including discount rates. Here, we draw lessons on the discount rates from court practice in the state of Delaware, summarizing some of the observations from the much longer review by Gilbert Matthews in 2014.

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Textbooks
Finance practice is shaped by finance education, which again draws from textbooks. Valuation and corporate finance textbooks generally discuss the mechanics of valuation in detail but allocate very little space to the variation of discount rates, not to mention their convergence. As a result, the view students get on the topic likely comes from examples, which are meant to illustrate the mechanics of a concept, like the CAPM, and not necessarily serve as a realistic description of the world. These examples may build in a 4%-5% spread in the expected returns on two stocks, which is a very high figure in the light of our evidence.20

The most transparent example of the variation in the cost of capital we could find comes from Aswath Damodaran,21 perhaps the most prolific author of valuation textbooks. He estimates that in the beginning of 2016, the lowest 10% of U.S. public companies had a cost of capital of 5.23% and the largest 10% had a cost of capital of 10.00%.22 In his view, “the spread in costs of capital is surprisingly small.” We agree but deem the spread smaller still. The spread between the top 10% and bottom 10% of the firms in the cost of capital in Damodaran’s calculations is over four times as large as the comparable spread in the cost of equity in our calculations.

We do not mean to say that Damodaran would not understand the forces at play. Although he does not allocate much space to expected return convergence, he does caution that the cost of capital tends to change as firms change. For example, he explicitly suggests “there is a strong tendency toward mean reversion in implied equity premiums.” He also suggests that “small cap premiums (and other premiums, where applicable) fade over time as firms’ market cap (or other aspect) grows (or diminishes, depending on the type of the premium).” We think the biggest difference in his and our thinking comes from how fast the discount rates converge. The speed of convergence has strong implications on the discount rate variation.

How Our Results Inform Practice
Our work suggests that analysts, investment banks, courts, and firms tend to apply more extreme discount rates than they should. As we discuss in this section, an important reason for this is that many practitioners use the CAPM to assess expected returns. Yet, it is well known that CAPM does not fit the data: the empirical security market line, which represents the association between historical betas and average returns, is too flat.23 As a result, high-beta stocks tend to be associated with too high expected returns and low-beta stocks with too low expected returns. This has profound effects on capital budgeting, valuation practice, and securities analysis. We will discuss these implications in turn.

Capital Budgeting
Miscalibrated discount rates can have a significant effect on investment. If the discount rate differences within a firm are too small to reflect divisions’ risk differences, perhaps because the same firm-level discount rate is used to evaluate all projects, the investments of higher-risk divisions are encouraged and those of lower-risk divisions are discouraged.24 But the discount rate differences between different projects may also be much larger than what their risk differences would justify. In their 1995 survey of Fortune 1000 companies, MIT professors James Poterba and Larry Summers report on discount rate differences between risky and safe projects within the same firm.25 The average within-firm spread is

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21 Professor of Finance at New York University’s Stern School of Business.
as large as 11%, which is much greater than the expected stock return spread we find for firms at the opposite ends of the risk spectrum. Although we caution that individual projects are different from the entire firms we study, the evidence in the Poterba and Summers survey nevertheless raises the question whether existing firm practices discourage risky investment and encourage low-risk investment. Aggregated over all firms, such practices could lead to too little risk capital being formed in the economy.

Valuation
Survey evidence suggests that the vast majority of firms use the CAPM for estimating the cost of equity. This results in much greater variation in firms’ estimated cost of equity than we find is implied by market prices. Prospective corporate investors who falsely take the discount rate from the CAPM are likely to undervalue acquisition targets with high beta risk—i.e., those which CAPM predicts have high discount rates—and overvalue acquisition targets with low beta risk. This not only can affect the price firms are willing to pay for other firms, but potentially also which firms are more likely to acquire or be acquired.

In their 2021 MIT Working Paper, Nicolas Hommel, Augustin Landier, and David Thesmar test how good various valuation techniques are at explaining the cross-section of equity prices. They find that valuation methods that rely on discount rates computed using the CAPM generate poor predictions of equity values. Even a simple constant multiple of forecasted earnings does better as a valuation tool.

In their 2021 paper, Olivier Dessaint and others test how the poor performance of the CAPM shows up in M&A data. They find that bids for low-beta private targets generate negative bidder returns and those for high-beta targets positive bidder returns. This suggests that firms are willing to buy low-beta assets at prices the market deems too high. The authors estimate that the value discrepancy arising from using the wrong discount rate corresponds, on average, to 23% of deal value.

Applying a wide range of discount rates makes it possible to justify a wide range of outcomes. Law and finance professors Matthew Cain and David Denis find that in target-side fairness opinions, the high-minus-low valuation range is on average 60% of the offer price. Applying a large spread of discount rates makes it easier to write an opinion that is consistent with the offer price as being fair to the target shareholders—regardless of the merits of the offer. Correspondingly, imposing more discipline in the range of discount rates would make it harder for investment banks to influence the outcome of their recommendations by tinkering with the discount rate assumptions.

Courts also tolerate a wide range of discount rates and thereby of awards. We would expect a greater range of award outcomes to have an effect on the incentives of the litigants: whether to litigate in the first place, how much to invest in the litigation, and what kind of fact finding to focus on in the trial. Likewise, we would expect a narrower range of accepted discount rates to decrease the expected cost of litigation and channel the fact-finding efforts to matters other than discount rates.

