# Firms' Perceived Cost of Capital*

Niels Joachim Gormsen and Kilian Huber

January 2025

**Abstract**

We study hand-collected data on firms' perceptions of their cost of capital. Firms with higher perceived cost of capital earn higher returns on invested capital and invest less, suggesting that the perceived cost of capital shapes long-run capital allocation. The perceived cost of capital is partially related to the true cost of capital, which is determined by risk premia and interest rates, but there are also large deviations between the perceived and true cost of capital. Only 20% of the variation in the perceived cost of capital is justified by variation in the true cost of capital. The remaining 80% reflects deviations that are consistent with managers making mistakes. These deviations lead to misallocation of capital that lowers long-run aggregate productivity by 5% in a benchmark model. Forcing all firms to apply the same cost of capital would improve the allocation of capital relative to current corporate practice. The deviations in the perceived cost of capital challenge standard models, in particular the production-based asset pricing paradigm, and lead us to reject the "Investment CAPM." We describe actionable methods that allow firms to improve their perceptions and capital allocation.

*Keywords*: cost of capital, misallocation, production-based asset pricing
*JEL classification*: G1, G10, G12, G31, G32, G40

*We thank John Campbell, Thummim Cho, Kent Daniel (discussant), Gene Fama, Xavier Gabaix, Robin Greenwood, Sam Hanson, Tarek Hassan, John Heaton, Chang-Tai Hsieh, Ralph Koijen, Eben Lazarus, Christian Leuz, Lira Mota, Tyler Muir, Stefan Nagel, Lasse Pedersen, Thomas Philippon, Andrei Shleifer, Amir Sufi, Adi Sunderam, David Thesmar, Rob Vishny, Annette Vissing-Jorgensen, and Ivo Welch as well as many seminar and conference participants for useful comments. The research was supported by Asness Junior Faculty Fellowship, the Fama Faculty Fellowship, the Fama-Miller Center, and the Lee Economics Program Faculty Fellowship at the University of Chicago. We thank Rahul Chauhan, Sonali Mishra, and Esfandiar Rouhani for outstanding research support. This paper is a substantially revised version of an earlier paper entitled "Equity Factors and Firms' Perceived Cost of Capital." Both authors are at the University of Chicago, niels.gormsen@chicagobooth.edu and kilianhuber@uchicago.edu

# 1 Introduction

According to standard theory, firms should invest in all projects for which the expected return exceeds the cost of capital. In theory, this straightforward investment rule leaves little room for error. In practice, however, the rule is complicated by the fact that firms cannot directly observe their cost of capital. The cost of capital depends on the returns that financial investors expect to earn from holding a given firm's debt and equity. Since estimating these expected returns is notoriously difficult, firms' perceptions about their own cost of capital may deviate from their "true" cost of capital. Such deviations would distort investment decisions, lead to misallocation of capital, and reduce aggregate output.

In this paper, we study hand-collected data on firms' perceived cost of capital. The perceived cost of capital predicts firms' long-run capital allocation in line with theory, but it deviates substantially from firms' true cost of capital. These deviations lead to capital misallocation and reduce aggregate total factor productivity by around 5% in a standard model. Forcing all firms to use an identical cost of capital would improve the allocation of capital. The observed variation in the perceived cost of capital is at odds with production-based asset pricing and, more generally, conventional investment models. While estimating the cost of capital is inherently difficult, we present actionable alternatives that would improve firm perceptions and capital allocation.

A firm's perceived cost of capital can be written as the "true" cost of capital plus an error term:

$$r^{\text{perc.}} = r^{\text{true}} + \upsilon. \tag{1}$$

We define the true cost of capital as the expected return on the firm's outstanding debt and equity in financial markets, adjusted for the tax benefits of debt. This is the textbook definition of the cost of capital that is used in most academic work and widely taught to practitioners (see, e.g., Welch 2011). The term $\upsilon$ captures deviations from this true cost of capital. Standard models assume that firms have perfect information about their true cost of capital and use it in their investment decisions, so that there are no such deviations in firms' perceptions. We use novel data to document large deviations and study their economic implications.

We measure firms' perceived cost of capital using data from corporate conference

calls between firm managers, financial investors, and analysts (see, e.g., Hassan et al. 2019 for the use of conference calls in economics). During these calls, managers occasionally share their internal perceptions of their cost of debt, equity, and total capital. We collect the data through manual reading of call transcripts. The data contain around 2,500 large firms from 2002 to 2022. The sample is generally representative of the listed firm population except for a skew toward large firms, which implies that firms for which we observe the perceived cost of capital capture roughly 40% of the total assets of Compustat firms in advanced economies. The conference call data are useful because the perceived cost of capital is not observed in publicly available data.

We verify that these data on the perceived cost of capital are related to long-run capital allocation in line with standard models. We find that, in the long run, firms with a higher perceived cost of capital have a higher return on invested capital, lower investment rate, and lower capital-labor ratio. These results suggest that the perceived cost of capital reported on conference calls is used for long-run capital allocation in line with standard models. We emphasize, however, that these findings refer to firms' long-run capital allocation decisions: in the short run, changes in the perceived cost of capital have limited impact on firm investment because of stickiness in firms' required returns on new investments (see Gormsen and Huber 2024 and Fukui et al. 2024).

We begin by documenting stylized facts about which factors shape the perceived cost of capital. In the time series, firms largely incorporate time variation in the equity risk premium and interest rates correctly. In the cross section of firms, the perceived cost of capital is related to a firm's market beta, market capitalization, and valuation ratio, which are the traditional risk factors in the Fama and French (1993) model. The perceived cost of capital also falls with leverage due to the tax benefits of debt. Going beyond the traditional factors, firm age, reliance on external finance, and other measures of risk are also associated with the perceived cost of capital.

We next test whether the perceived cost of capital is equal to the true cost of capital. The true cost of capital is given by the expected returns on the firm's debt and equity, so the perceived cost of capital has to be an unbiased estimate of these expected returns in order to equal the true cost of capital. We use a standard asset pricing technique to analyze whether the perceived cost of capital is indeed an unbiased estimate of expected returns. This technique allows us to test for bias in estimates of expected returns even though we do not observe true ex ante expected returns. In particular, we exploit that an unbiased estimate of expected returns must

predict future realized returns with a slope coefficient of one. We strongly reject this hypothesis for the perceived cost of capital. This finding implies that firms' perceived cost of capital is not equal to the true cost of capital.

We quantify to what extent the perceived cost of capital deviates from the true cost of capital through a simple variance decomposition. We implement the decomposition based on the same asset pricing technique as well an additional technique relying on firms' "implied cost of capital." We find that only 20% of the variation in the perceived cost of capital can be justified by variation in the true cost of capital. The remaining 80% is driven by deviations from the true cost of capital (i.e., the error term in (1)). We refer to this variation as "excess dispersion" because it would not exist in standard models. Standard models assume that firms base their cost of capital on expected returns and that firms have perfect knowledge about the properties of the distribution of returns. Since firms have perfect knowledge about the distribution of returns, they can perfectly calculate their true cost of capital in real time, so there should be no excess dispersion.

The excess dispersion in the perceived cost of capital is apparent from summary statistics alone. The 10-90 percentile range in the perceived cost of equity is 8 percentage points. This is a large spread relative to the typically estimated variation in long-run expected returns. The annualized ten-year return on the value factor—a prominent example of cross-sectional variation in long-run stock returns—is around 2%. It is therefore not surprising that the large cross-sectional variation in the perceived cost of equity cannot be justified by variation in the true cost of equity (see, e.g., Daniel et al. 2020 for a discussion of cross-sectional variation in long-run returns).

We present four additional facts to shed light on the nature of the excess dispersion in the perceived cost of capital. First, we show that the excess dispersion is driven by the perceived cost of equity and that there is essentially no excess dispersion in the perceived cost of debt. Second, the excess dispersion is not solely due to firms using the CAPM or other standard models with known problems. Rather, the excess dispersion is equally large in the part of the perceived cost of capital that is not spanned by standard risk factors, implying that non-standard terms added by firms increase the bias generated by standard models even more. Third, the excess dispersion arises from persistent differences in the perceived cost of capital across firms, as opposed to time variation in the perceived cost of capital. Finally, the excess dispersion is marginally less pronounced for large firms and firms more dependent on external finance, but we

find no other significant dimensions of heterogeneity across firms.

We verify that our results are not driven by measurement error in the perceived cost of capital. We can rule out that the data on firm perceptions are subject to general measurement error because we find no excess dispersion in the perceived cost of debt. We further verify that measurement error does not drive our results by using an instrumental variable approach and by analyzing the relation between the perceived cost of capital and realized returns on invested capital. In our data collection, we take care to only record explicit mentions of the firm-level cost of capital, rather than other objects related to financing, to avoid measurement error from such misclassification.

Given how difficult it is to estimate the true cost of capital, one may wonder whether it is possible to avoid excess dispersion in the perceived cost of capital. Avoiding excess dispersion does not require that the perceived cost of capital exactly equal the true cost of capital, but only for it to be an unbiased estimate of the true cost of capital. Constructing such an unbiased estimate is a difficult, yet not insurmountable challenge. We accordingly introduce two methods that managers could easily employ to substantially reduce excess dispersion. The key is for managers to be more conservative, shrinking their estimates of expected returns toward cross-sectional means. We refer to Hommel et al. (2023) for a complementary evaluation of different discounting methods.

Excess dispersion in the perceived cost of capital leads to misallocation of capital through the lens of a standard model. Firms with too low a perceived cost of capital invest too much and firms with too high a perceived cost of capital invest too little, relative to the optimal allocation. We quantify the impact of such misallocation through the lens of the framework by Hsieh and Klenow (2009). While the framework is very stylized, it provides a useful way to gauge the economic magnitude of deviations in the perceived cost of capital. In the framework, excess dispersion in the perceived cost of capital translates directly into lower total factor productivity (TFP). According to the model, the excess dispersion observed in the data generates misallocation that lowers TFP by around 5%. The allocation of capital would be closer to optimal if all firms were forced to use the same cost of capital, rather than firms relying on their own perceptions. It would also strongly improve if firms used the new methods that we suggest to estimate the cost of capital. (See Krüger et al. 2015 and Giroud et al. 2022 for related work on misallocation.)

Our results challenge theories in which rational expectations about the cost of

capital are important. One example is production-based asset pricing, which assumes that firms know expected returns and, by extension, their cost of capital perfectly and that they invest based on this knowledge. The models then attempt to learn about the dynamics of expected returns implied by firm investment. However, the large deviations between firms' perceived and true cost of capital suggest that firms' investment decisions do not reflect expected returns accurately, challenging the underlying idea. We discuss the challenges posed by our results for the production-based asset pricing paradigm. Moreover, we show that the deviations in the perceived cost of capital lead to a rejection of the "Investment-CAPM," a popular production-based model used to describe risk premia through the lens of rational behavior by firms.

We have so far been silent on why the perceived cost of capital deviates from the true cost of capital. A natural interpretation is that the deviations reflect mistakes made by managers when forming perceptions about their true cost of capital. Such mistakes are plausible given that estimating expected returns is notoriously difficult (Fama and French 1997, Pástor and Stambaugh 1999), which means that even sophisticated managers would find it hard to calculate their true cost of capital. Less sophisticated managers are likely to make mistakes given that the standard methods taught to managers lead to bias (e.g., the CAPM) and their own beliefs about expected returns may be biased (Greenwood and Shleifer 2014, Giglio et al. 2021, Nagel and Xu 2022). The important role played by non-standard terms added by firms and the high persistence in the perceived cost of capital are consistent with individual managers suffering from durable and idiosyncratic biases.

The market for corporate control may not undo potential mistakes in managerial perceptions. In principle, mistakes lower stock prices, so an arbitrageur could take over the firm, correct the cost of capital, and sell the firm at a profit. There are, however, limits to arbitrage (Shleifer and Vishny 1997) in the market for corporate control. For one, takeovers require large investments that may expose the arbitrageur to prohibitively large idiosyncratic risk. Moreover, takeover attempts can drive up stock prices and make potential deals unprofitable, particularly in inelastic markets (Gabaix and Koijen 2021). Finally, attempts to correct the cost of capital without a full takeover could be prevented by other investors if they share the biased beliefs of managers (it is indeed rare that analysts on conference calls disagree with managers' perceptions of the cost of capital).

It may be possible for future work to rationalize excess dispersion as a second-best

solution to frictions, rather than as the result of mistakes in perceptions. A successful model would need to make it optimal for firms to invest based on a cost of capital that deviates strongly from the true cost of capital. Doing so may prove challenging because investing based on the true cost of capital optimizes market value in standard models. We discuss to what extent different types of models may be consistent with the empirical findings.

One potential modeling approach involves signaling. For example, one could posit that some firms purposely use a lower cost of capital to signal to investors that their operations are safe and should be valued at a low discount rate. However, such signaling models face multiple challenges. First, the signaling would distort firm investment given that firms allocate capital in line with the perceived cost of capital. Second, the average perceived cost of capital is higher than standard estimates of the true cost of capital. Finally, we do not find evidence that firms mention their perceived cost of capital in states where the value of signaling may be particularly high. Firms that appear undervalued, earn low returns, or are in distress are not more likely to discuss their perceived cost of capital. Similarly, we find no evidence that the within-firm timing coincides with unusual times of stress, mispricing, or other firm characteristics.

We also consider whether excess dispersion may arise because managers think that financial markets are mispriced. On its own, this explanation is not sufficient because its optimal for firms with the standard objective of maximizing current market value to use expected returns as their cost of capital even when markets are mispriced (Stein 1996, Nagel 2019). If firms instead maximize future (not current) market value and believe certain risk premia reflect temporary mispricing, as in Stein (1996), it is optimal for firms to leave out these risk premia from their perceived cost of capital. While such behavior generates a wedge between the perceived and true cost of capital, it generally implies that there will be too little dispersion in the perceived cost of capital, rather than excess dispersion.

Finally, an alternative type of model could involve learning. For instance, if managers are Bayesian updaters and uncertain about true expected returns (as in Martin and Nagel 2022), a rationally derived expected return measure may place strong emphasis on individual past returns, which could lead to a finding of excess dispersion in ex post data. However, rational Bayesian updaters often also impose shrinkage, which can weaken this channel. Moreover, it may be difficult for such models

to quantitatively match the large degree of excess dispersion and high persistence in the perceived cost of capital that we observe in the data.

Previous research on the perceived cost of capital relies on qualitative survey evidence about the methods used by firms to estimate their cost of capital. According to the Duke CFO Survey, 80% of large firms apply the CAPM, 70% additionally use multi-factor models, and 40% use historical returns (Graham and Harvey 2001, Graham 2022). Other surveys find similar results (Jacobs and Shivdasani 2012, Mukhlynina and Nyborg 2016, Jagannathan et al. 2016). These findings leave open how exactly firms apply and combine different approaches, whether firms act "as if" certain factors mattered, and how quantitatively important different factors actually are. More generally, there is no evidence on the relation between expected returns and the perceived cost of capital as well as the implications for misallocation and macro-finance models.[1]

# 2 Framework and Data

## 2.1 Framework

The cost of capital for a given investment is the return required by outside investors (i.e., holders of the firm's debt and equity) in exchange for providing capital to finance the investment. A new investment project only adds to the market value of the firm (which is determined by investors) if the expected return of the project exceeds its cost of capital. As a result, the cost of capital plays a key role in firms' investment decisions, both in textbook theory and in corporate practice.

The appropriate cost of capital for a given investment depends on its riskiness. Because outside investors can earn a higher expected return on riskier investments in financial markets, they will require a higher return for providing capital to riskier projects. In fact, if the law of one price holds, the cost of capital can be calculated as the expected return in financial markets for an investment with a similar level of risk as the project under consideration.

We are interested in the firm-level cost of capital. This cost of capital refers to a project that is representative of the overall firm, in the sense that the project has the

[1] Previous work has studied the quantitative importance of one factor, the market beta, for firms' discount rates (i.e., required returns, or hurdle rates, but not the perceived cost of capital), finding mixed results (Poterba and Summers 1995, Jagannathan et al. 2016, Cho and Salarkia 2020).

same riskiness as the average project of the firm. Most firms focus on a firm-level cost of capital in their investment decisions, rather than a project-specific cost of capital (Graham and Harvey 2001). Some firms then set required returns on investment, called discount rates or hurdle rates, that are project- or division-specific to account for differences in risk. In the cases where firms discuss a project-specific cost of capital on conference calls, we will collect the numbers separately but will not use them in our analysis.

The firm-level cost of capital is usually expressed in terms of the weighted average cost of capital (WACC), which is the weighted average of the cost of equity and the cost of debt, accounting for tax benefits of debt:

$$r_{i,t}^{\text{WACC}} = \omega_{i,t} \times (1 - \tau) \times r_{i,t}^{\text{debt}} + (1 - \omega_{i,t}) \times r_{i,t}^{\text{equity}}, \tag{2}$$

where $r_{i,t}^{\text{WACC}}$ denotes the weighted average cost of capital of firm $i$ at time $t$, $\omega$ is the percentage of debt finance (leverage), $\tau$ is the tax rate, and $r_{i,t}^{\text{debt}}$ and $r_{i,t}^{\text{equity}}$ are the cost of debt and equity.

Because the firm-level cost of capital refers to a project with a riskiness that is representative of the overall firm, the firm's cost of capital is determined by the expected return on a financial investment with similar risk as the overall firm. The "true" cost of capital of the firm is therefore obtained by using the expected returns on the firm's debt and equity to measure the firm's cost of debt and equity, respectively:

$$r_{i,t}^{\text{true}} = \omega_{i,t} \times (1 - \tau) \times \mu_{i,t}^{\text{debt}} + (1 - \omega_{i,t}) \times \mu_{i,t}^{\text{equity}}, \tag{3}$$

where $\mu_{i,t}^{\text{equity}}$ is the expected long-run return on the firm's equity and $\mu_{i,t}^{\text{debt}}$ is the expected return on the firm's debt. A fundamental challenge is that the expected returns on debt and equity are unobserved, even by the firm. There is no uniformly agreed way of estimating expected returns, so firms must rely on their own perceptions when determining their cost of capital.

Throughout much of the paper, we are interested in how the perceived cost of capital deviates from the benchmark (3). To this end, we write the perceived cost of capital as

$$r_{i,t}^{\text{perc.}} = r_{i,t}^{\text{true}} + \upsilon_{i,t}, \tag{4}$$

where $v_{i,t}$ reflects deviations in the perceived cost of capital relative to the standard definition. The deviations may arise if firms rely on biased estimates of the expected returns on debt and equity when forming their perceptions about their cost of capital. Such deviations are plausible because estimating expected returns is notoriously difficult (Fama and French 1997, Pástor and Stambaugh 1999) and because many agents are known to have biased beliefs about expected returns (Greenwood and Shleifer 2014, Giglio et al. 2021, Engelberg et al. 2020, Nagel and Xu 2022).

In standard models, firms maximize their market value by setting the required return on representative projects equal to the true cost of capital (defined in (3)). As a result, practitioners are typically taught to use the true cost of capital and firms in standard models end up using the true cost of capital. This optimality of the true cost of capital does not rely on market efficiency. If the law of one price holds and firms want to maximize their market value, firms should use the true cost of capital, which implies that they should use the expected returns on their debt and equity as their cost of debt and equity (Stein 1996, Nagel 2019). To see this, note that a firm optimizes its market value by maximizing the expected product of its future cash flows and the stochastic discount factor. This stochastic discount factor may be driven by "mispricing" or "behavioral" factors, leading stock markets to be inefficiently priced (Kozak et al. 2018). But as long as the law of one price holds, firms maximize market value by using the stochastic discount factor. Using the stochastic discount factor to optimize market value leads to the same rule for the calculation of the true cost of capital as the one described above (see Appendix B).

If firms want to maximize future rather than current market value, the optimal cost of capital may change. In this case, firms should use the expected future stochastic discount factor when making their investment decisions. In practice, doing so would imply that firms should not incorporate transitory variation in expected returns in their true cost of capital. If, for instance, the expected return on a firm is temporarily elevated due to behavioral mispricing, the firm will want to leave out this variation from its true cost of capital (Stein 1996). Such behavior could explain why firms may not want to fully incorporate certain risk factors, such as the value factor, but it cannot explain the large excess dispersion that we document in this paper.

## 2.2 Data Collection

We analyze a new firm-level dataset containing the perceived cost of capital, asset prices, exposure to risk factors, and capital investment.

Firms do not typically report a perceived cost of capital in official financial reports, whereas survey data are mostly anonymized and cannot easily be matched to firm characteristics and asset prices. We overcome these challenges by relying on data from earnings calls, investor conferences, and similar events, which we jointly call "conference calls." We build on the data collection in Gormsen and Huber (2024) and describe details in Appendix C.

Most listed firms hold quarterly conference calls to inform analysts and investors about their strategy. Firm managers occasionally disclose an internal estimate of their cost of capital on these calls, which we term the perceived cost of capital. The calls are relatively high-stakes settings, so managers have incentives to report accurate numbers if those numbers can be challenged and cross-checked by analysts and investors (Hassan et al. 2019). Indeed, analysts and investors often ask managers detailed questions about how past realized investment decisions relate to their cost of capital and statements from conference calls appear as evidence in securities lawsuits (Rogers et al. 2011). We verify in Section 6.1 that the perceived cost of capital measured on the conference calls predicts future investment and realized returns on invested capital.

