Corporate Discount Rates*

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Abstract

Standard theory implies that the discount rates used by firms in investment decisions play a key role in determining investment and transmit shocks to asset prices and interest rates to the real economy. However, there exists little evidence on how corporate discount rates change over time and affect investment. We construct a new global database of firms' discount rates based on manual entry from earnings conference calls. We show that corporate discount rates move with the cost of capital, but the relation is less than one-to-one, leading to time-varying wedges between discount rates and the cost of capital. The average wedge has increased substantially over the last decades as the cost of capital has dropped. Discount rate wedges are negatively related to future investment, with a magnitude close to that predicted by theory. Moreover, the large and growing discount rate wedges can account for low investment (relative to high asset prices) in recent decades. We find that risk and the combination of market power and beliefs about value creation explain levels and trends of discount rate wedges.

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Asset prices and interest rates are highly volatile, exhibiting both short-run fluctuations as well as persistent trends. Over the last decades, for instance, asset prices have increased dramatically and interest rates have declined secularly. These trends reflect that investors have substantially lowered their required returns to holding stocks and bonds and, similarly, that banks have lowered their required returns to lending.

According to a stylized view, often maintained in standard models and policy debates, changes in the returns required by investors and banks should lead to equivalent changes in the returns required by firms on their new investment projects. The argument is that the required returns of investors and banks represent the cost of new funding to firms, the so-called "financial cost of capital," and that firms should take on any investment project that offers returns above this cost. The stylized view thus implies that firms' required returns on investment should have dropped substantially over the last decades, leading to a boom in corporate investment. More generally, the view implies that any shock to the financial cost of capital, such as shocks to stock prices, monetary policy, and credit provision, directly influence firms' required returns and thus investment.

It is possible, however, that fluctuations in the financial cost of capital are largely irrelevant for firm investment. For the stylized view to work, firms must actively choose to incorporate fluctuations in the financial cost of capital into their required returns, a metric over which they have substantial discretion.[1] Firms need to take two steps to do so. First, firms estimate their financial cost of capital based on observed asset prices and interest rates. As this is a non-trivial exercise, the resulting estimate, which we term the "perceived cost of capital," may deviate substantially from the financial cost of capital. Second, firms choose a required return, their so-called "discount rate." The discount rate often incorporates a host of other, time-varying factors, apart from the perceived cost of capital. It is thus possible that discount rates hardly comove with the financial cost of capital, so that financial fluctuations and policy shocks have modest impacts on investment.

Despite the importance of these discount rate dynamics, our understanding is limited because firms' perceived cost of capital and discount rates are not easily observed. Existing surveys suggest that many firms use discount rates greater than the financial cost of capital (Poterba and Summers 1995, Jagannathan et al. 2016, Graham 2022). However, there exist little data tracing individual firms' perceived cost of capital and discount rates over time

[1] For instance, firms with market power can raise their required return above the financial cost of capital while remaining profitable in the product market. See Section 5 for additional discussion of how differences between required returns and the financial cost of capital can persist in equilibrium.

and linking them to real outcomes. As a result, we do not know whether individual firms dynamically adjust their perceived cost of capital with asset prices and interest rates, whether discount rates change with the perceived cost of capital and other factors, and whether discount rates can account for investment dynamics.

In this paper, we construct a new dataset to study the dynamics of corporate discount rates and their relation to investment. The dataset measures discount rates and the perceived cost of capital for 2,500 firms, including many of the world's largest corporations. We show that firms' perceived cost of capital comoves with the financial cost of capital. Firms also incorporate changes in their perceived cost of capital into discount rates, but the relation is significantly below one-to-one. The partial incorporation generates large and time-varying "discount rate wedges" between discount rates and the perceived cost of capital. The average wedge has increased substantially since 2002, as firms have incorporated the secular decline in the financial cost of capital into their perceived cost of capital but only partly into their discount rates. Discount rate wedges are strongly associated with firm investment. At the aggregate level, the increase in the average wedge is large enough to account for the fact that US investment has been relatively low since 2002. We show that the combination of market power and investor beliefs about value creation as well as uncertainty have contributed to higher discount rate wedges among US firms.