Securities Analysis
Our findings have important implications on how to interpret sell-side analyst forecasts. Analyst forecasts inform on the cost of equity in two distinct ways. On the one hand, the forecasts occasionally include direct cost of equity estimates by equity analysts as shown in the 2021 paper by Balakrishnan and others. On the other hand, one can use analyst forecasts to compute the implied cost of equity—i.e., the internal rate of return—at which the present value of forecasted earnings equals current stock price. Past research finds much larger differences in the implied cost of equity than what we find. For example, accounting scholars and investment practitioners William Gephardt, Charles Lee, and Bhaskaran Swaminathan document a 11% difference in mean implied risk premiums between the top and bottom quintile of firms.

To better understand why our cost of equity figures vary much less than those in the implied cost of equity literature, consider how equity analyses are being conducted. In 2020, University of Zurich professors Liliya Mukhlynina and Kjell Nyborg find that the CAPM is the method analysts most often use to calculate discount rates. Given that historical betas are unrelated to subsequent returns, this has the potential of making analysts undervalue high-beta stocks and overvalue low-beta stocks.

53. In fact, this miscallibration of the cost of equity is more general and is likely to arise even when the practitioner uses some other model than the CAPM. If a model predicts sizeable differences in short-term expected returns, and these predictions are used to estimate the cost of equity, the outcome cannot be compatible with the data.


Discounted cash flow calculations are only as good as their inputs. Many practitioners spend a considerable amount of effort in fine tuning their cost of capital estimates, yet end up with estimates that differ too much from the crowd. We think that they would be better off by satisfying with a simple, heavily shrunk estimate of the discount rate and getting the predicted cash flows as right as possible.

Matti Keloharju is Aalto Distinguished Professor at the Aalto University School of Business. He is also a Research Fellow of the CEPR and a Research Affiliate of the IFN.

Juhani Linnainmaa is Professor of Finance at Tuck School at Dartmouth College. He is also a Research Associate of the NBER and a Researcher at Kepos Capital, L.P.

Peter Nyberg is Associate Professor of Finance at the Aalto University School of Business.

Getting Things Right

The fact that many firms get their cost of capital wrong does not mean they have to. The similarity of firms' cost of equity in our analyses suggests that many firms can actually have better cost of capital estimates than they currently do without investing more in their estimation. Because there is little cross-sectional variation around the mean cost of equity, even the stock market's expected return would not be a bad estimate for most firms.

If one uses the CAPM to estimate the cost of equity, it is important not to apply estimated betas naively, as this is bound to generate too much variation in the cost of equity. Because beta estimates include estimation error and because betas tend to revert to their mean in the long term, Levi and Welch recommend decreasing the variation in the beta estimates by shrinking them twice before applying them to cost of capital calculations. This procedure significantly decreases the cost of capital differences between firms.

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Appendix: Return Predictors

This table reports the 55 return predictors we use to sort portfolios. We group predictors into fundamental, event, market, and valuation subgroups using the McLean and Pontiff (2016)\textsuperscript{35} classification scheme.

<table>
<thead>
<tr>
<th>Fundamental</th>
<th>Event</th>
<th>Market</th>
<th>Valuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross profitability</td>
<td>Inventory growth</td>
<td>52-week high</td>
<td>Earnings-to-price</td>
</tr>
<tr>
<td>Piotroski’s F-score</td>
<td>Net working capital changes</td>
<td>Amihud’s illiquidity</td>
<td>Enterprise multiple</td>
</tr>
<tr>
<td>Abnormal investment</td>
<td>Share issuance, 1 year</td>
<td>Market beta</td>
<td>Sales-to-price</td>
</tr>
<tr>
<td>Leverage</td>
<td>Share issuance, 5 years</td>
<td>Idiosyncratic volatility</td>
<td>Book-to-market</td>
</tr>
<tr>
<td>Accruals</td>
<td>Sustainable growth</td>
<td>Industry momentum</td>
<td>Advertising-to-price</td>
</tr>
<tr>
<td>Net operating assets</td>
<td>Total external financing</td>
<td>Long-term reversals</td>
<td>R&amp;D-to-price</td>
</tr>
<tr>
<td>O-score</td>
<td>Industry-adjusted CAPX growth</td>
<td>Maximum daily return</td>
<td>Cash flow-to-price</td>
</tr>
<tr>
<td>Sales growth</td>
<td>Inventory growth rate</td>
<td>Intermediate momentum</td>
<td>Nominal stock price</td>
</tr>
<tr>
<td>Asset growth</td>
<td>Earnings surprise (SUE)</td>
<td>Nominal stock price</td>
<td>High volume premium</td>
</tr>
<tr>
<td>Z-score</td>
<td>Earnings surprise (CAR3)</td>
<td>Share volume</td>
<td>Cash volume</td>
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<tr>
<td>Investment-to-capital</td>
<td></td>
<td>Coskewness</td>
<td>Coskewness</td>
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<td>Firm size</td>
<td>Fundamental</td>
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<tr>
<td>QMJ profitability</td>
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<td>Operating profitability</td>
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<td>Valuation</td>
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<tr>
<td>Operating leverage</td>
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<tr>
<td>Tax-to-price</td>
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<tr>
<td>Cash-based operating profitability</td>
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<td>Return on assets</td>
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<tr>
<td>Return on equity</td>
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<td></td>
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<tr>
<td>Asset turnover</td>
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