We search through all transcripts of calls available on the databases by Refinitiv and FactSet for the years 2002 to 2022. We download paragraphs where managers mention at least one of 22 keywords.[2] Together with a team of research assistants, we manually read through roughly 110,000 downloaded paragraphs and collect all instances where firms state the "cost of capital," the "weighted average cost of capital," or the "WACC" for the whole firm. The collected data do not include instances where firms discuss hypothetical values (e.g., "imagine a cost of capital of x%"), where outsiders posit a cost of capital or ask suggestive question (e.g., "am I correctly assuming that your cost of capital is x%?"), or where managers discuss rates associated with specific debt issuances (e.g., "the yield associated with the new bond issuance is

[2]The keywords include capital asset pricing model, cost of capital, cost of debt, cost of equity, discount rate, expect a return, expected rate of return, expected return, fudge factor, hurdle rate, internal rate of return, opportunity cost of capital, require a return, required rate of return, required return, return on assets, return on invested capital, return on net assets, weighted average cost of capital, weighted cost of capital. We also include abbreviated keywords, for example, WACC.

x%.") Firms almost always discuss the after-tax cost of capital, but we convert the few pre-tax values to after-tax values.

In addition to the perceived cost of capital, we also collect firms' perceived cost of debt, perceived cost of equity, and the discount rates (required returns) used by firms to assess the net present value of new investment projects. To identify discount rates, we rely on explicit manager statements about the minimum required IRR that they want to earn on new investment projects.[3]

We link firm names from the conference call data to a Compustat firm key using manual matching of firm names. This allows us to then merge firm-level asset prices from the Center for Research in Security Prices and firm-level exposure to 153 equity factors, assembled by Jensen et al. (2023).

## 2.3 Summary Statistics and Representativeness

The mean perceived cost of capital is 8.6%, with substantial variation ranging from 5.3% at the 5$^{\text{th}}$ percentile to 13% at the 95$^{\text{th}}$ percentile, as shown in Table 1. The mean discount rate, used internally by the firm to evaluate investment projects, is 15.3%, although the cost of capital and the discount rate cannot be directly compared because some firms do not account for overhead in the discount rate they report on surveys and conference calls (see Gormsen and Huber 2024 for details).

We compare firms included in the conference call sample to the population of listed firms. We report the average percentile of firms in the sample, relative to the population of firms in Compustat in the same year and country, in Panel A of Table A1. The main difference is that firms in the sample are larger, with the average market value rank of firms in the perceived cost of capital sample lying at the 83$^{\text{rd}}$ percentile. The skew toward larger firms implies that we cover a substantial share of aggregate market value. For instance, firms appearing in the cost of capital sample with at least one observation cover 40% of the total assets of Compustat firms in advanced economies. The sample includes well-known firms, such as AT&T, Bank of America, Disney, Exxon, Home Depot, Intel, JPMorgan Chase, Mastercard, Nestle, Novartis, UnitedHealth, and Visa.

As a result of the skew toward large firms, the sample contains few financially

[3]Other rates (such as realized and expected IRR) and ratios (such as required, realized, and expected ROA, ROIC, ROE) were separately recorded during the data collection to ensure that the perceived cost of capital and discount rate were clearly differentiated from these other objects.

constrained firms, with the average financial constraints (Hadlock and Pierce 2010) rank in the cost of capital sample lying at the $20^{\text{th}}$ percentile. The average firm in the cost of capital sample has slightly higher return on equity, physical capital to assets, and leverage, although these differences are not large, with average ranks around the $60^{\text{th}}$ percentile. The average book-to-market ratio, investment rate, and bankruptcy risk (Z-score) ranks are relatively close to the $50^{\text{th}}$ percentile, indicating that the average firm in the sample is representative of the Compustat population along these characteristics.

Firms do not systematically disclose their perceived cost of capital during periods that are unusual for the firm, as shown in Panel B of Table A1. We regress indicator variables (scaled by 100) for whether a firm mentions a particular variable in a given quarter on firm characteristics as well as firm and year fixed effects, so that we analyze only within-firm variation over time. For instance, in column (3), the included firm characteristic is bankruptcy risk, measured in country-year percentile ranks of the Z-score. The point estimate is small and insignificant. It implies that the probability of observing a perceived cost of capital rises by only 0.07 percentage points if bankruptcy risk falls from the highest to the lowest value observed in the country-year bin. We similarly find small and insignificant associations in column (4), where we include other firm characteristics, many of which are part of the Z-score. In column (6), we are significantly more likely to observe a perceived cost of debt when leverage is high relative to the firm's average, likely because firms discuss the cost of debt more when they have issued more debt than usual. Firms also discuss the cost of debt slightly more often when their return on equity is high.

# 3 Stylized Drivers of the Perceived Cost of Capital

We start the empirical analysis by presenting stylized facts on time variation and cross-sectional variation in the perceived cost of capital. We show that firms incorporate time variation in expected returns along with some traditional asset pricing factors into their perceived cost of capital. We then construct a parsimonious empirical model that summarizes the drivers of the perceived cost of capital.

### 3.1 Time Variation in the Perceived Cost of Capital

Our sample for the perceived cost of capital runs from 2002 to 2022. Over this period, there have been substantial fluctuations in expected returns in financial markets. We have seen a secular downward trend in expected returns in both equity and debt markets, with fluctuations around the financial crisis, the sovereign debt crisis, and the 2022 inflation spike.

Gormsen and Huber (2024) document that firms have generally incorporated time variation in financial prices into their perceived cost of capital. To illustrate this finding, Table 2 presents regressions of firms' perceived cost of capital on measures of the financial cost of capital. For simplicity, we use the earnings yield plus expected inflation as a proxy for time variation in the cost of equity and the long-term government interest rate as a proxy for time variation in the cost of debt (this approach abstracts from the impact of credit risk).

In column (1) of Table 2, we regress the firm-level perceived cost of capital on the country-level earnings yield and interest rate for US firms. The slope coefficients are 0.51 and 0.27. Firms are, on average, financed with 2/3 equity and 1/3 debt, so if the proxies capture the cost of equity and debt perfectly, we should expect slopes of 2/3 on the equity yield and $1/3 \times$ the tax rate on the interest rate. However, fluctuations in the earnings yield (plus expected inflation) are not a pure measure of fluctuations in the cost of capital in financial markets, as they also reflect fluctuations in expected real growth rates, which would lead to lower slopes. For instance, if one believes that 80% of the fluctuations in the earnings yield represent discount rates and 20% represent growth rates (and the two are orthogonal), we should expect a slope coefficient of $0.8 \times 2/3 = 0.53$ (see, e.g., Campbell 1996 for a discussion of such variance decompositions). The estimated slope coefficients are therefore close to what one would expect if firms perfectly incorporated fluctuations in expected financial returns into their perceived cost of capital.

Columns (2) and (3) document similar results when using firm fixed effects and when studying a global sample. The results suggest that firms, on average, incorporate long-run fluctuations in expected stock returns and interest rates into their perceived cost of capital. But while the slope coefficients are close to what full incorporation would predict, the $R^2$ is far from one, suggesting substantial heterogeneity across firms. We will study this cross-sectional variation in the upcoming section.

Figure 1 visualizes the time variation in the perceived cost of capital. The left

panel shows a downward trend in the perceived cost of capital that moves almost one-to-one with the trend in the earnings yield (the earnings yield is on a separate y-axis, but the ranges of the two y-axes are the same). We observe a similarly close relation between the average perceived cost of debt in the US and the long-term Treasury rate in the right panel (with a level difference driven by credit risk).

The finding that firms appear to incorporate fluctuations in expected stock returns into their perceived cost of capital may be surprising, given the syllabuses of MBA classes. Most MBA programs teach simplified methods for estimating the cost of equity and not how to incorporate time variation in expected stock returns. In his AFA Presidential Address, Cochrane (2011) notes that students are typically taught to use a 6% market risk premium and that "it is interesting that investment decisions get so close to right anyway." He speculates that perhaps "a generation of our MBAs figured out how to jigger the numbers and get the right answer" (page 1087, Cochrane 2011). Our results suggest that managers explicitly incorporate time-varying risk premia in line with standard models of expected returns.

## 3.2 Traditional Cross-Sectional Drivers

In this section, we provide an initial analysis of the cross section of the perceived cost of capital, focusing on the seminal theory of Modigliani and Miller (1958) and the model by Fama and French (1993). According to Modigliani and Miller, firms with higher leverage should have lower cost of capital due to a higher tax shield (see equation 2). According to Fama and French, cross-sectional variation in the cost of equity—and therefore to some extent the cost of capital—should be determined by exposure to the market, size, and value factors.

Figure 2 illustrates the empirical relevance of leverage, market beta, size, and value for cross-sectional variation in the perceived cost of capital. In the top-left panel, we plot the perceived cost of capital for five different groups based on leverage ratios. The perceived cost of capital is around 9.5% for firms with the lowest leverage and 8.5% for firms with the highest leverage. The magnitude of this drop is roughly consistent with the benefits of the tax shield. To see this, note that leverage increases from around 0.1 to 0.6 when going from the bottom to top group. If we assume a tax rate of 20% and a cost of debt of around 4.66% (the average in our sample), the difference in the tax shield should be around $0.5 \times 0.2 \times 4.66\% = 0.47\%$.

The remaining three panels plot the results for market beta, size, and value. The perceived cost of capital increases by around 1.5 percentage points when going from low to high beta firms. This relatively large increase is consistent with past surveys, according to which many firms use market betas as one input into their perceived cost of capital (see, e.g., Graham and Harvey 2001). Regarding size, the perceived cost of capital decreases by almost 3 percentage points when going from nano-cap to mega-cap firms. The large effect may be surprising in light of past survey evidence, according to which managers do not explicitly account for size premia (Graham and Harvey 2001), but the effect is consistent with the fact that financial analytics firms, like the Kroll Cost of Capital Navigator by Duff and Phelps, account for size premia.[4] Finally, regarding value, the perceived cost of capital increases by around 20 basis points when going from growth to value firms. Although the magnitude of the effect is very limited, the direction is qualitatively consistent with the value premium documented by Fama and French (1992).

We also study the above characteristics in multivariate panel regressions in the Online Appendix. The multivariate relations between the perceived cost of capital and the variables in Figure 2 are similar to the univariate relations. The cost of capital significantly increases in market beta and decreases in size and leverage. The effect of value is again modest. In general, the perceived cost of capital is higher for value firms, but the effect tends to be statistically insignificant. See Table A2 and Section Appendix D.2 in the Online Appendix.

## 3.3 An Empirical Model of Cross-Sectional Variation in the Perceived Cost of Capital

We produce a parsimonious empirical model describing the variation in the perceived cost of capital. Following the discussion in Section 2.1, we model firms' perceived cost of capital as a function of exposure to equity risk factors. We select the empirically relevant risk factors using a Lasso model.

Our analysis is based on the 153 risk factors identified by Jensen et al. (2023). The authors measure firm-level exposure to each risk factor through firm-level characteristics (a high book-to-market ratio, for instance, reflects a high exposure to the value factor). The characteristics are measured in cross-sectional percentiles relative

[4] See https://www.kroll.com/en/cost-of-capital/frequently-asked-questions.

to firms in the same country and quarter. We use a Lasso procedure to pick the combination of characteristics that best describes the perceived cost of capital. In addition to the 153 characteristics that proxy for exposure to risk factors, we also include a dummy for European versus US firms.

The Lasso procedure selects 11 characteristics. Figure 3 plots the loadings of the perceived cost of capital on each of these characteristics. The loadings tell us how much the perceived cost of capital increases when a firm goes from the bottom to the top of the cross-sectional distribution of the given characteristic, keeping the other characteristics constant. For instance, the loading on the CAPM beta is around 2, which means the perceived cost of capital is 2 percentage points higher for firms with the highest market beta than firms with the lowest market beta.

The Lasso procedure also picks leverage and size characteristics. There are three variables related to leverage, namely the debt-to-market value of the firm, the net debt-to-price of the firm, and assets to book equity. All of these are associated with a lower perceived cost of capital, consistent with Figure 2. Market size also shows up with the expected negative sign. There is no direct value characteristic, consistent with the modest effect shown in Figure 2. However, when we use the Lasso model to calculate predicted values of the perceived cost of capital, those predicted values are positively associated with book-to-market ratios, suggesting that the other variables in combination capture a value effect. The lasso procedure additionally picks firm age, access to external finance, idiosyncratic volatility, and the European dummy (due to the lower nominal interest rate during our sample period) among the relevant risk factors.

We use the Lasso model to construct a database of predicted values for the perceived cost of capital. By using the Lasso model, we can construct predicted values for firm-quarter observations where we do not observe the perceived cost of capital. The resulting database contains 250,000 firm-quarter observations of predicted values. We share the resulting data on costofcapital.org. We explain the details of our methodology in Appendix G, which also includes a description of a related methodology for firms' discount rates (required returns on investment).

Another salient driver of cross-sectional variation in the perceived cost of capital, which is excluded from the above analysis, is the "greenness" of the underlying firm. Gormsen et al. (2023) study how firms' perceived cost of capital relates to the greenness of the firm, as measured by the MSCI. That paper finds that green and brown firms

historically have had similar perceived cost of capital, but that the cost of capital between the two has diverged substantially since the rise of the sustainable investment movement. At the end of the 2020s, firms with above-median greenness reported a perceived cost of capital that was 1 percentage point below their brown counterparts. We do not analyze greenness in the above analysis as it is not part of the classical risk factors in the dataset of Jensen et al. (2023).

# 4 Excess Dispersion in the Perceived Cost of Capital

The previous section documents that firms' perceived cost of capital is related to expected returns and interest rates in financial markets, in line with the standard definition of the true cost of capital. In this section, we test whether the perceived cost of capital is, in fact, equal to cost of capital implied by expected returns. We find that it is not: firms' perceived cost of capital is excessively dispersed relative to what can be justified by variation in expected returns and interest rates in financial markets.

## 4.1 Motivating Evidence from Summary Statistics

Raw summary statistics already suggest that the perceived cost of capital is excessively dispersed. Figure 4 plots histograms of the perceived cost of capital and equity. The 10-90 percentile range in the perceived cost of equity is 8 percentage points. This range is well beyond the usual spread observed in long-expected returns across firms. Consider, for instance, the value premium documented by Fama and French (1992). In the US, we find that value firms have 3.5% higher one-year stock returns than growth firms (with growth and value firms defined as firms at the $10^{\text{th}}$ and $90^{\text{th}}$ percentile of book-to-market ratio). If one extends the horizon to 10-year returns, which is the relevant horizon for the cost of capital, the annualized return difference decreases to around 2% (although standard errors are wide).[5] The variation is also large relative to the time variation in true expected returns (see Figure 1). It is thus plausible that much of the volatility in the perceived cost of capital cannot be justified by true variation in expected returns. The upcoming sections studies this possibility formally.

[5] Keloharju et al. (2019) study long-run expected returns to leading anomalies and find estimates of similar magnitude.

## 4.2 Variance Decomposition Framework

Recall from Section 2.1 that the perceived cost of capital is

$$r_{i,t}^{\text{perc.}} = r_{i,t}^{\text{true}} + \upsilon_{i,t}, \tag{5}$$

where $r_{i,t}^{\text{true.}}$ is the true cost of capital, as defined in equation (3) of Section 2.1, and $\upsilon_{i,t}$ reflects deviations from this standard definition.

We are interested in whether variation in the perceived cost of capital reflects variation in the true cost of capital. We first assess whether the perceived cost of capital is an unbiased estimate of the true cost of capital. Conceptually, one can test for bias by projecting the true cost of capital on the perceived cost of capital:

$$r_{i,t}^{\text{true}} = \beta_0 + \beta_1 r_{i,t}^{\text{perc.}} + \varepsilon_{i,t}. \tag{6}$$

For the perceived cost of capital to be an unbiased estimate of the true cost of capital, the slope coefficient $\beta_1$ in (6) must be one: when firms perceive their cost of capital to be one percentage point higher, the true cost of capital must, on average, be one percentage point higher.

The empirical challenge in implementing (6) is that $r^{\text{true}}$ represents an expected return that is unobserved. A standard approach used in asset pricing is to replace the unobserved expected return on the left-hand side with an ex post realized return (Fama and French 1988, Campbell and Shiller 1988). The realized return consists of the ex ante expected return plus a realized error term. Since the error term is, by definition, uncorrelated with ex ante expectations, it does not influence the slope coefficient $\beta_1$ in (6).

To implement this approach for the cost of capital, we define the realized return between period $t$ and $t+j$ on stock $i$ as $r_{i,t+j}^{\text{equity, realized}} = \mu_{i,t}^{\text{equity}} + e_{i,t+j}^{\text{equity}}$, where $\mu_{i,t}^{\text{equity}}$ is the expected return at time $t$ and $e_{i,t+j}^{\text{equity}}$ is the unexpected error. We analogously define $r_{i,t+j}^{\text{debt, realized}} = \mu_{i,t}^{\text{debt}} + e_{i,t+j}^{\text{debt}}$ as realized debt return. Finally, we define a new variable for the cost of capital $r_{i,t+j}^{\text{realized}}$, in which we replace the cost of debt and equity with the realized returns:

$$\begin{aligned} r_{i,t+j}^{\text{realized}} &= \omega_{i,t} \times (1-\tau) \times r_{i,t+j}^{\text{debt, realized}} + (1-\omega_{i,t}) \times r_{i,t+j}^{\text{equity,realized}} && (7) \\ &= r_{i,t}^{\text{true}} + \omega_{i,t} \times e_{i,t+j}^{\text{debt}} + (1-\omega_{i,t}) \times e_{i,t+j}^{\text{equity}}, && (8) \end{aligned}$$

where the second equality follows from (3) as long as $j$ is sufficiently large. The slope coefficient $\beta_1$ in the regression

$$r_{i,t+j}^{\text{realized}} = \beta_0 + \beta_1 r_{i,t}^{\text{perc.}} + \eta_{i,t}, . \tag{9}$$

is the same as in regression (6) because the error terms in the realized returns are orthogonal to time-$t$ expectations. Testing whether $\beta_1 = 1$ thus informs whether $r_{i,t}^{\text{perc.}}$ is an unbiased estimate of $r_{i,t}^{\text{true}}$. Equivalently, one can regress a forecast error, defined as $r_{i,t}^{\text{perc.}} - r_{i,t+j}^{\text{realized}}$, on $r_{i,t}^{\text{perc.}}$, so that the coefficient on $r_{i,t}^{\text{perc.}}$ is $1 - \beta_1$. In that case, the test of unbiasedness is whether the coefficient on $r_{i,t}^{\text{perc.}}$ equals zero (i.e., whether forecast errors are unpredictable).

The slope coefficient $\beta_1$ also reveals the share of variation in the perceived cost of capital that can be justified by variation in the true cost of capital. Starting from (5), we can write the variance of $r_{i,t}^{\text{perc.}}$ as

$$\text{var}\left(r_{i,t}^{\text{perc.}}\right) = \underbrace{\text{cov}\left(r_{i,t}^{\text{perc.}}, r_{i,t}^{\text{true}}\right)}_{\text{true variation}} + \underbrace{\text{cov}\left(r_{i,t}^{\text{perc.}}, \upsilon_{i,t}\right)}_{\text{excess variation}}. \tag{10}$$

The first term on the right-hand side of (10) reflects variation in the perceived cost of capital that is justified by variation in the true cost of capital (i.e., variation in expected returns on debt and equity). The second term reflects variation that is not justified by variation in the true cost of capital. We refer to the latter variation as "excess dispersion." This term captures variation in the perceived cost of capital that should not exist according to standard models.[6]

Dividing both sides of (10) by the variance of the perceived cost of capital yields

$$1 = \underbrace{\frac{\text{cov}\left(r_{i,t}^{\text{true}}, r_{i,t}^{\text{perc.}}\right)}{\text{var}\left(r_{i,t}^{\text{perc.}}\right)}}_{\gamma^{\text{true}}} + \underbrace{\frac{\text{cov}\left(\upsilon_{i,t}, r_{i,t}^{\text{perc.}}\right)}{\text{var}\left(r_{i,t}^{\text{perc.}}\right)}}_{\gamma^{\text{excess}}}, \tag{11}$$

where $\gamma^{\text{true}}$ and $\gamma^{\text{excess}}$ denote the share of the variance in the perceived cost of capital that reflects true and excess dispersion, respectively. The share $\gamma^{\text{true}}$ arithmetically

[6]The term is related to the "excess volatility" documented by Shiller (1981), although our excess dispersion differs conceptually. Shiller documents excess dispersion in stock prices, which can be rationalized by movements in risk premia, whereas we document excess dispersion in what is effectively an expectation, which cannot be rationalized by risk premia.

equals the slope coefficient $\beta_1$ from the regressions (6) and (9). In turn, $1-\beta_1$, which is the coefficient on $r_{i,t}^{\text{perc.}}$ when the forecast error is on the left-hand side, exactly equals the excess dispersion share $\gamma^{\text{excess}}$.

In the upcoming sections, we implement the variance decomposition in (11) and document substantial excess dispersion in the perceived cost of capital. As per the discussion above, this excess dispersion implies that firms' perceived cost of capital is a biased estimate of the true cost of capital. We implement the variance decomposition in two ways. In Section 4.3, we use realized returns to capture variation in the true cost of capital, as outlined above, and in Section 4.4, we use the "implied cost of capital" to capture variation in the true cost of capital.

### 4.3 Excess Dispersion Relative to Realized Returns

To implement the variance decomposition approach, we need to calculate realized equity returns over a horizon at which the expected return is a meaningful proxy for the cost of equity. In principle, the cost of equity is the expected return over the same horizon as the duration of investments, often considered to be 10 years or more. To ensure a sufficient number of observations, we will calculate realized returns over a 3-year horizon. If expected equity returns are constant over time, the horizon is irrelevant. If expected returns mean-revert over time, as is often assumed, using too short a time horizon results in upward biased slope coefficients in equation (9). Our choice of horizon is thus conservative in that it may overestimate $\gamma^{\text{true}}$ and underestimate $\gamma^{\text{excess}}$.