We measure firms' discount rates and perceived cost of capital using corporate conference calls. The majority of listed firms hold conference calls every quarter, so that managers can inform financial analysts and investors about their firms' operations. On these calls, managers sometimes reveal their discount rates and perceived cost of capital as a way of providing transparency to investment decisions.[2] An advantage of conference calls is that they are held regularly and that analysts can compare previously reported discount rates to realized outcomes. These aspects incentivize managers to report meaningful numbers. We collect transcripts for conference calls between 2002 and 2021 and identify 74,000 paragraphs where managers discuss their discount rates or perceived cost of capital. We read through each paragraph with a team of research assistants and manually extract relevant information.

The product of this data collection effort is a large, global database of firms' discount

[2]The perceived cost of capital is the firm's internal estimate of the weighted average of the after-tax cost of debt and cost of equity. The discount rate is the rate at which the firm values future cash flows and which enters its net present value (NPV) calculation, also usually expressed in after-tax terms. Managers often discuss discount rates in terms of minimum required returns or hurdle rates on new investments. For the marginal project, the minimum required return is equal to the discount rate. We therefore use the terms discount rate, hurdle rate, and required internal rate of return interchangeably in our data collection.

rates and perceived cost of capital, matched to investment rates. The data contain roughly 2,500 firms across 20 countries. A unique feature of the data is that we collect repeated observations for the same firms and countries. We observe discount rates and the perceived cost of capital for 19 sequential years in multiple countries, giving rise to a country-level panel; and we observe many firms multiple times, giving rise to a firm-level panel. This panel variation is new to the literature and key to understanding how discount rates and the perceived cost of capital relate to one another and to investment.

We start the analysis by relating firms' perceived cost of capital to estimates of the cost of capital in financial markets. The financial cost of capital is the weighted average after-tax cost of debt and equity. Firms can approximate the financial cost of debt using bond yields and interest rates. It is thus not surprising that the financial cost of debt in a given country is closely associated with the cost of debt perceived by firms. However, to calculate the cost of equity, firms need to estimate expected stock returns, which is notably difficult (Fama and French 1997, Pástor and Stambaugh 1999).[3] Nonetheless, we find that firms' perceived cost of capital incorporates variation in the cost of equity. We measure the cost of equity at the country level using the earnings yield on the market and at the firm level using the Capital Asset Pricing Model. On average, the perceived cost of capital increases by 0.8 percentage points when the financial cost of capital increases by 1 percentage points. Given the uncertainty inherent in estimating the financial cost of capital, we cannot reject that the estimate is close to 1 on average. We do, however, find substantial heterogeneity in the perceived cost of capital across firms that cannot be easily justified by variation in the financial cost of capital.

We next study how discount rates relate to the perceived cost of capital. We confirm the existing finding that discount rates are substantially higher than the perceived cost of capital, on average twice as large. More importantly, using within-firm variation, we find that changes in the perceived cost of capital are incorporated into discount rates, but the relation is significantly below the one-to-one mapping implied by the stylized theoretical view. We find that a 1 percentage point increase in the perceived cost of capital leads to a 0.4 percentage point increase in discount rates. We use a two-stage estimation procedure to ensure that these estimates are not subject to attenuation bias and we reject a slope coefficient of 1 with a high level of significance.

[3] Also see Welch and Goyal (2008), Greenwood and Shleifer (2014), Jagannathan et al. (2017). MBA students are often taught simplified approaches, for example to assume a constant equity risk premium, which would lead to mistakes in the perceived cost of equity (Cochrane 2011).

The imperfect relation between discount rates and the perceived cost of capital gives rise to a time-varying wedge between discount rates and the perceived cost of capital.[4] In the United States, this wedge has risen substantially over the last two decades because the perceived cost of capital has decreased while discount rates have remained relatively stable. Using within-firm variation, we find that the wedge has increased by around 2.5 percentage points between 2002 and 2021 for the average US firm in our sample. This increase is large relative to typical movements on financial markets, for example due to secular trends and monetary policy.[5] An increase of this magnitude is likely to be important for our understanding of investment dynamics, which we turn to next.