We could similarly rely on realized returns to measure the cost of debt. However, since debt includes includes many different bonds and types of bank debt, it is easier to calculate a proxy for expected than realized returns for debt. We follow Gormsen and Huber (2024) and use interest expenses (including coupon payments on bonds) over total debt in Compustat to proxy for the cost of debt. This measure is simplified and neglects, for instance, default risk. We will later verify that this measure captures most of the relevant variation in the perceived cost of debt and that the estimated excess dispersion does not arise from our measurement of the cost of debt.

Panel A of Table 3 presents estimates of $\gamma^{\text{excess}}$. In the first column, we regress the forecast error $r_{i,t}^{\text{perceived}} - r_{i,t+j}^{\text{realized}}$ on the perceived cost of capital of the same firm in the same quarter without any fixed effects. The estimate is 0.89, implying that

89% of total variation in the perceived cost of capital reflects excess variation. The estimate has large standard errors given the high ratio of noise-to-signal inherent in realized returns (see, e.g., Fama and French 1988). While we can strongly reject the hypothesis that there is no excess variation, we cannot reject the hypothesis that there is no true variation (i.e., that the slope is equal to 1). In the upcoming Section 4.4, we will pursue an alternative approach with more power that allows us to reject the hypothesis that there is no true variation.

Column (2) focuses on cross-sectional variation by adding country and year fixed effects. The slope coefficient increases to 1.09. A slope coefficient above 1 implies a negative slope in regressions of $r_{i,t+j}^{\text{realized}}$ on $r_{i,t}^{\text{perceived}}$, which is to say that a higher perceived cost of capital is associated with a lower true cost of capital. While the coefficient is not statistically different from 1, the estimate highlights a substantial disconnect between cross-sectional variation in the perceived and the true cost of capital.

In Appendix D.1, we analyze a cost of capital factor, constructed following the methodology in Fama and French (1993). We again conclude that the perceived cost of capital is a biased estimate of expected returns. This analysis focuses solely on cross-sectional differences in returns and considers returns at the monthly horizon. This approach alleviates potential concerns about inference in the baseline panel of long-horizon returns.

One may be concerned that the realized returns over our sample are not representative of true ex ante expectations. For instance, the relations between realized returns and the beta, size, and value factors have been unusually weak post-2000. We find a similar, marginally smaller degree of excess dispersion when controlling for firm-level exposure to these three factors in columns (3) and (4) of Panel A of Table 3. This finding suggests that excess dispersion is not just driven by firms incorporating classic factors into their perceptions.

## 4.4 Excess Dispersion Relative to the Implied Cost of Capital

We now estimate excess dispersion using an approach based on "the implied cost of capital." This approach has more statistical power than the one based on realized returns, but requires additional assumptions.

The implied cost of capital calculates the expected long-run stock return of a firm

as implied by current valuations and expectations among investors. The implied cost of capital is known to be a noisy predictor of true expected returns (Lee et al. 2021). In a global sample of stock returns of 4,500 firms between 1976 and 2021, we find that our implied cost of capital measure predicts future returns with a slope coefficient of 0.60 ($p$-value of 0.00). The measure is thus a useful predictor of expected returns, but because the slope coefficient is 0.6 and not 1, 40% of the variation in the implied cost of capital is noise that is not justified by expected returns. Assuming that the implied cost of capital is equal to the true expected return plus noise that is uncorrelated with firms' perceptions, we can use the implied cost of capital to uncover the true amount of excess dispersion in the perceived cost of capital (following the logic in (9)). Our approach follows the strand of literature in asset pricing that uses the implied cost of capital as a measure of long-run expected stock returns (see Pástor et al. 2022 and Eskildsen et al. 2024 for recent examples).

We follow the methodology of Eskildsen et al. (2024) to construct the implied cost of capital. This method constructs the implied cost of capital by averaging four accounting measures of the cost of capital: the residual income models of Gebhardt et al. (2001) and Claus and Thomas (2001) and the dividend discount models of Easton (2004) and Ohlson and Juettner-Nauroth (2005). The implied cost of capital captures only the implied cost of equity, so we use the same measures for the cost of debt, leverage, and taxes as in the previous subsection.

Panel B of Table 3 reports estimates of $\gamma^{\text{excess}}$ based on the implied cost of capital. The slope coefficient in the leftmost column is 0.83, implying that 83% of the variation in the perceived cost of capital represents excess dispersion. Adding country and year fixed effects slightly increases the coefficient. The estimates are close to their counterparts based on realized returns in Panel A. The standard errors are substantially smaller than for realized returns because the implied cost of capital is an expected return, which is less volatile than a realized return. We can now reject the hypothesis that there is no true variation (i.e., a coefficient of 1).

## 4.5 The Sources of Excess Dispersion

The excess dispersion in the perceived cost of capital reflect excess dispersion in either the perceived cost of debt or cost of equity. Since we have data on both, we estimate excess dispersion in each separately by projecting the forecast error in the perceived

cost of equity on the perceived cost of equity and doing the analogue for the cost of debt. The errors for the perceived cost of equity are based on the implied cost of capital, whereas the errors for the perceived cost of debt are based on the interest rate expense measure described in Section 4.3.

Figure 5 shows that the excess dispersion in the perceived cost of equity is around 80%, similar to the amount of excess dispersion in the overall perceived cost of capital. In contrast, the excess dispersion in the perceived cost of debt is only 13%. The excess dispersion in the perceived cost of capital is thus driven by the perceptions about the cost of equity rather than the cost of debt. This finding may reflect that the cost of debt is substantially easier to estimate than the cost of equity. Conceptually, most of the variation in the perceived cost of capital comes from the perceived cost of equity, because the perceived cost of equity is much more volatile than the perceived cost of debt (see Table 1) and because firms are mostly financed with equity. Consistent with this argument, the excess dispersion in the perceived cost of capital is close to the excess dispersion in the perceived cost of equity.

We explore heterogeneity across firms in Figure 6. The figure shows excess dispersion for subsamples defined by splitting the sample at the median for five different characteristics. We use the method based on the implied cost of capital to maximize power. The top row shows that excess dispersion is slightly lower for firms with above-median market size, consistent with large firms being more sophisticated. The difference is the only dimension of heterogeneity that is statistically significant (at the 5% level). We also find that firms with above-median dependence on external finance have slightly less excess dispersion, possibly because these firms interact more with financial markets and are more disciplined as a result. Finally, firms with lower market beta have slightly less excess dispersion, which may be because estimates of the cost of equity for these firms are less sensitive to estimates of the market risk premium. We find little heterogeneity related to book-to-market ratios or the firm-level propensity to issue new equity.

The perceived cost of capital can be decomposed into a part that reflects exposure to underlying risk factors and a part that reflects idiosyncratic perceptions of firms. It is theoretically possible that the excess dispersion comes entirely from idiosyncratic perceptions and that the part coming from risk factors does not contain excess dispersion. To test this possibility, we use the predicted firm-level value of the perceived cost of capital from Section 3.3 as an instrument in a two-stage least square

regression. We first project the perceived cost of capital on the predicted value in a first stage. We then project our measure of the true cost of capital on the estimates from the first stage. The results of the two-stage least square regressions are in columns (3) to (4) of Panel B in Table 3. The excess dispersion in the predicted part of the perceived cost of capital is 53% without fixed effects and 61% with country and year fixed effects. These results show that there is substantial excess dispersion even in the part of the perceived cost of capital that is driven by risk factors.

## 4.6 Measurement Error Concerns

One may be concerned that the estimates of excess dispersion are driven by measurement error. If the perceived cost of capital that we measure on conference calls contains error, our results would overstate the amount of excess dispersion. However, we argue that there is unlikely to be a substantial amount of measurement error. For one, managers are unlikely to state wrong numbers on conference calls as the cost of capital is a well-defined construct they are expected to know. Moreover, we collect the data manually and examine all records multiple times, minimizing the risk that numbers are saved incorrectly. We also record potential project-specific cost of capital estimates separately from the firm-level cost of capital that our analysis is based on, making potential measurement error from confusing project-specific and firm-level perceptions unlikely (discussions of a project-specific cost of capital are very rare, as explained in Section 2.2).

The clearest evidence against measurement error is the fact that we find almost no excess dispersion in the perceived cost of debt. If the excess dispersion mechanically reflected measurement error, we would find excess dispersion in both the perceived cost of debt and equity. As a result, measurement error can only affect our excess dispersion estimates if the error were only in the perceived cost of equity and capital, but not in the cost of debt. Given that we record them using identical procedures, it is not clear how such specific measurement error could arise.

Another argument against measurement error driving the results can be found in columns (4) to (6) of Panel B in Table 3. We find excess dispersion in the part of the perceived cost of capital that is driven by exposure to risk factors. Since this part is predicted using a two-stage procedure, the results in columns (4) to (6) cannot be driven by classical measurement error. This argument does not imply that we

consider the other part, which is not driven by risk factor exposure, as containing measurement error. We are merely pointing out that the two-stage procedure ensures that the part driven by risk factor exposure cannot contain error.

Finally, in Section 6.1, we study how the perceived cost of capital relates to real outcomes. We find that the perceived cost of capital relates to real outcomes with a magnitude close to that predicted by theory and we find that other measures of the cost of capital do not predict real outcomes once controlling for the perceived cost of capital. Both of these findings support the notion that there is little measurement error in the perceived cost of capital.

## 4.7 Managerial Mistakes As Driver of Excess Dispersion

The results on excess dispersion are consistent with the view that managers make mistakes when they set their perceived cost of capital. Such mistakes are plausible given the inherent difficulty in estimating expected equity returns, as discussed in Section 2.1.

An alternative hypothesis is that managers deliberately report a low perceived cost of capital to signal that their investments are safe and should be valued highly. However, the average perceived cost of capital is high relative to standard estimates of expected returns (Table 1). The analysis of within-firm timing in Section 2.3 also showed that firms are not more likely to report their cost of capital when they are particularly underpriced (see Table A1), which otherwise would be a period where the returns to signalling a low cost of capital presumably would be higher. More generally, the lack of predictable timing in the reporting of the perceived cost of capital is difficult to align with a signaling motive.

The excess dispersion is also unlikely to arise as a consequence of market mispricing, as firms that maximize current market value should use expected returns as their cost of capital even if prices are inefficient (see Section 2.1). Models where firms have non-standard objective functions (i.e., they do not maximize current market value) or where managers are Bayesian updaters learning about expected returns may be able to rationalize part of the excess dispersion. Such models still face several challenges, however. For example, it is difficult to rationalize the large share of variation that is due to excess dispersion (80%) as well as the high persistence in the perceived cost of capital.

A related question is why the market for corporate control cannot undo the mistakes made by managers. If the mistakes lower stock prices, an arbitrageur could in principle buy the firm, correct the cost of capital, and sell the firm at a profit. There are, however, limits to arbitrage in the market for corporate control (Shleifer and Vishny 1997). A takeover of one of the large corporations in our sample requires an investment in the order of hundreds of billions of dollars, exposing the arbitrageur to large idiosyncratic risk that can make the trade infeasible. Moreover, building the large position necessary for obtaining corporate control pushes prices up, particularly if the arbitrageur is prevented from building the position slowly over time. If demand is highly inelastic (Gabaix and Koijen 2021), the price pressure from the takeover may destroy the potential gains from correcting the cost of capital. In addition, attempts to change firms' estimates of their cost of capital without a takeover could be prevented by other investors sharing managers' biased perceptions. This argument is supported by the literature documenting mistakes in investor perceptions (Greenwood and Shleifer 2014, Nagel and Xu 2022) and the fact that we rarely observe push-back from investors when managers share the perceived cost of capital on conference calls.

Independently of why deviations in the cost of capital arise and how they can persist, our results below will show that the perceived cost of capital affects long-run capital allocation (see Section 6.1). As a result, the finding of excess dispersion is relevant for real outcomes and inconsistent with standard models in economics and finance.

# 5 New Methods to Estimate the Cost of Capital

We introduce new methods that managers could use to reduce the amount of excess dispersion in the perceived cost of capital. Since there is no excess dispersion in the perceived cost of debt, we focus on the perceived cost of equity.

We first consider the standard textbook method, the CAPM. We focus on the implementation applied by the courts of Delaware when ruling on mergers and acquisitions. The method calculates the cost of equity as the long-run interest rate plus the CAPM beta times the market risk premium. The market risk premium is usually based on the historical average, around 6%. We calculate market betas using 5-year rolling windows. The other inputs into the cost of capital (leverage, cost of debt, and tax) are calculated using the method described in Section 4.3.

Column (1) of Table 4 restates the earlier finding that excess dispersion is around 89% when using realized returns and 84% when using the implied cost of capital. In comparison, column (2) shows that excess dispersion for the CAPM-based method is around 140% when using realized returns and 55% when using the implied cost of capital. The high excess dispersion for realized returns echoes the fact that the CAPM does not predict stock returns well (Fama and French 1992, Frazzini and Pedersen 2014).[7] More importantly, the high excess dispersion highlights the serious shortcomings of the widely taught textbook method.

We introduce two alternative methods that managers could use to estimate the cost of equity. The idea behind both methods is to incorporate only limited information about expected stock returns into the cost of equity. Our alternative methods can easily be implemented using free and publicly available information. We do not consider sophisticated machine learning methods, although we note that estimates by Kelly et al. (2023) produce out-of-sample estimates of expected returns that are close to unbiased (see Table A5).[8]

In the first method, we shut off cross-sectional variation in expected stock returns and incorporate only market-wide time variation. We measure the time variation using the market-wide earnings yield plus 2% plus expected inflation (as is standard in practice, Pedersen 2019):

$$r_{i,t}^{\text{equity,CAPE}} = \frac{\text{Earnings}_t}{\text{Price}_t} + 2\% + E_t[\text{Inflation}], \tag{12}$$

where earnings are the total earnings of firms in the market portfolio in the past and the price is the total price of firms in the market portfolio. We estimate total earnings as average earnings over the past 10 years in the US and the past 5 years outside the US. Our measure of the earnings yield in the US is thus the inverse of the CAPE, which is why we label the measure $r^{\text{equity,CAPE}}$. The method is motivated by the assumption that long-run real growth is constant over time. To ensure that the performance of this measure is not driven by fluctuations in inflation expectations, we assume that expected inflation is constant at 2% for all countries in our sample.

[7] Excess dispersion above 100% implies that a higher CAPM-based cost of capital is associated with a lower true cost of capital, as explained in Section 4.3.

[8] In principle, one could also construct an alternative based on the implied cost of capital. This would, however, require detailed information on analyst forecasts and complex calculations, which managers are unlikely to pursue. The implied cost of capital would also lead to excess dispersion when evaluated against realized returns (see Section 4.4).

A somewhat more sophisticated version of the CAPE-based measure makes the expected returns horizon-specific. Due to term structure effects, the relation between the earnings yield and expected returns varies with the return horizon.[9] The correct way to incorporate the earnings yield thus depends on the horizon. To get estimates of the cost of equity for a specific horizon, one can estimate the horizon-specific relation between realized market returns and the earnings yield in predictive regressions and use out-of-sample predicted values from such a regression to calculate expected returns over the desired horizon. However, in most cases, firms are interested in long-run expected returns when calculating the cost of equity, so the simple method described in (12) would suffice.

Column (3) of Table 4 shows that the CAPE-based method produces a small degree of excess dispersion: 27% based on realized returns (using the horizon-adjusted CAPE) and 25% based on the implied cost of capital.[10]

In our second measure, we shut off both time variation and cross-sectional variation. We accordingly assign a constant 6% cost of equity for all firms. This method also results in modest excess dispersion, as shown in column (4).

Our new methods for the cost of equity purposely leave out cross-sectional variation in the cost of equity. The measures are therefore less volatile by construction. To compare the different methods on an equal footing in terms of volatility, Figure 7 plots the amount of true and excess variation in raw rather than scaled terms (i.e., the covariances in equation 10). The figure shows that the new CAPE-based method not only limits the amount of excess variation, but also increases the amount of true variation, relative to the simple CAPM-based cost of capital. The new method based on constant risk premia limits excess variation even further, but it does so at the cost of leaving out true variation relative to the CAPM- and CAPE-based measures.[11]

[9] Regressing one-year returns on the earnings yield yields a substantially higher slope coefficient than regressing the ten-year annualized return on the earnings yield.

[10] We adjust the horizon of the perceived cost of equity to match the horizon of the realized returns. If we do not make this adjustment, the estimated excess dispersion $\gamma^{\text{excess}}$ is lower and $\gamma^{\text{true}}$ is higher.

[11] One way to formalize this trade-off is by comparing out-of-sample $R^2$ values for the different measures in regressions with the true cost of capital on the left-hand side and the measures on the right-hand side.

# 6 Capital Misallocation due to Excess Dispersion

In this section, we study the real effects of excess dispersion. We first document that firms' perceived cost of capital is related to the long-run allocation of capital, in line with standard theory. This finding suggests that excess dispersion in the perceived cost of capital generates long-run capital misallocation. Using the framework of Hsieh and Klenow (2009), we find that misallocation due to excess dispersion in the perceived cost of capital decreases total factor productivity by around 5%.

The effect of the perceived cost of capital on long-run capital allocation is consistent with Gormsen and Huber (2024). That paper shows that firms' required returns to capital, known as their discount rates, are sticky over time, which means that variation in the perceived cost of capital is slowly incorporated into discount rates and has limited impact on investment in the short run. In the long run, however, variation in the perceived cost of capital is fully incorporated into discount rates and thereby determines long-run capital allocation.

## 6.1 The Perceived Cost of Capital and Long-Run Capital Allocation

We begin by studying how the perceived cost of capital relates to measures of long-run capital allocation. In Table 5, we regress the firm-level return on invested capital (ROIC), calculated using Compustat accounting data, on the perceived cost of capital. The ROIC captures the average return to a firm's investments. If the perceived cost of capital determines firms' long-run required return, the ROIC should be higher for firms with a higher perceived cost of capital. The slope coefficient in column (1) is 0.7, suggesting that a firm's ROIC is 0.7 basis points higher when the perceived cost of capital is 1% higher. Deviations from 1 could be explained by the fact that the perceived cost of capital is not perfectly persistent.

In column (2), we control for the firm-level implied cost of capital and interest expenses, two proxies of the true cost of capital. The coefficients on both proxies are insignificant at the 10% level, whereas the coefficient on the perceived cost of capital remains stable. This finding lends support to the view that all components of the perceived cost of capital shape the ROIC and not just the component reflecting the true cost of capital (i.e., the deviations matter as well).

In columns (3) and (4) of Table 5, we consider the capital-to-labor ratio of the firm, measured as the net value of property, plant, and equipment over the number of employees in Compustat. We find that firms with higher perceived cost of capital employ less capital per worker, both with and without controls for the proxies of the true cost of capital.

In columns (5) and (6), we consider the average firm-level investment rate over the subsequent five years. We measure the investment rate as net investment (capital expenditure minus depreciation) during the year over capital at the beginning of the year (net value of property, plant, and equipment). We find that the perceived cost of capital predicts future investment with a slope coefficient of approximately -0.8, both with and without controls for the proxies of the true cost of capital. This magnitude is consistent with a simple Q-model (see Gormsen and Huber 2024). Figure 9 plots slope coefficients using investment rates of different future years as outcome. The figure shows that the effect is relatively stable over time, supporting the view that the perceived cost of capital shapes long-run investment.

In order to influence long-run economic outcomes, the variation in the perceived cost of capital must be persistent. To document the persistence, we leverage the panel structure of our data and regress a firm's current perceived cost of capital on its lagged perceived cost of capital:

$$r_{i,t}^{\text{perc.}} = \sum_{j=1}^{9} \varphi_j r_{i,t-j}^{\text{perc.}} + FE_j + e_{i,t}, \tag{13}$$

where $\varphi_j$ are autoregressive coefficients, $FE_j$ represent lag-specific fixed effects for the $j = (1, .., 9)$ lags. Figure 8 shows that the autoregressive coefficients fall from 0.9 to 0.6 in the first six years. From year six onward, the curve flattens and the autoregressive coefficients stabilize around 0.6. This finding implies a high degree of persistence in the perceived cost of capital.

## 6.2 Model of Misallocation

We build on the framework of Hsieh and Klenow (2009).

**Assumptions** The model features monopolistic competition between heterogeneous firms. Firms produce differentiated products that are combined into sector outputs,

which in turn are combined into a final good. The final good $Y$ is produced by a representative firm without market power:

$$Y = \prod_{s=1}^{S} Y_s^{\theta_s},$$

where $Y_s$ is the output of sector $s$ and the sectoral output elasticities $\theta_s$ sum to one.

The output of sector s is a CES aggregate of the output $Y_{si}$ produced by firms $i = 1, .., M_s$ in the sector:

$$Y_s = \left( \sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}},$$

with $\sigma$ denoting the elasticity of substitution of products in the sector. Each firm produces output using a Cobb-Douglas function

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s},$$

where $A_{si}$ is total factor productivity (TFP) of firm $i$ in sector $s$, $K_{si}$ and $L_{si}$ are capital and labor of firm $i$ in sector $s$, and $\alpha_s$ is the output elasticity of capital in sector $s$.

Firms face a perceived cost of capital $r_{si} = (1 + \tau_{si}) \times r_{si}^{\text{true}}$, where $r_{si}^{\text{true}}$ is the true cost of capital and $\tau_{si}$ captures deviations between the true and perceived cost of capital. We assume that $\tau_{si}$ is independent of $r_{si}^{\text{true}}$ and that TFP and the perceived cost of capital are jointly log-normally distributed. All firms pay the same wage $w$ for labor.[12] Total capital and labor are in fixed supply, and $P$, $P_s$, and $P_{si}$ denote the product prices of the final good, sectoral output, and firm-level output, respectively.