We first explore how discount rates relate to investment. We find that time variation in discount rates is negatively related to investment, both at the firm and country level. Average discount rates and aggregate investment in the US in the past two decades strongly comove. At the firm level, we find that a one percentage point increase in the discount rate lowers the investment rate by -0.8 points. This estimate is robust to controlling for firm and year fixed effects, Tobin's Q, the financial cost of capital, and other firm observables. We show that the magnitude is consistent with a simple Q-model where firms use the measured discount rates in investment decisions. The result suggests that our measured discount rates accurately capture a firm's investment demand, conditional on its investment opportunities.

We next address how the large and rising discount rate wedges influence our understanding of the relation between aggregate investment and pricing in financial markets. A literature argues that US investment has been low in recent decades relative to the falling financial cost of capital. In particular, declines in the financial cost of capital have raised firms' market value and thereby led to high and rising values of Tobin's Q. According to standard Q-theory, investment should have risen with Tobin's Q. However, if anything, observed investment rates have been low relative to historical standards, leading researchers to argue that there is "missing investment" summing to over 10 percent of the capital stock (Gutiérrez and Philippon 2017, Alexander and Eberly 2018).

We find that the evolution of discount rate wedges can account for a large part of the decoupling between Tobin's Q and investment since 2002. Intuitively, the rising average discount rate wedge implies that firms are holding back increasingly more investment relative

[4]By focusing on the wedge between discount rates and the perceived cost of capital, we can rule out that the results are driven by perceptions about the financial cost of capital.

[5]The secular decline in the natural real rate of interest amounts to roughly 1 percentage point since 2002 (Bauer and Rudebusch 2020), whereas the Fed's quantitative easing events reduced corporate bond yields by 0 to 0.5 percentage points (Krishnamurthy and Vissing-Jørgensen 2011, Swanson 2011).

to what the financial and perceived cost of capital would suggest. To make this point precise, we develop an "adjusted Q," which accounts for discount rate wedges in the measurement of firms' investment demand. Using the adjusted Q, we find that the increase in the average discount rate wedge over the last decades is large enough to account for most of the missing investment. This finding does not imply that discount rate wedges fully explain the economic mechanisms behind missing investment. Rather, it suggests that investigating the drivers of discount rate wedges is useful for our understanding of why investment appears lower than suggested by financial markets.[6]

We discuss and test multiple theories of why discount rate wedges vary across firms and time. We consider three theories of cross-sectional variation in wedges, namely, theories related to the interaction of market power and investor beliefs, risk, and financial constraints. First, we systematically analyze manager statements on conference calls. We find that many managers and investors believe that high discount rates attract investors and raise firm value. A high discount rate may serve as a signal of profitability or managerial prudence, consistent with models where investors worry about overinvestment (Jensen 1986) and rely on salient signals to evaluate firms (Bordalo et al. 2022). While competitive forces likely eliminate such considerations in perfectly competitive markets, firms with market power are able to maintain them over time. Second, real options theory suggests that firms with market power and irreversible investment should postpone investments in the face of increased risk and uncertainty (see, e.g., Abel and Eberly 1996), which can lead riskier firms to use higher discount rates (McDonald 2000). Third, the shadow costs of financial and managerial constraints may generate discount rate wedges (Jagannathan et al. 2016). We find that measures of market power, risk, and financial constraints all have substantial power in explaining cross-sectional variation in discount rate wedges.

We also consider drivers of time variation in discount rate wedges. We find a strong role for market power. In particular, firms with high market power have kept their discount rates stable since 2002, despite the falling financial cost of capital. Firms without market power have, in contrast, decreased their discount rates almost one-to-one with the financial cost of capital. This pattern is consistent with the idea that many managers are averse to lowering their discount rates and only do so in response to competitive pressures. Firms with high

[6] Discount rate wedges also generally shed light on the sensitivity of investment with respect to the financial cost of capital. We show that the wedges lower the sensitivity of investment by a factor of five in a simple Q-model. This finding may help to explain why macroeconomic models that abstract from such wedges need to assume sizable adjustment costs to match the investment elasticities estimated by, for example, Gilchrist and Zakrajšek (2012) and Zwick and Mahon (2017).

market power, on the other hand, are free to keep their discount rates high as the financial cost of capital falls. Market power has therefore limited the extent to which the secular decline in the financial cost of capital has been incorporated into firms' discount rates. We also find that evidence that time variation in risk influences discount rate wedges through the real options channel, meaning that fluctuations in uncertainty (Baker et al. 2016) may have contributed to changes in discount rate wedges.

Related Literature

Firms' cost of capital and discount rates have long been thought to play a prominent role in understanding investment dynamics among academics (e.g., Jorgenson 1963, Tobin 1969, Barro 1990, Cochrane 1991, Gilchrist and Zakrajšek 2012, Hall 2017, van Binsbergen and Opp 2019) and policymakers (Cieslak and Vissing-Jørgensen 2021). We provide the first firm-level dataset that links discount rates, the perceived cost of capital, and investment over time. The data allow us to present novel evidence on the full chain of transmission from the financial cost of capital to the perceived cost of capital, discount rates, and ultimately investment, thereby assessing the empirical foundation for this school of thought.

Previous surveys have produced mixed results about the extent to which discount rates respond to the financial cost of capital.[7] Sharpe and Suarez (2021) and Graham (2022) compare the average perceived cost of capital and discount rates from different surveys across eight calendar years. In these comparisons, both the average perceived cost of capital and the average discount rate in 2019 were almost identical to their respective 2003 value, despite the falling financial cost of capital. In contrast, our approach relies on dynamic, within-firm variation and annual data. Our results reveal that the average perceived cost of capital has, in fact, trended downward substantially since 2002. Moreover, we show that the average discount rate has fallen for firms with little market power, but remained roughly constant for other firms. We also reveal substantial short-run variation in discount rates over time, partly driven by risk.

The evolution of discount rates is just one step in the chain that we analyze, however. We also show that our measured discount rates predict investment dynamics at the firm and

[7] Bruner et al. (1998) find that 78 percent of firms update their perceived cost of capital at annual frequency or more regularly and that 96 percent use their cost of capital as discount rate. Meier and Tarhan (2007) report that cost of capital fluctuations trigger discount rate changes for 80 percent of firms and that 48 percent changed their discount rate between 2000 and 2003. Sharpe and Suarez (2021) document that few managers would adjust investment if interest rates changed. Graham (2022) reports that roughly 60 percent of firms enacted at least one large discount rate change (by more than 1 percent) in the last ten years.

aggregate level. We uncover discount rate wedges that have varied over time and shaped recent "missing investment." Finally, we contribute an adjusted Q framework that accounts for investment when firms use discount rate wedges.

Existing data on firms' discount rates come from surveys (e.g., Summers 1986, Poterba and Summers 1995, Jagannathan et al. 2016). The influential Duke CFO Survey has generated broad insights into corporate governance and includes discount rates for five years since 2007 (Graham and Harvey 2001). In general, survey data have not been linked over time to construct a panel and do not include actual investment. We construct a panel containing discount rates, the perceived cost of capital, and investment for 2,500 listed firms since 2002. This allows us to study within-firm dynamics, annual changes, and investment.

Our results also inform a large literature on the link between secondary asset markets and real outcomes (reviewed in Bond et al. 2012). For instance, Krüger et al. (2015) and Dessaint et al. (2021) study how wedges between perceived and financial cost of capital cause real distortions; Pflueger et al. (2020) argue that pricing of risk in financial markets influences the financial cost of capital and investment; and an asset pricing literature explains anomalies assuming that firms invest based on expected stock returns (Zhang 2005, Gomes et al. 2003, Hennessy et al. 2007, Hou et al. 2015). Several papers analyze whether equity prices affect investment because firms issue equity (e.g., Morck et al. 1990, Blanchard et al. 1993, Baker et al. 2003, Gilchrist et al. 2005, Jeenas and Lagos 2022). We find that equity prices affect discount rates and investment even when firms do not issue equity.