**Solution** Total output is

$$Y = \prod_{s=1}^{S} \left( \text{TFP}_s K_s^{\alpha_s} L_s^{1-\alpha_s} \right)^{\theta_s}, \tag{14}$$

where $L_s$ and $K_s$ are labor and capital employed in sector $s$ and

[12]The assumption of constant wages is introduced for simplicity but can be relaxed without any implications for our main results. Hsieh and Klenow (2009) allow for distortions in both output and labor. The labor distortion is isomorphic to firm-level differences in wages. The impact of this distortion on TFP does not change the impact of distortions in the perceived cost of capital (see equation 16 on page 1411 in that paper).

$$\text{TFP}_s = \left[ \sum_{i=1}^{M_s} \left( A_{si} \frac{\overline{\text{TFPR}_s}}{\text{TFPR}_{si}} \right)^{\sigma-1} \right]^{\frac{1}{\sigma_1}} \tag{15}$$

is TFP of sector $s$. $\text{TFPR}_{si}$ is firm-level total factor revenue productivity, defined as firm-level TFP, $A_{si}$, times the price of the product produced by the firm, $P_{si}$. $\text{TFPR}_{si}$ can also be expressed as

$$\text{TFPR}_{si} = (r_{si})^{\alpha_s} \frac{1}{1-\alpha_s} \left( \frac{1-\alpha_s}{\alpha_s} \right)^{\alpha_s}. \tag{16}$$

$\overline{\text{TFPR}_s}$ is the geometric average of TFPR across firms in sector $s$. Absent deviations between the true and the perceived cost of capital, TFPR within a sector depends only on the true cost of capital, as shown in (16). Deviations between the true and the perceived cost of capital cause TFPR to deviate from this benchmark and reduce sectoral TFP.

Let $\text{TFP}_s^{\tau=0}$ denote TFP of sector $s$ absent any distortions to the cost of capital ($\tau_{si} = 0 \forall s, i$). Given (15) and (16) as well as the joint log-normality of $r_{si}$ and $A_{si}$, the sectoral TFP loss coming from mistakes in the perceived cost of capital is

$$\log\left(\text{TFP}_s\right) - \log\left(\text{TFP}_s^{\tau=0}\right) = -\frac{\sigma}{2} \underbrace{\text{var}\left(\log(1+\tau_{si})\right)}_{\text{excess dispersion (in logs)}}. \tag{17}$$

Expression (17) allows us to quantify the TFP loss coming from excess dispersion in the perceived cost of capital. The TFP loss is pinned down by an excess dispersion term, which equals the cross-sectional variance of the log of the cost of capital deviations $\tau_{si}$.

## 6.3 Estimates of the TFP Loss due to Misallocation

We quantify the excess dispersion term $\text{var}\left(\log(1+\tau_{si})\right)$ using estimates from Section 4. The relevant excess dispersion is given by

$$\text{var}\left(\log(1+\tau_{si})\right) = \text{var}\left(\log(r^{\text{perc.}})\right) \times \tilde{\gamma}^{\text{excess}}, \tag{18}$$

where $\tilde{\gamma}^{\text{excess}}$ is the share of long-run excess dispersion in the perceived cost of capital. Since the perceived cost of capital shapes long-run capital allocation, we need an estimate of long-run excess dispersion, rather than excess dispersion at one point in

time. Figure 8 suggests that the perceived cost of capital partially mean-reverts over time, so that the excess dispersion at any point in time may overstate long-run excess dispersion. However, the figure also shows that there are persistent differences across firms in the long run, because the autoregressive coefficients stabilize around 0.6 after a few years. We isolate long-run excess dispersion using the methodology explained in Appendix E.1. In short, we multiply $\gamma^{\text{excess}}$, the excess dispersion coefficient estimated in Table 3, by $(\varphi_9)^2$, the square of the autoregressive coefficient for the nine-year plus horizon, to get $\tilde{\gamma}^{\text{excess}} = (\varphi_9)^2 \times \gamma^{\text{excess}}$. This approach corrects downward the excess dispersion and thus the estimated TFP loss.[13] We set the elasticity of substitution between products in a sector, $\sigma$, to 4 in our baseline calibration, in line with recent work that puts it between 3 and 10 (Broda and Weinstein 2006, Hendel and Nevo 2006, Hsieh and Klenow 2009).

The baseline estimate of the TFP loss in Panel A of Table 6 is 5.4%, using the excess dispersion estimate based on realized returns (from Table 3 , Panel A, column 1). We find a TFP loss of 5% using the excess dispersion estimate based on the implied cost of capital (from Table 3, Panel B, column 1). The TFP loss is 4% when $\sigma$ equals 3 and 6.7% when $\sigma$ equals 5. The results suggest that excess dispersion in the perceived cost of capital could be a quantitatively relevant contributor to the large capital misallocation that has been found in the literature (David et al. 2016, Restuccia and Rogerson 2017, David and Venkateswaran 2019).[14]

We explore how the allocation of capital would change if firms set their perceived cost of capital to be identical or using the CAPE-based method described in Section 5. Both alternative methods reduce the share of excess dispersion, as shown above. However, both methods also introduce new deviations between true and alternative cost of capital because both leave out some true variation. Given that the excess dispersion in the observed perceived cost of capital is substantially larger than the true variation, the allocation of capital would nonetheless improve under the alternative methods. We illustrate this logic by analyzing the degree of capital distortion under different methods in Panel B of Table 6.

We calculate a firm-level capital distortion as the long-run level of capital that a

[13]The estimates in Table 3 come from regressions with untransformed outcome and regressor, whereas the model-based equation calls for log-log regressions. However, this difference is immaterial because the log-log regression gives almost identical estimates.

[14]In Appendix E.2, we find that misallocation based on discount rates is even larger than misallocation based on the perceived cost of capital.

firm would have in the model if it used a given perception method minus the level of capital that the firm would have in the model if it used the true cost of capital. To calculate the true cost of capital, we assume that firms' perceived cost of capital captures all true variation in the cost of capital plus excess dispersion. We then measure the average capital distortion as the average of the firm-level distortions in percent. The average capital distortion is 24% if firms use the observed perceived cost of capital.

In comparison, the average distortion is 11% if firms did not attempt to incorporate cross-sectional variation and instead used an identical cost of capital. If firms used the CAPE-method, the average distortion would be only 6%. The two alternative methods would also improve TFP. This increase is, however, partly mechanical, as TFP in this model always increases when dispersion in the marginal products of capital decreases, irrespective of whether the dispersion is driven by mistakes or variation in the true cost of capital (see also David et al. 2022).

# 7 Production-Based Asset Pricing Meets the Perceived Cost of Capital

Our results challenge models in which rational expectations about the cost of capital are important. One example is production-based asset pricing. In this section, we argue that mistakes in firms' perceived cost of capital challenge this literature. We first discuss general challenges and we then reject the "Investment CAPM," a popular production-based asset pricing model.

## 7.1 Implications for Production-Based Asset Pricing

The starting point for most of production-based asset pricing is the idea that firms know the stochastic discount factor (SDF) and make decisions to maximize the value of the firm implied by the SDF. Firms' investment decisions are therefore optimal given the prevailing SDF. From this starting point, production-based asset pricing attempts to learn the parameters of the SDF through firms' investment decisions and to explain cross-sectional variation in expected returns through the lens of optimal investment decisions by firms.

If firms know the SDF and use it to make investment decisions, then firms should

set their perceived cost of capital in line with the SDF. Specifically, firms' perceived cost of capital should be the best available estimate of expected returns on firms' outstanding securities. The results presented so far show that this is not the case.

Despite the large mistakes in the perceived cost of capital, there are certain aspects of expected returns that are properly incorporated into the perceived cost of capital. The analysis in Section 3 suggests that time variation in expected returns and certain cross-sectional risk factors are properly incorporated. These findings raise the possibility that production-based asset pricing models revolving around these dimension may work well.

To explore the potential scope of production-based asset pricing, we expand the analysis of the stylized risk factors in Section 3.2 to a comprehensive analysis of all the risk factors studied in asset pricing. We estimate risk premia implied by the perceived cost of capital—which we refer to as "perceived risk premia"—for each of the 153 risk factors in the dataset of Jensen et al. (2023). We use a multifactor model that controls for the market and leverage, as explained in Section Appendix D.2. We compare these risk premia to the "true" long-run risk premia associated with the different factors, as estimated by Cho and Polk (2024).

Figure 10 illustrates the relation the between the perceived and the true risk premia. Jensen et al. (2023) group the 153 factors into seven main groups. Within each group, we project the perceived factor premia on the true premia. The figure reports the associated slope coefficients along with $R^2$ values for all groups except momentum.[15]

The figure reveals a strong relation between perceived and true factor premia for the category called "traditional risk factors and liquidity." This group includes risk factors based on volatility and skewness of stock returns as well as measures of liquidity. It also includes the size factor.[16] The slope coefficient and $R^2$ are both close to 1, suggesting a strong relation between perceived and true factor premia within this category. In unreported results, we find that the intercept is close to zero for this group, which suggests that the perceived premia are correct on average (given the slope is almost 1). The strong relation between perceived and true factor premia

[15]We exclude the momentum factors as these are transient factors that should not explain the cost of capital under the standard view. We indeed find slope coefficients close to zero, although standard errors are very large.

[16]Jensen et al. (2023) refers to the group as "trading frictions," but we refer to it as traditional risk given the inclusion of standard risk measures such as volatility, skewness, and size.

within this category is consistent with the results on the stylized drivers in Section 3.2.

For most other categories, however, we observe a weak relation between true and perceived factor premia. The slopes coefficients are close to zero. This finding suggests a limited relation between true and perceived factor premia within a category, but it does not rule out that the risk premia on average are correct within a category. For the value factors, for instance, the average perceived factor premium is positive, as is the case for the true premia, but the slope is low because the ranking of the perceived value premia is largely orthogonal to the ranking of the true value premia. For investment factors, the average factor premium has the wrong sign, and for the remaining groups the average factor premium is close to zero (see Appendix D.2). Taken together, the findings suggest that production-based asset pricing models revolving around traditional risk factors may be consistent with firms' perceptions of their cost of capital, but models revolving around other factor groups are more difficult to reconcile with data on firm perceptions.

## 7.2 Testing the Investment CAPM

We illustrate the challenges for production-based asset pricing through a test of the Investment CAPM (Hou et al. 2015). This model is used to account for cross-sectional variation in expected stock returns through the lens of rational behavior of firms. It is sometimes branded a rational explanation of asset pricing anomalies because it is consistent with rational expectations of managers. The model relies on specific assumptions about how firms' perceived cost of capital varies with expected stock returns. We test and reject these assumptions.

In the model, firm investment depends on the cost of capital and thereby expected stock returns. The model argues that expected returns, profitability, and investment are all directly related. If a firm is highly profitable but invests sparingly, it must be because the firm has a high cost of capital (i.e., high expected stock return). Following this argument, Hou et al. (2015) construct investment and profit factors and estimate that firms with high investment indeed have low expected stock returns (keeping profitability fixed). The authors, through the lens of the model, argue that this empirical finding must be driven by the fact that firms with high investment rates perceive that they have a low cost of capital and adjust their investment accordingly.

We showed in Table 5 that firms with high perceived cost of capital indeed invested less. On the surface, the data on the perceived cost of capital may thus appear consistent with the Investment CAPM. We document, however, that the perceived cost of capital does not align with the formulation of the model by Hou et al. (2015) and that the variation in the perceived CAPM, in fact, runs counter to the predictions of the model.

The issue relates to how Hou et al. (2015) measure investment. Our regressions in Table 5 measure investment as future net capital expenditure relative to the current value of property, plant, and equipment, as is standard in the literature on corporate investment. Hou et al. (2015) instead use past asset expansion (i.e., $\text{AssetExpansion}_t = \text{Assets}_t/\text{Assets}_{t-1}$). Asset expansion is a highly transitory investment measure that is almost orthogonal to the traditional capital expenditure measure that we consider (the correlation between the characteristics, measured in cross-sectional percent, is around 0.1). The Investment CAPM hinges on this choice of investment measure, as the model does not work if one uses traditional measures of investment (Cooper et al. 2024). For the Investment CAPM by Hou et al. (2015) to hold, it is thus crucial that the predictions work for the asset expansion measure.

Contrary to the prediction of the model, we find that firms with high past asset expansion do not have lower perceived cost of capital. If anything, the relation points toward a positive cross-sectional relation between past asset expansion and the perceived cost of capital. This finding suggest that firms with high asset expansion do not have high asset expansion because they perceive a low cost of capital, challenging the basic idea behind the Investment CAPM's interpretation of the data.

Our tests of the Investment CAPM are reported in Table 7. In the first three columns, we replicate the empirical finding of the Investment CAPM literature by regressing future realized stock returns on past asset expansion. We measure asset expansion in cross-sectional percentiles of the population of firms in the country in a given quarter (ranging from 0 to 1). In the first three columns, we consider all firms in the CRSP/Compustat sample and all quarters between January 2002 and December 2022. We find similar results to Hou et al. (2015). The relation between future stock returns and past asset expansion is strong, negative, and significant in column (1). It becomes even stronger when we condition on bins for deciles of firm profitability in column (2). Further controlling for market beta and size does not change the coefficient much in column (3).

In columns (4) to (6), we confirm that the same results also hold in the subsample of firm-quarter observations where we observe the perceived cost of capital. The slope coefficients are similar to the full sample, suggesting that our sample of firms is similar to the population along this dimension (see also Section 2.3).

In columns (7) to (9), we use the perceived cost of capital on the left-hand side instead of realized future stock returns. The slope coefficients are now of the opposite, positive sign: the greater asset expansion, the greater the perceived cost of capital. The effect is significant once we condition on profitability, as prescribed by the Investment CAPM. These results reject the fundamental idea behind the Investment CAPM. Firms with asset expansion (for a given level of profitability) do not have a low perceived cost of capital. The low future realized returns on high investment firms therefore cannot be interpreted as the outcome of an optimal capital budgeting decision where firms with low expected returns use a low cost of capital. We find similar results using discount rates (required returns to investment) on the left-hand side in Appendix F, suggesting that "as if" behavior cannot save the Investment CAPM.

We visualize the rejection of the Investment CAPM in Figure 11 using two binscatters. The left-hand panel shows a negative relation between future realized stock returns and past asset expansion (controlling for country, quarter, and profitability). The right-hand panel shows a positive relation between the ex ante perceived cost of capital and past asset expansion (using the same controls). The opposite slopes are inconsistent with the Investment CAPM. The analysis of the Investment CAPM thus shows how our new data on the predicted cost of capital can be used to test production-based asset pricing models.

# 8 Conclusion

A bedrock assumption of standard investment models is that firms perfectly know their cost of capital and invest accordingly. We indeed find that firms' perceptions of their cost of capital shape their long-run capital allocation in accordance with theory. We also find that firms' perceptions of their cost of capital follow standard theory along a few dimensions. For instance, the average perceived cost of capital fluctuates correctly over time with interest rates and risk premia. Similarly, firms incorporate traditional cross-sectional drivers of expected returns in their perceived cost of capital.

However, only 20% of the variation in the perceived cost of capital can be justified

by variation in risk premia and interest rates. The remaining 80% of the variation reflects deviations from the standard assumptions about the cost of capital. The deviations are large enough to lead to substantial misallocation of capital. In our baseline estimates, the deviations decrease aggregate TFP by around 5%. The allocation of capital would, in fact, be closer to optimal in the extreme hypothetical scenario where all firms were forced to use the same cost of capital, as used to be the case for state-owned enterprises in China (He et al. 2022).

One interpretation of the deviations is that they reflect mistakes. It is plausible that firms try to incorporate risk premia and interest rates into their cost of capital in accordance with standard principles, but that they fail to do so correctly. This interpretation is supported by the fact that estimating the cost of capital is notoriously difficult (Fama and French 1997, Pástor and Stambaugh 1999) and the fact that many agents are known to have biased beliefs about expected returns (Greenwood and Shleifer 2014, Nagel and Xu 2022). It is also supported by the observations that deviations are driven by persistent, firm-specific terms, that large, arguably more sophisticated, firms perceive their cost of capital with less error, and that the deviations in firm perceptions arise from the cost of equity, rather than the cost of debt.

One of the main lessons taught in business school is that firms should account for risk in their investment decisions and that they should do so by using an appropriate cost of capital (Welch 2011). Our results suggest that most firms fail to implement this lesson properly. Absent better guidance on how to determine the cost of capital, the current business school curriculum may be counterproductive relative to a benchmark where firms ignore cross-sectional variation in risk and all firms use the same cost of capital. We accordingly provide new methods to help managers better estimate their cost of capital.

The results challenge the assumption that firms rationally know their cost of capital. A prominent literature that relies on this assumption to study asset prices and firm investment is production-based asset pricing. We formally show that the data on the perceived cost of capital are inconsistent with the "Investment CAPM," a prominent production-based model. However, more generally, the assumption that firms know their cost of capital plays a key role in much of modern macro-finance. Future work may find it helpful to account for the large differences between firms' perceived cost of capital and their true cost of capital. To this end, we share predicted data on firms'

perceived cost of capital and discount rates online under costofcapital.org.

## References


Benjamini, Y. and Y. Hochberg (1995): "Controlling the false discovery rate: a practical and powerful approach to multiple testing," *Journal of the Royal statistical society: series B (Methodological)*, 57, 289–300.

Broda, C. and D. E. Weinstein (2006): "Globalization and the Gains from Variety," *The Quarterly journal of economics*, 121, 541–585.

Campbell, J. Y. (1996): "Understanding Risk and Return," *Journal of Political Economy*, 104, 298–345.

Campbell, J. Y. and R. J. Shiller (1988): "Stock Prices, Earnings, and Expected Dividends," *Journal of Finance*, 43, 661–676.

Cho, T. and C. Polk (2024): "Putting the Price in Asset Pricing," *Journal of Finance, forthcoming*.

Cho, T. and A. Salarkia (2020): "Which Asset Pricing Model Do Firms Use? A Revealed Preference Approach," .

Claus, J. and J. Thomas (2001): "Equity premia as low as three percent? Evidence from analysts' earnings forecasts for domestic and international stock markets," *The Journal of Finance*, 56, 1629–1666.

Cochrane, J. H. (2001): *Asset Pricing*, Princeton, NJ: Princeton University Press.

——— (2011): "Presidential Address: Discount Rates," *Journal of Finance*, 66, 1047–1108.

Cooper, M., H. Gulen, and M. Ion (2024): "The use of asset growth in empirical asset pricing models," *Journal of Financial Economics*, 151, 103746.

Daniel, K., D. Hirshleifer, and L. Sun (2020): "Short-and long-horizon behavioral factors," *The review of financial studies*, 33, 1673–1736.

Daniel, K. and S. Titman (1997): "Evidence on the Characteristics of Cross Sectional Variation in Stock Returns," *Journal of Finance*, 52, 1–33.

David, J. M., H. A. Hopenhayn, and V. Venkateswaran (2016): "Information, Misallocation, and Aggregate Productivity," *The Quarterly Journal of Economics*, 131, 943–1005.

David, J. M., L. Schmid, and D. Zeke (2022): "Risk-Adjusted Capital Allocation and Misallocation," *Journal of Financial Economics*, 145, 684–705.

David, J. M. and V. Venkateswaran (2019): "The Sources of Capital Misallocation," *American Economic Review*, 109, 2531–2567.

Easton, P. D. (2004): "PE ratios, PEG ratios, and estimating the implied expected rate of return on equity capital," *The accounting review*, 79, 73–95.

Engelberg, J., R. D. McLean, and J. Pontiff (2020): "Analysts and Anomalies," *Journal of Accounting and Economics*, 69, 101249.

Eskildsen, M., M. Ibert, T. Jensen, and L. Pedersen (2024): "In Search of the True Greenium," *Copenhagen Business School Working Paper*.

Fama, E. F. and K. R. French (1988): "Dividend Yields and Expected Stock Returns," *Journal of Financial Economics*, 22, 3–25.

——— (1992): "The Cross-Section of Expected Stock Returns," *Journal of Finance*, 47, 427–465.

——— (1993): "Common Risk Factors in the Returns on Stocks and Bonds," *Journal of Financial Economics*, 33, 3–56.

——— (1997): "Industry Costs of Equity," *Journal of financial economics*, 43, 153–193.

Frazzini, A. and L. H. Pedersen (2014): "Betting against beta," *Journal of Financial Economics*, 111, 1–25.

Fukui, M., N. J. Gormsen, and K. Huber (2024): "Sticky Discount Rates," *University of Chicago Working Paper*.

Gabaix, X. and R. S. Koijen (2021): "In Search of the Origins of Financial Fluctuations: The Inelastic Markets Hypothesis," .

Gebhardt, W. R., C. M. Lee, and B. Swaminathan (2001): "Toward an implied cost of capital," *Journal of accounting research*, 39, 135–176.

Giglio, S., M. Maggiori, J. Stroebel, and S. Utkus (2021): "Five Facts About Beliefs and Portfolios," *American Economic Review*, 111, 1481–1522.

Giroud, X., G. Matvos, A. Seru, and R. C. Silva (2022): "Managing Resource (Mis)allocation," .

Gormsen, N. J. and K. Huber (2024): "Corporate Discount Rates," *University of Chicago Working Paper*.

Gormsen, N. J., K. Huber, and S. Oh (2023): "Climate capitalists," *University of Chicago Working Paper*.

Graham, J. R. (2022): "Presidential Address: Corporate Finance and Reality," *Journal of Finance*, 77, 1975–2049.

Graham, J. R. and C. R. Harvey (2001): "The Theory and Practice of Corporate Finance: Evidence from the Field," *Journal of Financial Economics*, 60, 187–243.

Greenwood, R. and A. Shleifer (2014): "Expectations of Returns and Expected Returns," *Review of Financial Studies*, 27, 714–746.

Hadlock, C. J. and J. R. Pierce (2010): "New Evidence on Measuring Financial Constraints: Moving beyond the KZ Index," *Review of Financial Studies*, 23, 1909–1940.