A further new feature of the dataset is that we observe firms' perceived cost of equity over time. We can therefore assess how asset prices dynamically affect firms' perceived cost of equity and discount rates. Other papers focus on cross-sectional variation in the cost of equity (Jagannathan et al. 2016, Gormsen and Huber 2022).

1 Conceptual Framework

Most investment projects incur costs today and are expected to earn revenue in the future. When deciding whether to undertake a project, firms therefore need to compare different cash flows across time. Firms invest only in projects with positive net present value (NPV):

$$\text{NPV}_t = \sum_{s=0}^{S} \delta_t^{-s}\, \mathbb{E}_t[\text{Revenue}_{t+s} - \text{Cost}_{t+s}], \tag{1}$$

where NPV is evaluated at time t, $\mathbb{E}_t[\text{Revenue}_{t+s}]$ and $\mathbb{E}_t[\text{Cost}_{t+s}]$ are expected cash flows at time $t+s$, and δ_t is the discount factor applied at time t. The discount factor measures how much firms value cash flows in a future period relative to t and, equivalently, the minimum internal rate of return that firms want to earn on an investment.

In typical, stylized models, economists assume that firms use their financial cost of capital as their discount factors. This financial cost of capital reflects both the time value of money and the riskiness of the firm's assets. The stylized assumption is thus

$$\delta_t = 1 + r_t^{\text{fin}} \tag{2}$$
$$= 1 + \omega_t \times (1-\tau) \times r_t^{\text{debt}} + (1-\omega_t) \times r_t^{\text{equity}}, \tag{3}$$

where r_t^{fin} is the financial cost of capital, equal to the weighted average cost of debt and equity (WACC), where r_t^{debt} and r_t^{equity} are the cost of debt and equity, τ is the firm's tax rate, and ω_t is the leverage ratio (i.e., the market value of debt relative to the market value of debt plus equity). The financial cost of capital is the optimal choice of discount rate if firms want to maximize their market value and the project under consideration carries the same risk as the firm's existing investments.[8]

Two processes within firms may cause discount rates to diverge from the financial cost of capital. First, firms cannot directly observe the financial cost of capital, but have to estimate it. Estimating long-run expected stock returns is difficult (Fama and French 1997, Pástor and Stambaugh 1999, Campbell and Thompson 2008) and practitioners are often taught simplifying assumptions (like a constant equity risk premium of 6 percent, Cochrane 2011). The cost of debt is easier to calculate, but still needs to be estimated based on bond prices and assumptions about default risk. As a result, firms' perceived cost of capital likely differs from their financial cost of capital. We define a "cost of capital wedge," called υ. The perceived cost of capital is the financial cost of capital plus υ:

$$r_t^{\text{per.}} = r_t^{\text{fin.}} + \upsilon_t. \tag{4}$$

In a second internal process, firms decide how to incorporate their perceived cost of capital into their discount rates. Existing surveys suggest that firms use discount rates above the perceived cost of capital (Poterba and Summers 1995, Jagannathan et al. 2016,

[8]If project risk differs, the optimal discount rate is project-specific. However, if a firm on average carries out new projects that are in line with its existing ones, the average discount rate should still be close to the financial cost of capital.

Graham 2022, see discussion in Section 5 for potential motives). We define the "discount rate wedge," κ_t, as the difference between the discount rate and the perceived cost of capital:

$$\delta_t = 1 + r_t^{\text{per.}} + \kappa_t \tag{5}$$

$$= 1 + r_t^{\text{fin.}} + \upsilon_t + \kappa_t, \tag{6}$$

so that the discount rate differs from the financial cost of capital both because of the cost of capital wedge and the discount rate wedge.