Hassan, T. A., S. Hollander, L. Van Lent, and A. Tahoun (2019): "Firm-Level Political Risk: Measurement and Effects," *Quarterly Journal of Economics*, 134, 2135–2202.

He, Z., G. Liao, and B. Wang (2022): "What gets measured gets managed: Investment and the cost of capital," Tech. rep., National Bureau of Economic Research.

Hendel, I. and A. Nevo (2006): "Measuring the implications of sales and consumer inventory behavior," *Econometrica*, 74, 1637–1673.

Hommel, N., A. Landier, and D. Thesmar (2023): "Corporate Valuation: An Empirical Comparison of Discounting Methods," .

Hou, K., C. Xue, and L. Zhang (2015): "Digesting Anomalies: An Investment Approach," *Review of Financial Studies*, 28, 650–705.

Hsieh, C.-T. and P. J. Klenow (2009): "Misallocation and manufacturing TFP in China and India," *The Quarterly journal of economics*, 124, 1403–1448.

Jacobs, M. T. and A. Shivdasani (2012): "Do You Know Your Cost of Capital?" *Harvard Business Review*, 90, 118–124.

Jagannathan, R., D. Matsa, I. Meier, and V. Tarhan (2016): "Why Do Firms Use High Discount Rates?" *Journal of Financial Economics*, 120, 445–463.

Jensen, T. I. (2022): "Subjective Risk and Return," .

Jensen, T. I., B. Kelly, and L. H. Pedersen (2023): "Is there a replication crisis in finance?" *The Journal of Finance*, 78, 2465–2518.

Kelly, B., D. Xiu, et al. (2023): "Financial machine learning," *Foundations and Trends® in Finance*, 13, 205–363.

Keloharju, M., J. T. Linnainmaa, and P. Nyberg (2019): "Long-term Discount Rates Do Not Vary Across Firms," .

Kozak, S., S. Nagel, and S. Santosh (2018): "Interpreting factor models," *Journal of Finance*, 73, 1183–1223.

Krüger, P., A. Landier, and D. Thesmar (2015): "The WACC fallacy: The real effects of using a unique discount rate," *Journal of Finance*, 70, 1253–1285.

Lee, C. M., E. C. So, and C. C. Wang (2021): "Evaluating firm-level expected-return proxies: implications for estimating treatment effects," *The Review of Financial Studies*, 34, 1907–1951.

Martin, I. W. and S. Nagel (2022): "Market Efficiency in the Age of Big Data," *Journal of Financial Economics*, 145, 154–177.

Modigliani, F. and M. H. Miller (1958): "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review*, 48, 261–297.

Mukhlynina, L. and K. G. Nyborg (2016): "The Choice of Valuation Techniques in Practice: Education versus Profession," .

Nagel, S. (2019): "Investor expectations, asset prices, and corporate policies," *Keynote lecture at the 2019 COAP Conference at Cass Business School*.

Nagel, S. and Z. Xu (2022): "Dynamics of Subjective Risk Premia," .

Ohlson, J. A. and B. E. Juettner-Nauroth (2005): "Expected EPS and EPS growth as determinantsof value," *Review of accounting studies*, 10, 349–365.

Pástor, L. and R. F. Stambaugh (1999): "Costs of Equity Capital and Model Mispricing," *Journal of Finance*, 54, 67–121.

Pástor, L., R. F. Stambaugh, and L. A. Taylor (2022): "Dissecting green returns," *Journal of Financial Economics*, 146, 403–424.

Pedersen, L. H. (2019): *Efficiently inefficient: how smart money invests and market prices are determined*, Princeton University Press.

Poterba, J. M. and L. H. Summers (1995): "A CEO survey of US companies' time horizons and hurdle rates," *MIT Sloan Management Review*, 37, 43.

Restuccia, D. and R. Rogerson (2017): "The Causes and Costs of Misallocation," *Journal of Economic Perspectives*, 31, 151–174.

Rogers, J. L., A. Van Buskirk, and S. L. Zechman (2011): "Disclosure Tone and Shareholder Litigation," *The Accounting Review*, 86, 2155–2183.

Shiller, R. J. (1981): "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?" *American Economic Review*, 71, 421–436.

Shleifer, A. and R. W. Vishny (1997): "The limits of arbitrage," *The Journal of finance*, 52, 35–55.

Stein, J. (1996): "Rational Capital Budgeting in an Irrational World," *Journal of Business*, 69, 429.

Welch, I. (2011): *Corporate finance*, Ivo Welch.

## Table 1
## Summary Statistics

This table reports summary statistics at the level of firm-quarter observations. The perceived cost of capital, the perceived cost of debt, and the discount rate are observed in the conference call data and reported in percent. The levels of the perceived costs and the discount rate cannot be directly compared because some firms do not account for overhead in the discount rate (see Gormsen and Huber 2024 for details). The sample includes the years between 2002 to 2022.

| | N | mean | p5 | p95 |
|---|---|---|---|---|
| Perceived cost of capital | 3,139 | 8.67 | 5.30 | 13.0 |
| Perceived cost of debt | 5,165 | 4.66 | 1.70 | 8.90 |
| Perceived cost of equity | 485 | 10.3 | 5.00 | 15.0 |
| Discount rate | 3,286 | 15.4 | 8.00 | 25.0 |

## Table 2
## Time Variation in the Perceived Cost of Capital

This table reports regressions of the firm-level perceived cost of capital on the contemporaneous earnings yield plus expected inflation of the stock market in the country of the firm as well as on the long-term interest rates in the country. Firms are denoted by $i$ and $k$ denotes the country of residence of firm $i$. The sample includes 2002 to 2022. Standard errors are clustered by firm. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) |
|---|---|---|---|
| | Perceived Cost of Capital$_{i,t}$ | | |
| Sample: | U.S. only | | Global |
| Earnings yield + exp. inf$_{k,t}$ | 0.52*** | 0.59*** | 0.51*** |
| | (0.12) | (0.22) | (0.12) |
| Long-term interest rate$_{k,t}$ | 0.28*** | 0.32*** | 0.25*** |
| | (0.077) | (0.065) | (0.041) |
| Observations | 1,543 | 1,543 | 2,625 |
| R-squared | 0.051 | 0.84 | 0.89 |
| FE | None | Firm | Firm |
| $R^2$ | 0.051 | 0.89 | 0.89 |
| Within $R^2$ | 0.051 | 0.16 | 0.15 |

## Table 3
## Excess Dispersion in the Perceived Cost of Capital

This table present results of regressions of forecast errors in the perceived cost of capital onto the ex ante perceived cost of capital. In Panel A, we proxy for the true cost of capital using future realized 3-year returns, as explained in Section 4.3. In Panel B, we proxy for the true cost of capital using the implied cost of capital, as explained in Section 4.4. The estimates in column (1) represent the share of excess dispersion (see Section 4.2). The sample includes 2002 to 2022. Standard errors in Panel A are double clustered at the firm and year level and standard errors in Panel B are double clustered at the industry and year level. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

| | Panel A: Market-based CoC based on realized returns$_{i,t\to t+3\text{years}}$ | | | |
|---|---|---|---|---|
| Perceived CoC$_{i,t}$ | 0.89*** | 1.09*** | 0.77** | 0.90*** |
| | (0.29) | (0.27) | (0.30) | (0.30) |
| Controls: | | | | |
| Beta/size/value | | | X | X |
| FE | None | Country/Year | None | Country/Year |
| P(slope = 1) | 0.93 | 0.81 | 0.83 | 0.92 |
| Observations | 1,652 | 1,652 | 1,652 | 1,652 |
| $R^2$ | 0.017 | 0.15 | 0.021 | 0.16 |

| | Panel B: Market-based CoC based on implied cost of capital$_{i,t}$ | | | |
|---|---|---|---|---|
| | OLS | | 2SLS | |
| Perceived CoC$_{i,t}$ | 0.83*** | 0.91*** | 0.53*** | 0.61*** |
| | (0.052) | (0.043) | (0.11) | (0.14) |
| Instrument | | | Predicted perceived cost of capital$_{i,t}$ | |
| FE | None | Country/Year | None | Country/Year |
| P(slope = 1) | 0.0044 | 0.062 | 0.000011 | 0.011 |
| Observations | 2,105 | 2,105 | 1,557 | 1,556 |
| $R^2$ | 0.325 | 0.394 | 0.319 | 0.343 |

## Table 4
## Excess Dispersion Using Alternative Estimates of Cost of Capital

This table estimates excess dispersion in four different measures of the cost of capital, all detailed in Section 5. The first is the perceived cost of capital. The second is the CAPM-based cost of capital, which estimates the cost of equity using the CAPM. The third is the CAPE-based cost of capital, which estimates the cost of equity based on the earnings yield of the aggregate stock market in the country. The fourth uses a constant cost of equity of 6% for all firms, as implied by the historical average. The sample includes 2002 to 2022 and only quarters for which we observe the perceived cost of capital of a given firm. Standard errors are double clustered at the firm and year level. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Measure of cost of capital | | | |
| | Perc. CoC | CAPM-based CoC | CAPE-based CoC | Constant CoE |
| Excess dispersion based on: | | | | |
| Realized returns | 0.89*** | 1.40*** | 0.27 | 0.36 |
| | (0.29) | (0.42) | (0.27) | (0.40) |
| Implied CoC | 0.83*** | 0.55*** | 0.25 | -0.21** |
| | (0.052) | (0.068) | (0.16) | (0.090) |

## Table 5
## Long-Run Capital Allocation and the Perceived Cost of Capital

This table reports panel regressions of firm-level real outcomes on the firm's ex ante perceived cost of capital. In columns (1) and (2), the left-hand side variable is the return on invested capital (ROIC). We calculate the ROIC using Compustat as [earnings before interest] over [long-term book debt plus book equity minus cash minus financial investments]. In columns (3) and (4), the left-hand side variable is the ratio of capital to labor. We measure capital as net property, plant, and equipment (PPEN) and labor as number of employees. In columns (5) and (6), the left-hand side variable is long-run investment. Long-run investment is the average net investment rate over the subsequent five years. We calculate net investment as capital expenditure minus depreciation over the lagged value of property, plant, and equipment (PPEN). Panel B augments these regressions with the implied cost of capital as well as interest expense of the firm in the same quarter. The sample includes 2002 to 2022. Standard errors are double clustered at the firm and year level. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | $ROIC_{i,t}$ | | $Capital/labor_{i,t}$ | | $Long\text{-}run\ investment_{i,t+5}$ | |
| Perc. $CoC_{i,t}$ | 0.74** | 0.63** | -17.3*** | -18.6*** | -0.78** | -0.84* |
| | (0.31) | (0.25) | (2.91) | (3.26) | (0.36) | (0.43) |
| Implied $CoC_{i,t}$ | | -0.40* | | -3.74** | | 0.24 |
| | | (0.23) | | (1.65) | | (0.21) |
| $Interest\ expense_{i,t}$ | | -0.035 | | -2.89*** | | 0.23 |
| | | (0.16) | | (1.09) | | (0.31) |
| Country-year FE | X | X | X | X | X | X |
| Observations | 1,979 | 1,546 | 2,338 | 1,892 | 1,371 | 1,133 |
| $R^2$ | 0.036 | 0.049 | 0.24 | 0.25 | 0.088 | 0.099 |

## Table 6
## Misallocation from Excess Dispersion in the Perceived Cost of Capital

Panel A of this table reports the TFP loss arising from long-run excess dispersion in the perceived cost of capital, according to the model of Section 6.2 and using equation (17). The baseline elasticity of substitution, $\sigma$, is set to 4. Panel B reports the average firm-level capital distortion for three different cost of capital measures. The average capital distortion equals the percent difference between the long-run level of capital implied by the given cost of capital measure and the level of capital implied by the true cost of capital.

| | |
|---|---|
| Panel A: Impact of excess dispersion on TFP | |
| Excess dispersion estimated using realized returns (baseline) | -5.36% |
| Excess dispersion estimated using implied cost of capital | -5.02% |
| Low elasticity of substitution ($\sigma = 3$) | -4.02% |
| High elasticity of substitution ($\sigma = 5$) | -6.70% |
| Panel B: Average capital distortion under various cost of capital measures | |
| Distortion from observed $r^{\text{perc.}}$ | 24.2% |
| Distortion if all firms applied the same $r^{\text{perc.}}$ | 10.9% |
| Distortion if all firms applied suggested CAPE-based method | 5.8% |

## Table 7
## Testing the Investment CAPM

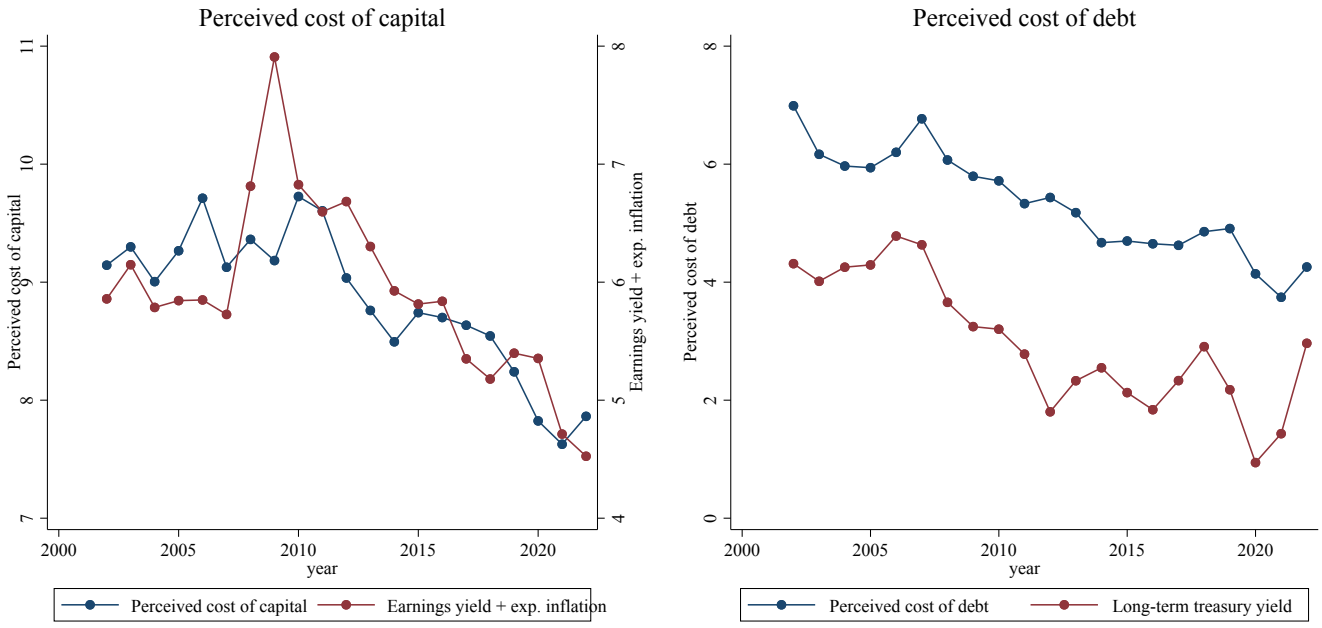
This table reports panel regressions of firm-level expected return measures on firm-level characteristics that are used by the "Investment CAPM". In columns (1) to (3), we regress future 3-year realized stock returns on ex ante investment characteristic, along with controls. In columns (4) to (6), we run the same regression for subset of firm-quarter observations where we also observe the firm-level perceived cost of capital. In columns (7) to (9), we run the same regressions but instead using perceived cost of capital as the dependent variable. All regressions include country and quarter fixed effects. We control for three different ex ante firm-level characteristics, namely fixed effects for 10 bins of beta, size, and return on equity (profitability). The asset expansion (investment) characteristic is growth in total assets over the previous year, measured in cross-sectional percentiles ranging from 0 to 1. The sample includes 2002 to 2022. Standard errors are double clustered at the firm and year level. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | |
|---|---|---|---|---|---|---|---|---|---|
| | All firm/quarters | | | Firm/quarters with observed perceived cost of capital | | | | | |
| | Realized stock returns | | | Realized stock returns | | | Perceived cost of capital | | |
| Asset expansion | -1.43** | -6.58*** | -4.61*** | -3.01 | -4.60* | -4.40* | 0.40 | 0.57** | |
| | (0.61) | (1.35) | (1.19) | (2.28) | (2.45) | (2.20) | (0.24) | (0.25) | |
| Controls: | | | | | | | | | |
| Profits bins | | X | X | | X | X | | X | |
| Beta bins | | | X | | | X | | | |
| Size bins | | | X | | | X | | | |
| Observations | 739,481 | 723,243 | 722,926 | 1,352 | 1,334 | 1,334 | 2,000 | 1,960 | |
| R-squared | 0.118 | 0.158 | 0.183 | 0.215 | 0.230 | 0.264 | 0.187 | 0.217 | |
| Cluster | Country/Quarter | Country/Quarter | Country/Quarter | Country/Quarter | Country/Quarter | Country/Quarter | Firm/Quarter | Firm/Quarter | Firm |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

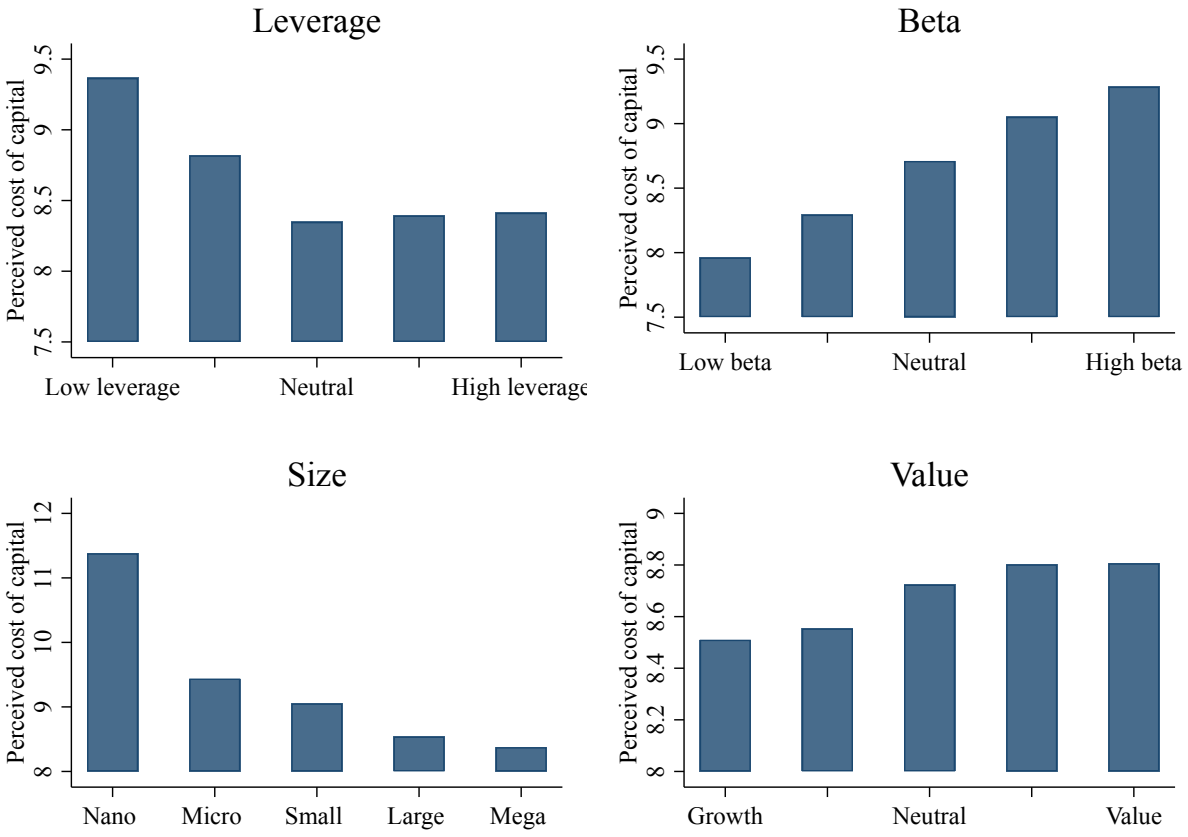
## Figure 1
## The Time Series of the Perceived Cost of Capital

In the left-hand figure, we plot the average cost of capital of US firms along with the earnings yield for the US stock market (the inverse of the CAPE ratio) plus expected long-run inflation from the Michigan survey. In the right-hand figure, we plot the average cost of debt of US firms along with the long-term Treasury yield.



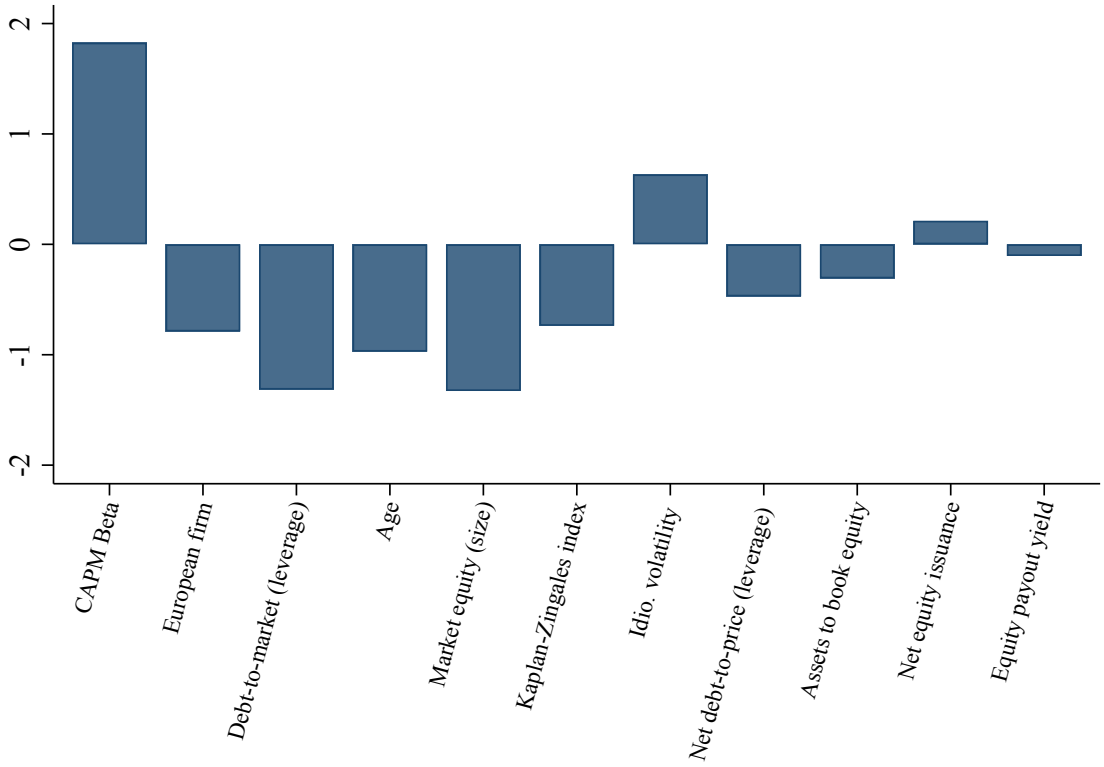
## Figure 2
## The Cross Section of the Perceived Cost of Capital

This figure shows the perceived of capital for firms sorted into bins based on four firm-level characteristics. The characteristics are leverage, market beta, size, and value. Leverage, beta, and, book-to-market are measured in cross-sectional percentiles of the population of firms in a country in a given quarter. For size, we assign all firms to one of 5 size categories based on the categorization by Jensen et al. (2023). The three other characteristics are sorted into equal-sized groups. The sample includes 2002 to 2022.



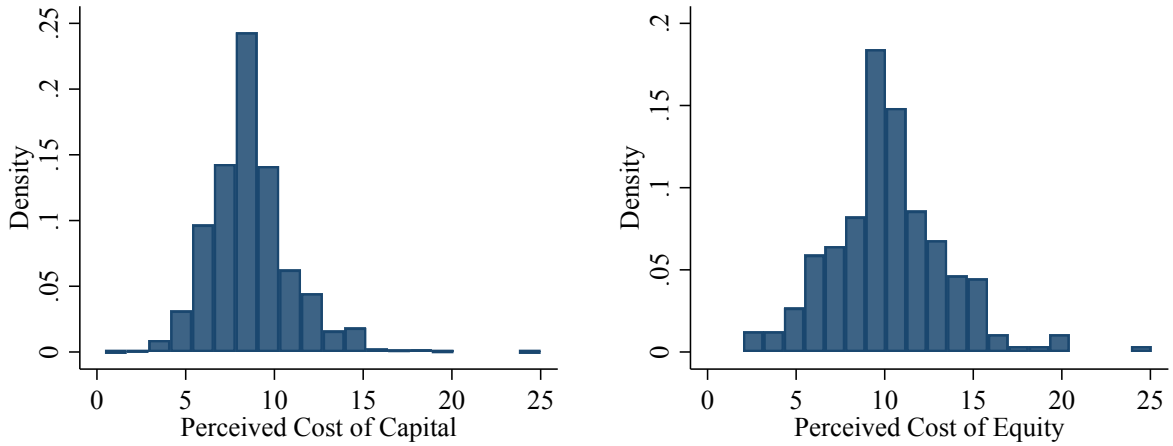
## Figure 3
## A Parsimonious Model of the Perceived Cost of Capital

This figure shows slope coefficients from regressions of predicted values of the firm-level perceived cost of capital on the variables selected by the Lasso procedure. The dependent variable in the Lasso regression is the firm-level perceived cost of capital in a given quarter. The set of possible explanatory variables includes firm exposure to the 153 risk factors in Jensen et al. (2023)—which are measured by firm characteristics—as well as a dummy for the region (US versus European firm). The firm-level characteristics are measured in cross-sectional percentiles of the universe of firms in the same country and same year, ranging from 0 (lowest) to 1 (highest). The left-hand side is measured in percentage points, so a loading of 1 means that the perceived cost of capital is predicted to be 1 percentage points higher for firms with the highest characteristics relative to firms with the lowest. The sample includes firms in Europe and the US between 2002 and 2022.



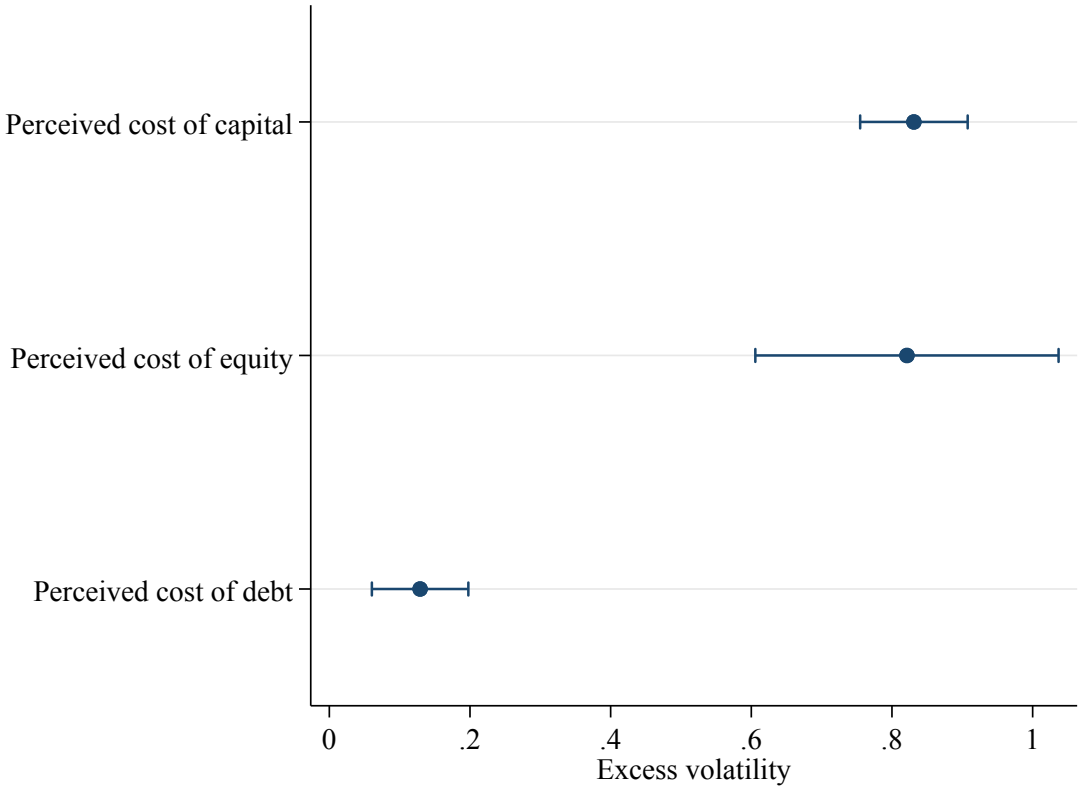
## Figure 4
## Histograms for the Perceived Cost of Capital and Equity

This figure shows histograms for the perceived cost of capital and the perceived cost of equity for all observations in the conference call data.



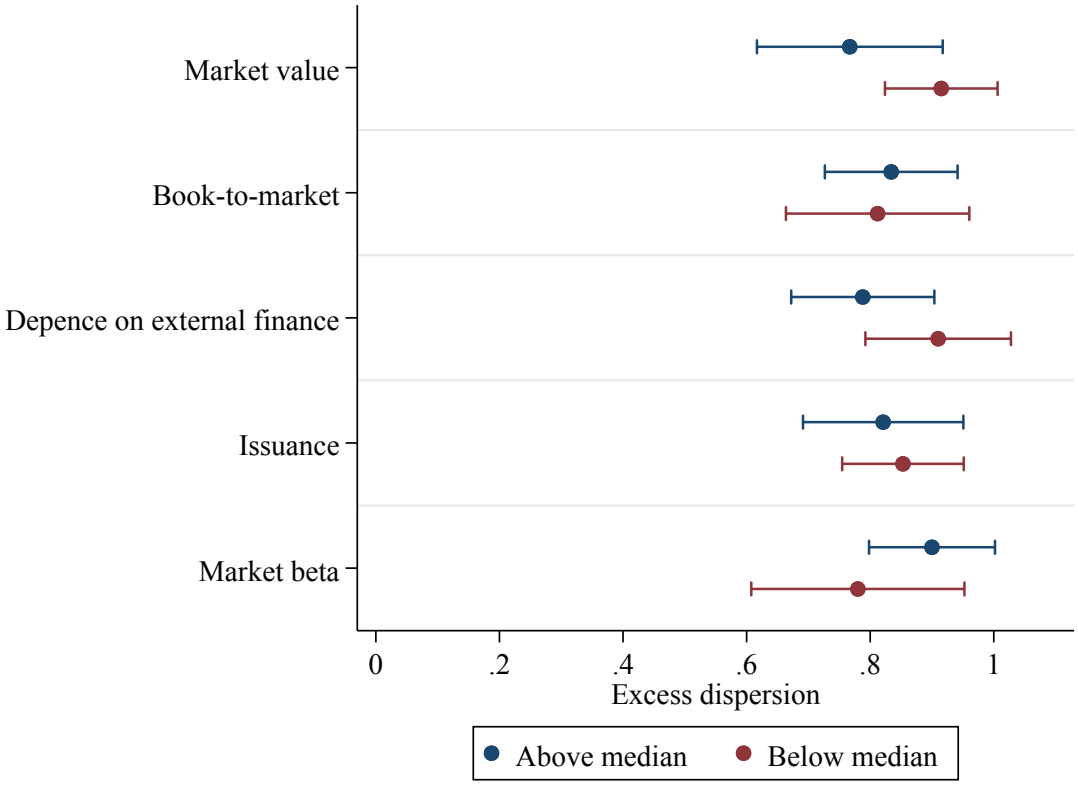
## Figure 5
## Excess Dispersion in the Perceived Cost of Capital, Equity, and Debt

This figure shows the fractions of the overall variance of the perceived cost of capital, equity, and debt that constitute excess dispersion. Excess dispersion in a perceived cost equals the slope coefficient in a regression of the error in the perceived cost on the perceived cost (see Section 4.2). The error in the perceived cost of capital is estimated using the implied cost of capital method, as in Table 3, Panel B. The error in the perceived cost of equity is calculated relative to the implied cost of equity. The error in the perceived cost of debt is calculated relative to the same measure of true cost of debt as the one used for the cost of capital. Standard errors are double clustered at the firm and year level. The bars represent 95% confidence intervals.



## Figure 6
## Excess Dispersion in the Perceived Cost of Capital: Heterogeneity

This figure shows excess dispersion in the perceived cost of capital for different subsets of the sample. For each of the five characteristics, we split the sample into two subsamples and estimate excess dispersion in both subsamples. We split based on the median characteristic measured in ex ante percentiles of a given country at a given time. We estimate excess dispersion using the method based on the implied cost of capital, as in Table 3, Panel B. The five characteristics are market capitalization, book-to-market, dependence on external finance (measured using the Kaplan-Zingales index), net issuance relative to assets, and market beta based on 5 years of monthly data. The sample includes 2002 to 2022. Standard errors are double clustered at the firm and year level. The bars represent 95% confidence intervals.

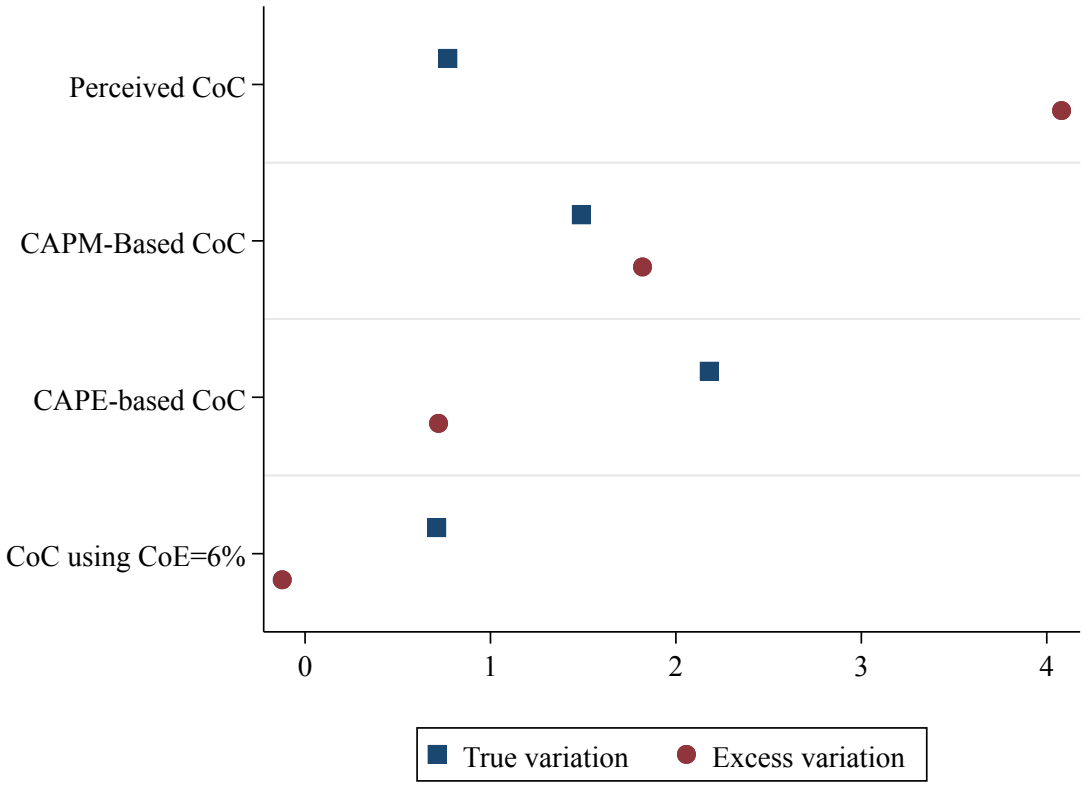


## Figure 7
## Excess and True Variation Under Alternative Measures

This figure shows the raw excess and true variation for different measures of the cost of capital. The excess and true variation are defined as in equation 10:

$$\text{var}\left(r_{i,t}^{\text{perc.}}\right) = \underbrace{\text{cov}\left(r_{i,t}^{\text{perc.}}, r_{i,t}^{\text{true}}\right)}_{\text{true variation}} + \underbrace{\text{cov}\left(r_{i,t}^{\text{perc.}}, \upsilon_{i,t}\right)}_{\text{excess variation}}.$$

The estimates of true and excess variation are calculated using the implied cost of capital method. In the first row of the figure, we consider the estimates for the observed perceived cost of capital. In the next row, our candidate measure is the CAPM-based cost of capital. In the third row, the candidate measure is the CAPE-based cost of capital. In the final row, the cost of capital measure assumes a constant cost of equity of 6%. The reported covariance terms are measured in squared percent. The sample includes 2002 to 2022.

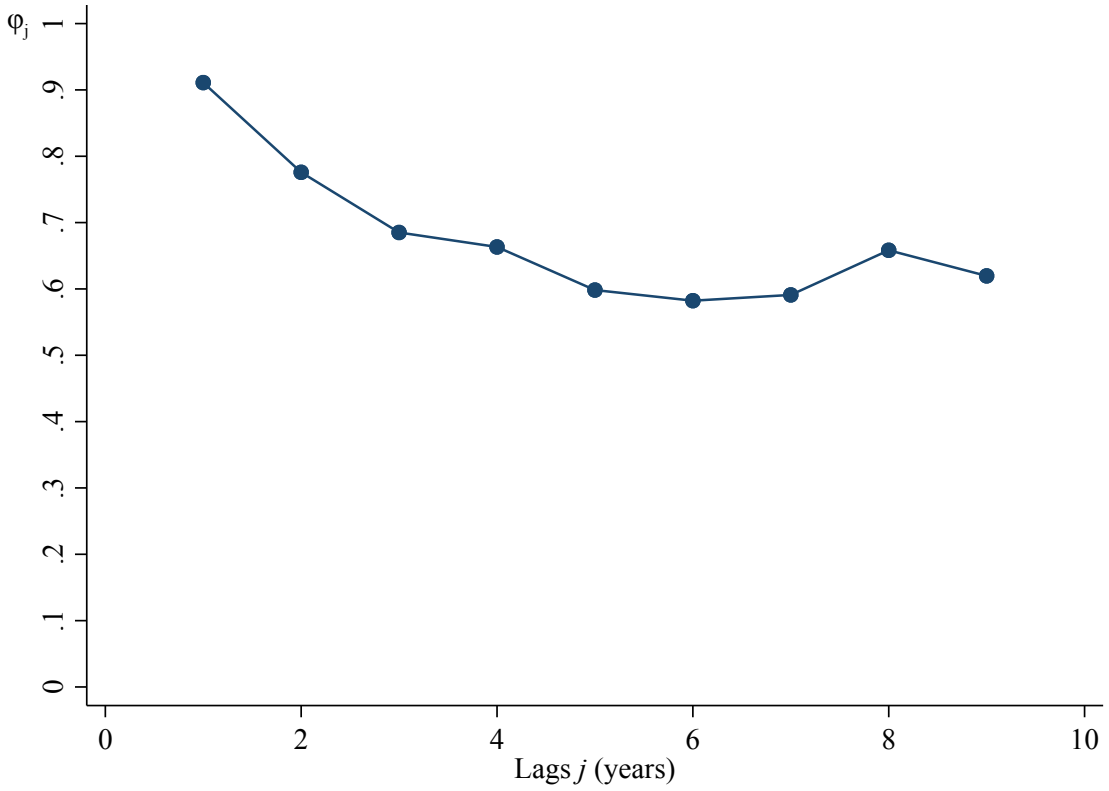


## Figure 8
## Persistence in the Perceived Cost of Capital

This figure shows slope coefficients $\varphi_j$ from the following regression of the perceived cost of capital on lags of the perceived cost of capital of the same firm:

$$r_{i,t}^{\text{perc.}} = \sum_{j=1}^{9} \varphi_j r_{i,t-j}^{\text{perc.}} + FE_j + e_{i,t},$$

where $FE_j$ represent lag-specific fixed effects and $j = (1, .., 9)$ the difference in years between the left- and right-hand side observation of the perceived cost of capital. The group $j = 9$ includes all observations with differences above 9 years. We smooth estimates for $j \neq 1$ and 9 by averaging $\varphi_j$ across the two nearest $j$s.

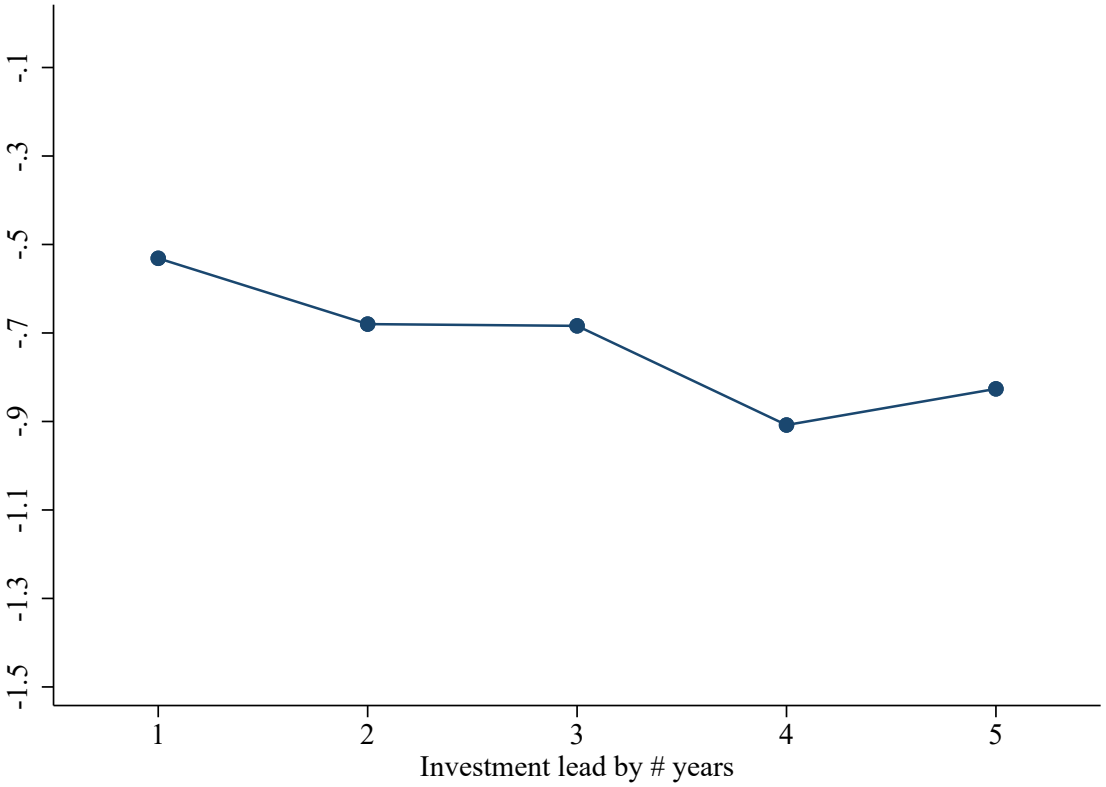


## Figure 9
## The Perceived Cost of Capital and Future Real Investment

This figure shows slope coefficients $\beta_j$ from regressions of a future net investment rate on the ex ante perceived cost of capital:

$$\text{Net Investment}_{i,t+j} = a_j + \beta_j r_{i,t}^{\text{perc.}} + FE_t + e_{i,t+j},$$

where $\text{Net Investment}_{i,t+j}$ is the net investment rate of firm $i$ in period $t+j$, measured as ($\text{capex}_{t+j}$ - $\text{depreciation}_{t+j}$)/$\text{PPEN}_{t+j-1}$. The regressions include year fixed effects.

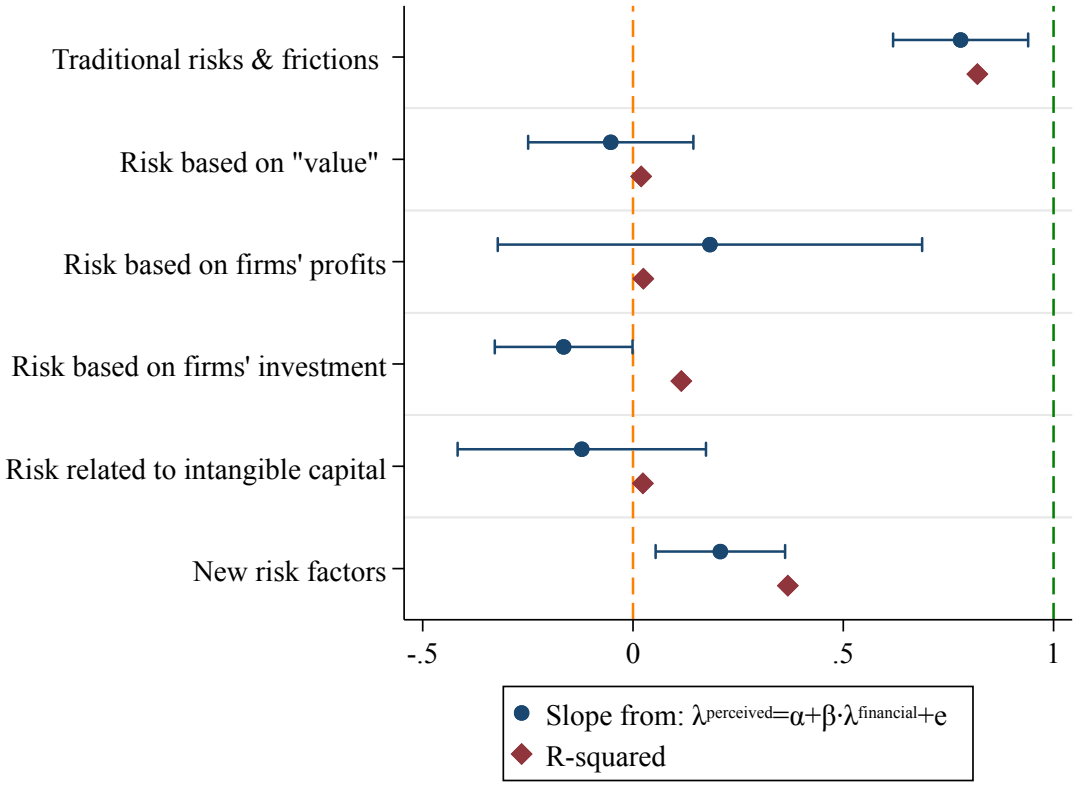


## Figure 10
## Perceived versus True Premia for Risk Factors

This figure shows slope coefficients from regressions of risk premia reflected in the perceived cost of capital and the "true" risk premia estimated in financial markets. For each group of risk factors $M$, we run the regressions

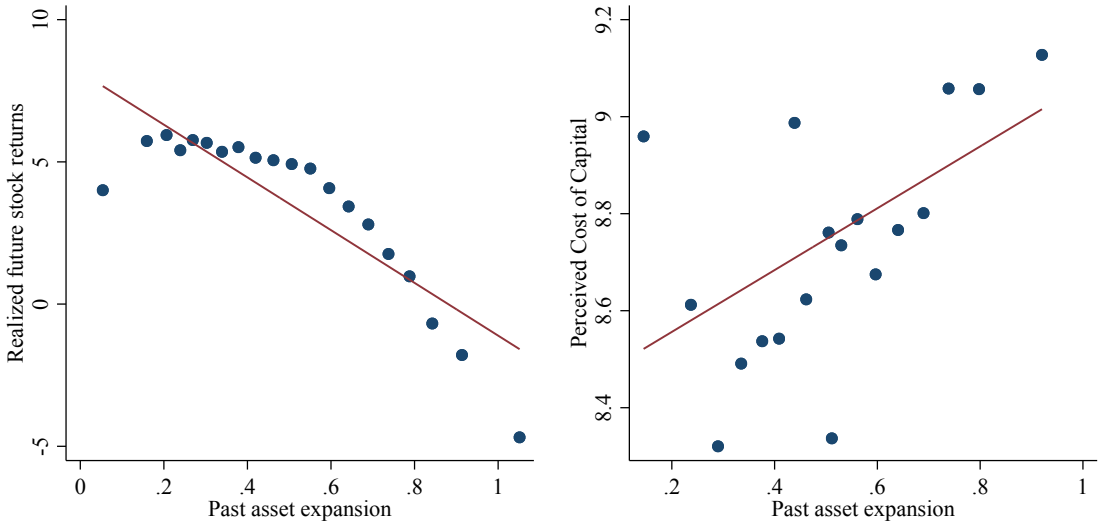
$$\lambda_k^{\text{perc.}} = a_M + \beta_M \lambda_k^{\text{true}} + e_{i,t},$$

where $\lambda_k^{\text{perc.}}$ and $\lambda^{\text{true}}$ are the risk premia for the $k^{\text{th}}$ risk factor in $M$. For each factor $k$, the associated risk premium is estimated in a model that controls for the market risk factor. The true risk premia are from Cho and Polk (2024) and the perceived risk premia are estimated as explained in the text. We observe 153 risk factors in total that are grouped into six groups following Jensen et al. (2023). Standard errors are double clustered at the firm and year level. The bars represent 95% confidence intervals.



## Figure 11
## Testing the Investment CAPM

This figure shows binscatters of future realized stock returns and the perceived cost of capital against the firm-level investment rate. The left-hand figure plots the realized future 3-year return against the ex ante investment of the firm. Investment is measured as asset expansion and in cross-sectional percentiles of the population of firms in the same country and year. The right-hand figure plots the perceived cost of capital against firm-level investment. Both plots control for country-quarter fixed effects as well as profit bins of the given firms. Profit bins are based on the return on equity, which is measured in cross-sectional percentiles of the full population of firms in the country in a given quarter. The sample includes 2002 to 2022.

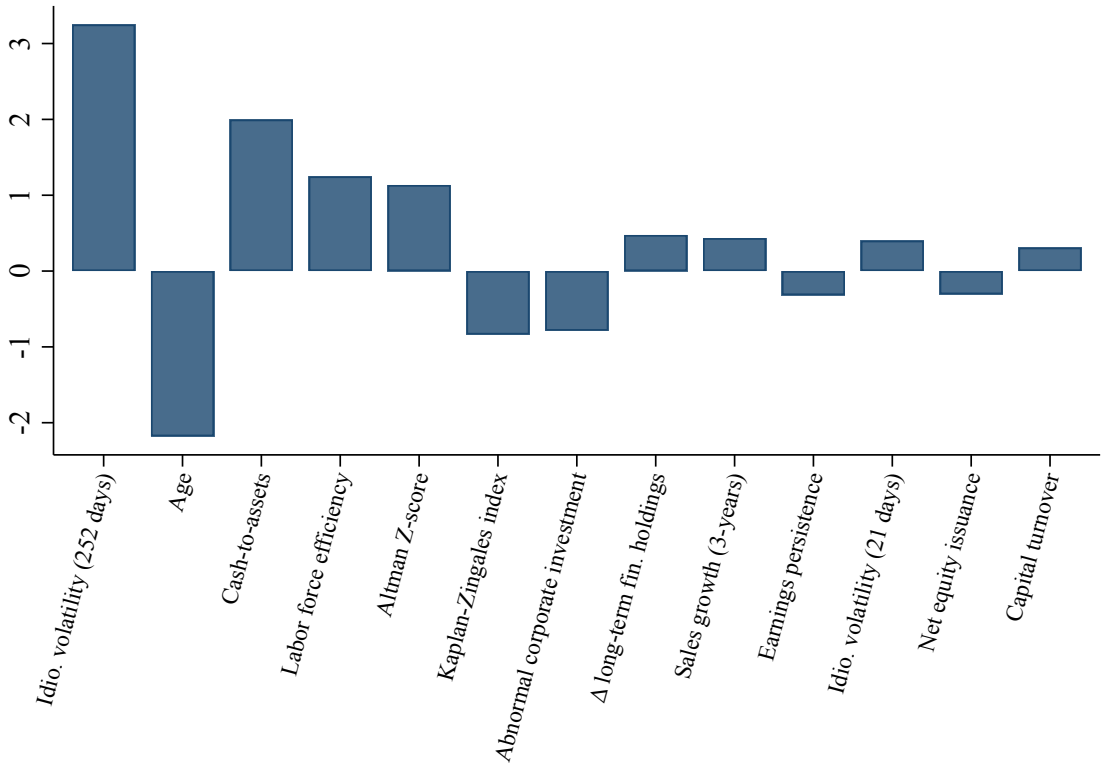


# Online Appendix

## Appendix A Figures and Tables

### Figure A1
### A Parsimonious Model of Firm Discount Rates

This figure shows slope coefficients from regressions of predicted values of the firm-level discount rate on the variables selected by the Lasso procedure. The dependent variable in the Lasso regression is the firm-level discount rate in a given quarter. The set of possible explanatory variables includes firm exposure to the 153 risk factors in Jensen et al. (2023)—which are measured by firm characteristics—as well as a dummy for the region (US versus European firm). The firm-level characteristics are measured in cross-sectional percentiles of the universe of firms in the same country and same year, ranging from 0 (lowest) to 1 (highest). The left-hand side is measured in percentage points, so a loading of 1 means that the discount rate is predicted to be 1 percentage points higher for firms with the highest characteristics relative to firms with the lowest. The sample includes firms in Europe and the US between 2002 and 2022.



## Table A1
## Representativeness of the Conference Call Data

Panel A reports characteristics of firms for three samples: firms for which we observe at least one discount rate; at least one perceived cost of capital; and at least one perceived cost of equity or debt. Characteristics are measured in percentile ranks relative to the universe of firms in Compustat in the same year and same country of listing. A mean value close to 50 indicates that the average rank of firms in our dataset is close to the average rank of firms in the Compustat year-country population. Financial constraints are measured using the index by Hadlock and Pierce (2010). Panel B reports firm-level panel regressions using a dataset at the firm-quarter level. The outcome is 100 when we observe the firm's discount rate (columns 1 and 2), the perceived cost of capital (columns 3 and 4), or the perceived cost of debt or equity (columns 5 and 6) in the given quarter, and 0 otherwise. The samples in Panel B include the full panel of firm-quarter observations between 2002 and 2021 for all firms, for which we observe at least once a discount rate, perceived cost of capital, perceived cost of debt, or perceived cost of equity. The regressors are in percentile ranks relative to the universe of firms in Compustat in the same year and country of listing. Standard errors are clustered by firm. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

### Panel A: Characteristics of included firms in cross-sectional percentiles

| | Firms with observed discount rates | | | Firms withobserved perc. cost of capital | | | Firms with observed perc. cost of debt/equity | | |
|---|---|---|---|---|---|---|---|---|---|
| | mean | min | max | mean | min | max | mean | min | max |
| Market value | 79.02 | 8.54 | 100 | 82.74 | 3 | 100 | 83.98 | 7.60 | 100 |
| Return on equity | 58.44 | 0.64 | 100 | 59.87 | 0.81 | 100 | 58.45 | 0.15 | 100 |
| Book-to-market | 46.64 | 0.16 | 100 | 49.36 | 0.17 | 100 | 45.87 | 0.26 | 100 |
| Investment rate | 53.77 | 1.36 | 100 | 53.68 | 0.41 | 100 | 53.43 | 0.13 | 100 |
| Physical capital to assets | 60.58 | 2.36 | 100 | 59.62 | 2.16 | 100 | 65 | 2 | 100 |
| Z-score (bankruptcy risk) | 49.53 | 6.56 | 98.98 | 48.41 | 0.77 | 99.02 | 37.18 | 1.40 | 99.36 |
| Financial constraints | 23.28 | 0.05 | 90.67 | 20.17 | 0.05 | 100 | 24.64 | 0.05 | 91.52 |
| Leverage | 58.88 | 0.53 | 100 | 60.02 | 1.17 | 100 | 61.21 | 0.84 | 100 |

### Panel B: Within-firm variation in characteristics and timing of inclusion

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Discount rate observed in quarter | | Perc. cost of capital observed in quarter | | Perc. cost of equity or debt observed in quarter | |
| Z-score (bankruptcy risk) | 0.0016 | | 0.00073 | | -0.00030 | |
| | (0.0022) | | (0.0018) | | (0.0023) | |
| Return on equity | | 0.0018 | | 0.0012 | | 0.0031* |
| | | (0.0014) | | (0.0012) | | (0.0016) |
| Book-to-market | | 0.0015 | | 0.0028 | | -0.0022 |
| | | (0.0017) | | (0.0017) | | (0.0028) |
| Investment rate | | -0.00057 | | 0.00081 | | 0.00011 |
| | | (0.0013) | | (0.0014) | | (0.0018) |
| Financial constraints | | 0.0033 | | 0.0031 | | 0.0017 |
| | | (0.0032) | | (0.0052) | | (0.0047) |
| Leverage | | -0.0028 | | -0.000033 | | 0.0088*** |
| | | (0.0028) | | (0.0022) | | (0.0031) |
| Observations | 208,596 | 208,596 | 208,596 | 208,596 | 208,596 | 208,596 |
| FE | Firm/year | Firm/year | Firm/year | Firm/year | Firm/year | Firm/year |
| Within $R^2$ | 9.0e-06 | 0.000055 | 1.7e-06 | 0.000047 | 2.5e-07 | 0.00016 |

## Table A2
## The Perceived Cost of Capital and the Fama-French Model

This table reports regressions of the firm-level perceived cost of equity on measures of firm-level exposure to the Fama and French (1993) factors. Exposure to the factors is measured using the characteristic of the underlying factor, such as size and book-to-market. The perceived cost of capital is in percent and characteristics are in cross-sectional percentiles ranging from 0 to 1. The sample includes 2002 to 2022. Standard errors are clustered by firm. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) |
|---|---|---|---|
| | | Perceived cost of capital$_t$ | |
| Market Beta$_t$ | | 2.91*** | 2.81*** |
| | | (0.29) | (0.27) |
| Market size$_t$ | | | -1.49** |
| | | | (0.63) |
| Book-to-market$_t$ | | | 0.11 |
| | | | (0.34) |
| Leverage ratio$_t$ | -7.02*** | -5.53*** | -4.85*** |
| | (1.85) | (1.57) | (1.54) |
| Leverage ratio$_t^{\text{squared}}$ | 4.26*** | 2.76** | 2.10 |
| | (1.59) | (1.37) | (1.37) |
| Observations | 2,099 | 2,099 | 2,099 |
| R-squared | 0.231 | 0.335 | 0.343 |
| FE | Ex/Year | Ex/Year | Ex/Year |
| Cluster | Firm/year | Firm/year | Firm/year |
| Within $R^2$ | 0.050 | 0.18 | 0.19 |

## Table A3
## Summary of Factor Regressions

This table reports average coefficients from factor regressions, separately for different groups of factors. For each factor in our sample, we project the firm-level perceived cost of capital on the firm-level market beta, leverage, leverage squared, and the characteristic associated with the factor. The characteristics are measured in cross-sectional percentiles ranging from 0 to 1 and the perceived cost of capital is measured in percent. The factors are signed such that higher exposure is associated with higher CAPM alpha in financial markets. The factors are grouped as in Jensen et al. (2023). For each group of factors, we report the average factor premium ($\lambda^i$), the number of factors in the group, the percent of factors for which $\lambda^i$ has the same sign as that observed in financial markets, and the percent of factors that are significant against the one-sided alternative of having a different sign than the sign observed in financial markets. A factor is significant if it has a $p-$value above 5% after doing a Benjamini and Hochberg (1995) correction for number of factors tested in the group. The sample includes 2002 to 2021.

| Factor category | Average $\lambda^i$ | # of factors | % Correct sign | % Significant |
|---|---|---|---|---|
| Value | 0.25 | 16 | 0.65 | 0.12 |
| Trading frictions | 0.22 | 24 | 0.66 | 0.16 |
| Intangibles | 0.15 | 29 | 0.53 | 0.20 |
| Profitability | 0.04 | 22 | 0.36 | 0.22 |
| New | -0.09 | 14 | 0.33 | 0.00 |
| Investment | -0.19 | 32 | 0.18 | 0.00 |
| Momentum | -0.23 | 9 | 0.22 | 0.00 |
| All | 0.04 | 146 | 0.43 | 0.12 |

## Table A4
## The Cost of Capital Factor

This table reports time series regressions of the return to the cost of capital factor on the Fama and French (1993) factors. We construct the cost of capital factor as follows. Each month, we rank all firms based on their most recently reported perceived cost of capital (going at most ten years back). We then split firms based on the median market size in the sample. For each size group, we sort firms into three value-weighted portfolios based on the 30th and 70th percentile of the perceived cost of capital. Each month, the cost of capital factor goes long fifty cent in each of the two portfolios with high perceived cost of capital and short fifty cent in each of the two portfolios with low perceived cost of capital. Portfolios weights are refreshed and balanced every month. The sample starts in January 2005, to ensure at least three years of data on perceived cost of capital, and ends in December 2022. The first column shows the weighted-average perceived cost of capital for the factor (the perceived cost of capital of the firms in the long leg minus the firms in the short leg). The next three columns show the realized returns on the factor. All returns are in monthly percent. The sample includes only the US. Standard errors are double clustered at the firm and year level. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Perceived. $CoC_t$ | Realized $return_{t,t+1}$ | | |
| Constant | 0.41*** | 0.0067 | -0.17 | -0.11 |
| | (0.0026) | (0.18) | (0.17) | (0.15) |
| $MKT_{t,t+1}$ | | | 0.25*** | 0.16*** |
| | | | (0.037) | (0.036) |
| $SMB_{t,t+1}$ | | | | 0.27*** |
| | | | | (0.066) |
| $HML_{t,t+1}$ | | | | 0.26*** |
| | | | | (0.049) |
| Observations | 216 | 216 | 216 | 216 |
| P(intercept = 0.41) | | 0.026 | | |
| R-squared | 0.000 | 0.000 | 0.173 | 0.355 |

## Table A5
## Testing for Bias in Machine-Learning Estimates of Expected Returns

This table reports panel regressions of realized one-month stock returns on ex ante predicted values of returns from Kelly et al. (2023). The predicted values are constructed out of sample in the sense that they use only information available ex ante. We thank Dacheng Xiu for sharing data. The data cover US firms from 1987 to 2021. Standard errors are clustered at the date level. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

| | (1) $R_{t+1}$ | (2) $R_{t+1}$ |
|---|---|---|
| $\widehat{E_t[R_{t+1}]}$ from Kelly and Xiu (2024) | 0.71*** | 0.91*** |
| | (0.21) | (0.13) |
| Constant | 0.0029 | 0.0014 |
| | (0.0035) | (0.0010) |
| FE | None | Date |
| Observations | 1,870,957 | 1,870,957 |
| $R^2$ | 0.0011 | 0.098 |

## Table A6
## Testing the Investment CAPM Using Discount Rates

This table reports panel regressions of firm-level discount rates on firm-level characteristics that are used by the "Investment CAPM". All regressions include country and quarter fixed effects. We control for three different ex ante firm-level characteristics, namely fixed effects for 10 bins of beta, size, and return on equity (profitability). The asset expansion (investment) characteristic is growth in total assets over the previous year, measured in cross-sectional percentiles ranging from 0 to 1. The sample includes 2002 to 2022. Standard errors are double clustered at the firm and year level. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

| | (1) | (2) | (3) |
|---|---|---|---|
| | | Discount rates | |
| Asset expansion (investment) | 0.012 | 0.029*** | 0.012 |
| | (0.010) | (0.011) | (0.0089) |
| Controls: | | | |
| Profits bins | | X | X |
| Beta bins | | | X |
| Size bins | | | X |
| Observations | 1,896 | 1,816 | 1,816 |
| R-squared | 0.130 | 0.198 | 0.286 |
| FE | Country/Quarter | Country/Quarter | Country/Quarter |
| Cluster | Firm/Quarter | Firm/Quarter | Firm/Quarter |

## Table A7
## Comparison of Predicted Data and Duke CFO Data

Columns (1) and (2) report regressions of the perceived cost of capital from the Duke CFO Survey on the predicted perceived cost of capital (predicted based on the conference call data). Columns (3) and (4) report regressions of discount rates (hurdle rates) from the Duke CFO Survey on the predicted discount rates (predicted based on the conference call data). The sample includes only US firms. Standard errors are double clustered at the firm and year level. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

| | (1) Duke CoC | (2) Duke CoC | (3) Duke discount rate | (4) Duke discount rate |
|---|---|---|---|---|
| Predicted CoC | 0.74*** | 0.90*** | | |
| | (0.17) | (0.21) | | |
| Predicted discount rate | | | 1.02*** | 0.98** |
| | | | (0.38) | (0.38) |
| Constant | 0.034** | 0.021 | 0.027 | 0.031 |
| | (0.014) | (0.018) | (0.036) | (0.037) |
| Observations | 319 | 319 | 92 | 92 |
| R-squared | 0.057 | 0.067 | 0.118 | 0.136 |
| FE | None | Year | None | None |
| Within $R^2$ | 0.057 | 0.057 | 0.12 | 0.11 |

## Appendix B Maximizing Market Value Using the SDF

A firm faced with a new investment opportunity should discount each cash flow produced by the project separately using the stochastic discount factor (SDF) and invest in the project if the total present value is positive. For representative projects (i.e., projects that have the same risk as the overall firm), this rule can can often be simplified to discounting based on the cost of capital and investing in projects with positive NPV. We formalize this logic below and refer to additional discussion in the Online Appendix of Gormsen and Huber (2024).

Consider a manager who at time $t$ evalutes a non-exclusionary investment opportunity $i$ that generates the cash flow

$$C^i_{t+T} = \mu_i + \varepsilon_{t+T}$$

in $T$ periods, where $\varepsilon_{t+T}$ is unknown at time $t$. Undertaking the investment costs $\zeta^i_t > 0$ today. In the absence of frictions, the manager maximizes market value by choosing the project only if

$$E_t[M_{t+T}C^i_{t+T}] - \zeta^i_t \geq 0, \tag{A1}$$

where $M_{t+T}$ is the stochastic discount factor. We can rewrite (A1) as

$$\mathbb{E}_t[\text{Return}^i_{t+T}] \geq R^f - \text{cov}\left(M_{t+T}, \text{Return}^i_{t+T}\right) R^f \tag{A2}$$

where $R^f$ is the gross risk-free rate and $\text{Return}^i_{t+T} = C^i_{t+T}/\zeta^i_t$ is the return the firm earns on the invested capital. If the stochastic discount factor is driven by a factor model,

$$M_{t+T} = a_t - \sum_k b^k_t f^k_{t+T},$$

we can rewrite (A2) as,

$$\mathbb{E}_t[IRR^i_{t+T}] \geq \lambda^0_{t,t+T} + \sum_k \beta^k_t \lambda^k_{t,t+T}, \tag{A3}$$

where $\beta^k_t$ is the multivariate beta of factor $k$ in a projection of the $IRR$ on the risk factors, $\lambda^0_{t,t+T}$ is the return on a zero-beta portfolio, and $\lambda^k_{t,t+T}$ is the premium on the k'th risk factor between $t$ and $t+T$.[A1]

The expression in (A3) says that managers should accept investments for which the expected return is higher than the expected return in financial markets for a project with similar risk. If the cash flows of the project are representative of the overall firm and the project has zero net present value (i.e., it is a marginal project), the required return is the expected return on the firm's assets in the financial markets. The firm can therefore approximate the optimal investment decision for such a project by using the cost of capital as its discount rate and choosing positive NPV projects.

[A1] See Cochrane (2001) for derivation.

Equation (A3) also shows that managers should use the expected return over the full horizon of the investment project. Since most corporate investment has fairly long duration, managers should therefore use the long-run expected returns as the basis of their cost of capital.

# Appendix C Details on Measurement

We follow the data collection procedure established by Gormsen and Huber (2024). We extend that dataset by adding conference calls for all years from FactSet and for the years 2021 and 2022 from FactSet and Refinitiv.

## Appendix C.1 Extraction of Paragraphs from Conference Calls

We access all calls held in English during the period January 2002 to December 2022 and available on the databases Refinitiv and FactSet. We download paragraphs from the calls that fulfill two criteria: first, they contain one of the terms "percent," "percentage," or "%" and second, they contain at least one keyword related to the cost of capital. The keywords are capital asset pricing model, cost of capital, cost of debt, cost of equity, discount rate, expect a return, expected rate of return, expected return, fudge factor, hurdle rate, internal rate of return, opportunity cost of capital, require a return, required rate of return, required return, return on assets, return on invested capital, return on net assets, weighted average cost of capital, weighted cost of capital. We also include abbreviations of the keywords in the search, for example, WACC. We identify roughly 110,000 paragraphs containing a keyword.

We match the firm name listed on the conference call to Compustat Global Company Keys by using a fuzzy merge algorithm, checking each match by hand. Ultimately, we link 93% of the paragraphs to a Compustat firm.

## Appendix C.2 Guidelines for Manual Data Entry

With our data collection team, we read through each paragraph and enter relevant figures into tables. We record the following financial variables from the calls:

- discount rate
- hurdle rate
- hurdle premium over the cost of capital
- fudge factor over the cost of capital
- cost of debt
- weighted average cost of capital (WACC)
- opportunity cost of capital (OCC)
- cost of capital
- cost of equity
- required, expected, and realized internal rate of return (IRR)

- required, expected, and realized return on invested capital (ROIC)
- required, expected, and realized return on equity (ROE)
- required, expected, and realized return on assets (ROA)
- required, expected, and realized return on net assets

We do not record hypothetical numbers (e.g., "we may use a discount rate of x%" or "imagine that we use a cost of capital of x") and figures given by someone outside the firm (e.g., an analyst on the call suggesting a specific cost of capital for the firm). The context of statements is often key, so automated text processing cannot easily replace human reading for this task. For instance, the abbreviation OCC may refer to the opportunity cost of capital but more often than not actually refers to Old Corrugated Cardboard, a term for cardboard boxes used in the transport and recycling industries.

We only measure discount rates when managers explicitly discuss them as part of an investment rule. This means, for example, that we do not record discount rates used to value firms' pension liabilities. We focus on discount rates and the cost of capital that represent investment rules of the firm, as opposed to specific figures related to individual projects. For instance, we do not record the interest rate for a particular bond issuance. The paragraphs in the data entry sheets are sorted by firm and quarter, which helps us to interpret statements from the same firm consistently. When managers list multiple discount rates (usually for different regions and industries), we enter the figures that are representative of most of the company's operations (e.g., US figures for a US company). We discuss all cases with multiple rates among the whole team.

Managers mostly discuss their after-tax discount rate and cost of capital. We note when managers refer to pre-tax discount rates and pre-tax cost of capital. We convert all observations into after-tax values in two steps. First, we estimate the average percentage point difference between after-tax and pre-tax observations, controlling for country-by-year fixed effects. Second, we then adjust the pre-tax values reported on the calls using this average difference.

Similarly, managers rarely mention a "levered" discount rate, which is used in return calculations that do not take into account all the capital used to finance the investment. We convert all levered observations into unlevered values. Again, we estimate the average percentage point difference between levered and unlevered observations, conditional on country-by-year fixed effects, and then adjust the levered values using this difference.

Managers sometimes specify a range rather than an actual value. We enter the average value in these cases. We do not record values when the range is very large or ambiguous. Managers sometimes give different realized returns depending on the time horizon (e.g., "we have achieved a 5% ROIC over the last five years and a 10% ROIC over the last ten.") We enter the most recent horizon for such cases. Realized returns referring to a previous episode unconnected to current years (e.g., "return in the 1990s") are not recorded.

### Appendix C.3 Data Collection Team

A total of 23 research assistants contributed to the data collection. The average team size at any point was 7. The team members were: Alexandra Bruner, Ben Meyer, Cagdas Okay, Charlotte Wang, Chris Saroza, Daniel Marohnic, Esfandiar Rouhani, Henry Shi, Izzy Sethi, Jasmine Han, Jason Jia, Madeleine Zhou, Manhar Dixit, Meena Rakasi, Neville Nazareth, Rachel Kim, Rahul Chauhan, Rohan Mathur, Sanjna Narayan, Scarlett Li, Sean Choi, Sungil Kim, Tony Ma.

Before assistants begin the actual data collection, we teach them basic asset pricing and capital budgeting. Each assistant then reads roughly 2,000 paragraphs to train, which we check and discuss.

All paragraphs containing values for a perceived cost of capital and a discount rate were read at least twice by different assistants and outliers were checked by the authors to avoid errors. The research team met every week to discuss individual cases and to coordinate on consistent data entry rules.

## Appendix D The Perceived Cost of Capital and Expected Returns: Extensions

This section contains additional analysis linking the perceived cost of capital to expected returns in financial markets. In Section Appendix D.1, we introduce a cost of capital factor and study its risk premia. In Section Appendix D.2, we study how the perceived cost of capital relates to a large set of risk factors.

### Appendix D.1 The Cost of Capital Factor

We construct a cost of capital factor by sorting firms into different portfolios based on their perceived cost of capital. Each month, we assign each firm to portfolios based on the firm's market capitalization and its most recently observed perceived cost of capital. We assign firms to portfolios following the methodology of Fama and French (1993).

Table A4 reports the performance of this cost of capital factor. In column (1), we report the average spread in the perceived cost of capital between the long leg and the short leg of the factor. The average spread is a 0.4% monthly return, translating to an annualized spread of around 6%. This spread is stable over time, leading to tight standard errors.

In column (2), we report the average return to the cost of capital factor. The factor has earned 0.007% per month, which is statistically indistinguishable from zero and statistically different from the spread in the perceived cost of capital of 0.4% per month. The expected return on the factor is the spread in the perceived cost of equity, which need not be the spread in the perceived cost of debt. However, we find that the spread in the perceived cost of debt is smaller than the spread in the perceived cost of capital, which means the spread in the perceived cost of equity must be even larger than the spread in the perceived cost of capital. The test therefore implies that the spread in

the perceived cost of equity is not an unbiased predictor of future realized returns.

In columns (3) and (4), we control for the market, size, and value factors. These regressions represent an alternative approach to studying whether the factors are represented in the perceived cost of capital. These regressions reveal whether returns on firms with higher cost of capital behave more like, for instance, returns on small or large firms. The results generally confirm the findings from the characteristics-based analysis in Section 2. Namely, firms with higher cost of capital have higher market betas, smaller size, and higher valuation ratios. However, the evidence for the value effect is now substantially stronger than when looking at the characteristics. In fact, the loading on the value factor is higher than the loading on the market factor and as high as the loading on the size factor. The loading is also highly statistically significant. One potential interpretation of these findings is that there is an economically important difference between characteristics and factor loadings, as first pointed out by Daniel and Titman (1997).

## Appendix D.2 Perceived Cost of Capital in the Factor Zoo

In addition to the Fama-French characteristics analyzed in Section 3.2, the asset pricing literature has uncovered hundreds of other factors that could influence the cost of equity and thereby the cost of capital. In this section, we conduct an initial exploration of these other factors. The main takeaway is that most factors are not reflected in the perceived cost of capital and, to the extent that they are, often have the wrong sign.

We consider all factors identified by Jensen et al. (2023). For each factor $k$, we extract factor premia from slope coefficients in the regression

$$r_{i,t}^{\text{cost of capital}} = b^0 + b^1 X_{i,t}^{\text{beta}} + b^2 X_{i,t}^{\text{lev}} + b^3 X_{i,t}^{\text{lev squared}} + b^4 X_{i,t}^{k} + \varepsilon_{i,t}^{k}, \tag{A4}$$

where, as before, $r_{i,t}^{\text{cost of capital}}$ is the perceived cost of capital of firm $i$ at time $t$, $X_{i,t}^{k}$ is the characteristic associated with the k$^{\text{th}}$ factor, and $b^k$ is the parameter estimate for the k$^{\text{th}}$ characteristic. The specification thus studies each characteristic $k$ separately, controlling for the CAPM beta, leverage, and leverage squared. We control for the CAPM beta because the equity factors we study are associated with positive CAPM alpha, not necessarily positive expected returns. We control for leverage to account for the mechanical effect of leverage on the cost of capital. We consider the factors in univariate specifications, only conditioning on the above controls, as these factors have typically been studied in univariate specifications.

To create an overview, we categorize the factors into the groups proposed by Jensen et al. (2023) and study average properties across groups. There are seven groups of factors based on well-known major drivers of stock returns: value, profitability, investment, trading frictions, intangibles, momentum, and a final group called "new", which captures a range of recent factors.

Table A3 reports results averaged across the different factor groups. We sign all factors such that a higher factor is associated with a higher monthly CAPM alpha in financial markets. The

first column reports the average factor premium in the group. For the group of value factors, the average premium is around 0.25 percentage points. While substantially smaller than the beta and size premia established in Table A2, it is larger than the average risk premium in any other factor group, most of which are either close to zero or negative.

The next column shows the percentage of factors in a given group that have the correct sign. We see that a reasonable fraction of the factors based on value and trading frictions have premia with the correct sign (66% and 67%). The other groups produce factors that consistently have the correct sign (intangibles is close to 50%).

The last column shows the percentage of the factors in a given group that have the correct sign and are statistically significant. That is, for each factor, we test whether the factor loading is equal to zero against the one-sided alternative that it has the same sign as observed in financial markets (i.e., whether the coefficient positive). To give the factor the best possible chance, we consider a factor to be statistically significant if it has a $p$-value below 5% in the one-sided test using conventional OLS errors. We correct for the number of factors tested within a group using the Benjamini and Hochberg (1995) method and setting a false discovery rate at 5% (this is lenient once again relative to, for instance, a Bonferroni adjustment).

Despite the arguably generous method for assessing significance, we find that most groups do not have many significant factors. Only a handful of factors are significant in the value, trading friction, intangible, and profitability groups. None of the factors in the investment, new, and momentum groups are significant with the correct sign.

The last row of Table A3 summarizes all factors. Overall, the average factor premium across the 146 factors tested is zero and less than 50% of the factors have the correct sign. Moreover, only 9% of the factors have premia with the correct sign that are statistically significant. Overall, these results leads us to conclude that the majority of factors studied in the asset pricing literature are not reflected in firms' perceived cost of capital. Complementary recent work also shows that most factors do not affect subjective return expectations of financial analysts (Engelberg et al. 2020, Jensen 2022).

Finally, many investment factors have the wrong sign. This finding seriously challenges the Investment CAPM and production-based asset pricing more generally, as discussed in Section 7.

# Appendix E Auxiliary Analyses on Misallocation

## Appendix E.1 Estimating Long-Run Excess Dispersion

We estimate long-run excess dispersion based on expected values of the future perceived cost of capital. For firm $i$ at time $t$, we can calculate the expected cost of capital nine years in the future as

$$E_t[r^{\text{perc.}}_{i,t+9}] = \varphi_{\text{constant}} + \varphi_9 \times r^{\text{perc.}}_{i,t}, \tag{A5}$$

where $\varphi_{\text{constant}}$ and $\varphi_9$ are the intercept and slope in regressions of the perceived cost of capital on lagged values of the perceived cost of capital (see regression specification (13) and estimation results in Figure 8). We then calculate the long-run variance as the variance of the expected value of the future perceived cost of capital:

$$\text{var}_{\text{long-run}}(r_{i,t}^{\text{perc.}}) = \text{var}_t\left(E_t[r_{i,t+9}^{\text{perc.}}]\right) \tag{A6}$$

$$= (\varphi_9)^2 \times \text{var}_t\left(r_{i,t}^{\text{perc.}}\right). \tag{A7}$$

We assume that the fraction of excess dispersion in the long- and short-run variance is equal, so we write long-run excess dispersion as

$$\text{var}_{\text{long-run}}(r_{i,t}^{\text{perc.}}) \times \gamma^{\text{excess}} = \text{var}_t\left(r_{i,t}^{\text{perc.}}\right) \times \tilde{\gamma}^{\text{excess}}, \tag{A8}$$

where $\tilde{\gamma}^{\text{excess}} = (\varphi_9)^2 \times \gamma^{\text{excess}}$.

### Appendix E.2 Misallocation Based on Discount Rates

In this robustness exercise, we quantify the TFP loss due to excess dispersion that would occur in the model if firm discount rates shaped the long-run allocation of capital. We conduct this exercise to show that deviations between discount rates and the true cost of capital are, in fact, larger than deviations between the perceived and true cost of capital. We find that the TFP loss implied by the model increases to roughly 20% if discount rates determine capital allocation across firms.

Discount rates are higher than the perceived cost of capital for almost all firms (Graham 2022, Gormsen and Huber 2024). While this may, in principle, lead to additional misallocation of capital, it does not influence the estimates of misallocation in our model. We follow Hsieh and Klenow (2009) and assume a fixed capital supply, which means that level distortions do not influence estimates of misallocation (see equation 17).

## Appendix F Can "As if" Behavior Save the Investment CAPM?

One may be tempted to rationalize the results on the Investment CAPM without rejecting the model by invoking an "as if" argument. The argument could be that low-investment firms do not explicitly articulate that they have a high cost of capital, but instead they implicitly know that they should require a high return on their investments. For instance, these firms may perceive that they face substantial risks, which then causes managers to require a higher return on new investments. Under this argument, firms behave "as if" they had a high perceived cost of capital. The argument could in principle be correct because many firms indeed maintain discount rates (i.e., required returns on new investment) that differ from their perceived cost of capital (Graham and Harvey 2001, Gormsen and Huber 2024).

We can test this hypothesis because the conference call data also contain firms' discount rates. In Table A6, we reproduce the regressions of Table 7, except we now use the firm-level discount rate on the left-hand side. The cross-sectional relation between the investment rate and discount rates is positive. The coefficient is significant when we condition on profitability, as the Investment CAPM does (in column 2). These results suggest that high-investment firms do not behave "as if" they have low discount rates.

It is important to emphasize that a firm's discount rates is negatively related to investment, once one uses a traditional investment measure and conditions on the investment opportunities available to firms. Indeed, Gormsen and Huber (2024) show that, conditional on firm fixed effects, discount rates negatively predict future capital expenditure in a manner that is quantitatively consistent with a simple Q-model. More generally, the results are not a rejection of the idea that the cost of capital raises discount rates and, ultimately, lowers investment. However, the results reject the specific Investment CAPM formulated by Hou et al. (2015), which uses asset expansion to measure investment.

# Appendix G Construction of Predicted Data

In Section 3.3, we estimate a simple empirical model to summarize the perceived cost of capital. On the basis of this model, we construct a series of predicted values of the perceived cost of capital for the universe of firms for which we observe the required characteristics. In this section, we explain the process through which we construct the predicted values. We also conduct a similar exercise for firms' discount rates. The predicted data can be found on costofcapital.org along with additional details on the estimation.

## Appendix G.1 A Multivariate Model of Discount Rates

We follow the procedure in Section 3.3 to estimate a similar model for firms' discount rates.

The Lasso procedure selects 13 variables that predict discount rates. The in-sample $R^2$ of the selected model is 16%. Figure A1 shows the slope coefficients for each of the 13 selected variables. These slope coefficients directly tell us how much the predicted value of the discount rate increases if we go from the bottom to the top of the cross section of a characteristic (keeping the other 12 characteristics constant). We control for the fact that some firms do not account for overhead in the discount rate reported on conference calls (see Gormsen and Huber 2024 for details). The predicted values refer to discount rates that fully account for overhead.

The most important characteristic is idiosyncratic volatility, which is measured over 252 days relative to the CAPM (see Jensen et al. 2023 for formal definitions). The coefficient is 3.2, which means that the perceived cost of capital is predicted to be 3.2 percentage points higher for firms with the highest volatility, relative to those with the lowest volatility. The second most important characteristic is age. The coefficient shows that the oldest firms in the economy have roughly 2

percentage points lower hurdle rates than the youngest firms. The next variable is cash-to-assets. Firms with more cash have higher hurdle rates. Firms with higher labor force efficiency and lower risk of default (higher Z-score) also have higher hurdle rates. Discount rates are lower for firms with abnormally high investment. This last finding is consistent with the idea that lower hurdle rates leads to higher investment.

### Appendix G.2 Generating Predicted Data

We construct predicted values of firms' perceived cost of capital and discount rates based on the Lasso procedures described in Section 3.3 and Appendix G.1. We calculate predicted values for all firms for which we observe the set of characteristics needed to calculate both a perceived cost of capital and discount rate. Since we only feed the model cross-sectional predictors, there is virtually no time variation in the aggregate series. To obtain the correct time variation, we add in the estimated time variation from the full sample of discount rates and perceived cost of capital. We estimate the time variation in these objects by projecting discount rates and perceived cost of capital on year dummies and absorbing firm fixed effects. This procedure ensures that all variation is driven by within-firm variation in the relevant estimates, following the methods in Gormsen and Huber (2024). We calculate time variation separately for the US and Europe. The European countries consists of both euro (or euro-pegged) countries and the UK. Using one time series for euro- and pound-denominated countries could be problematic if there is a large divergence in inflation across the two currencies, but helps to ensure a sufficient set of firms to estimate time variation robustly. We exclude firms from other countries from our sample of predicted values as we do not have enough observations to robustly estimate the time variation.

### Appendix G.3 Validation

We validate the predictive power of our data in an out-of-sample test. We use the predicted values to predict the perceived cost of capital and discount rates observed in the seminal Duke CFO survey, a quarterly survey of corporate managers (Graham and Harvey 2001). In some of the surveys, managers are asked about their cost of capital and their discount rates (referred to as hurdle rates in the survey). We use these data to test how well our predictive value work out of sample.[A2]

The results are in Table A7. The first two columns shows regressions of the perceived cost of capital in the Duke CFO data on our predicted values. The slope on the predicted values is 0.74 without year fixed effects and 0.9 with year fixed effects. These results are consistent with the notion that the time variation in the perceived cost of capital in the Duke CFO survey differs from the conference call data (see Gormsen and Huber 2024 for more discussion on this result), so including year fixed effects increases the slope. More importantly, the finding in column (2) suggests that the cross-sectional variation in our predicted values is close to the Duke CFO data (i.e., the slope is

[A2]We thank John Graham for generously sharing these data.

close to 1). The cross-sectional variation in our predicted values thus appears to be an unbiased predictor of the cross-sectional variation in the Duke CFO data.

Columns (3) and (4) show results for discount rates. The slope coefficients are close to one with and without year fixed effects. The discount rates in the Duke CFO data are around three percentage points higher than in the conference call data, as seen from the intercept. A likely driver of this difference is that our predicted discount rates account for overhead costs and are therefore lower, whereas the Duke CFO data likely contain some discount rates that do not fully account for overhead. However, the three percentage point difference is insignificant given the small sample of 92 observations.[A3]

[A3] While the Duke CFO data contain more than 92 observations, many of these are non-listed firms or firms that cannot be matched to firm-level identifiers.