2 Measurement

Firms' discount rates and perceived cost of capital are not observed in publicly available reports. We construct a new dataset that measures firms' discount rates and their perceived costs of capital, equity, and debt. Importantly, we combine these figures with measures of the financial cost of capital and firm investment, allowing us to shed light on how firms' internal decisions comove with capital markets and real outcomes.

2.1 Extracting Paragraphs from Conference Calls

Our measurement relies on transcripts of corporate earnings conference calls. The majority of listed firms hold conference calls every quarter, so that managers can inform financial analysts, investors, and other observers about the firm's strategy (Frankel et al. 1999, Hassan et al. 2019). We download all transcripts of conference calls for the period January 2002 to September 2021 available on the Thomson One database. We identify paragraphs that contain at least one keyword as well as one of the terms "percent," "percentage," or "%".[9] Details on the data extraction are in Appendix B.

It is difficult to train an algorithm to recognize discount rates and the perceived cost of capital from managers' transcripts, as context and background are of the essence. Instead, we rely on manual data entry. We trained a team of research assistants to identify and record the relevant figures from the text. Overall, the team read 74,000 distinct paragraphs over the span of roughly 2 years.

[9] 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, IRR.

2.2 Identifying Discount Rates and the Perceived Cost of Capital in Conference Calls

The discount rate defines the rate at which a firm values future cash flows. An equivalent interpretation is that a discount rate measures the lowest internal rate of return (IRR) that a firm is willing to accept on its investments (also know as hurdle rate). To see the equivalence, note that the expected rate of return on a project equals the discount rate if the NPV is zero and exceeds the discount rate if the NPV is positive. As a result, if a firm's rule is to invest in projects where NPV is above zero, it equivalently chooses only projects where the expected return exceeds the discount rate. For the purposes of our measurement, the terms discount rate, minimum IRR, and hurdle rate all capture the same concept (see also Jagannathan et al. 2016).[10]

There are three ways in which we identify discount rates. First, managers often state the required IRR for future investment projects. We only interpret an IRR as discount rate if it clearly refers to a required minimum rate as part of an investment rule. We separately record realized IRRs, when managers talk about current performance, and expected IRRs, when managers predict future performance without setting an explicit investment rule. Second, we interpret hurdle rates as discount rates if they are calculated on the basis of an IRR. Finally, managers sometimes define a discount rate based on a hurdle premium or fudge factor, which are added to the perceived cost of capital. To ensure that we differentiate between discount rates and other rates, we record a range of additional variables from the conference calls, including required, expected, and realized returns on assets, on invested capital, and on equity.

To measure the perceived cost of capital, we study paragraphs where managers state their costs of equity, debt, and capital. These figures come from firms' internal calculations, potentially relying on prices on capital markets and interest rates. We also consider abbreviations (e.g., WACC) and synonyms (e.g., required return on equity) as long as managers clearly relate them to financing costs.

[10] In line with standard theory, finance textbooks recommend that firms should make investment decisions using NPV. In practice, around 80 percent of firms follow this recommendation, according to surveys presented in Trahan and Gitman (1995), Graham and Harvey (2001), and Graham (2022). The second most common method involves comparing a project's IRR to the minimum IRR.

2.3 Practical Measurement Guidelines

We begin with an example from a conference call held by the S&P 500 firm Air Products and Chemicals on September 17, 2015:

"Our weighted average cost of capital for the company (...) is 8 percent. (...) We are not going to do any project which has a less than a 10 percent internal rate of return. (...) We have established a minimum hurdle rate of 10 percent internal rate of return for all new projects."

From this paragraph, we record that the firm's perceived cost of capital was 8 percent and its discount rate 10 percent, implying that the discount rate wedge $\kappa_t = 2$.

We generally record only contemporaneous measures stated by firm managers and exclude figures that are historical, speculative, or posited by outsiders. A handful of firms mention multiple discount rates, for example, varying by country. We record the rate that represents most of the firm's operations (e.g., the US discount rate for a firm with operations mainly in the US). We restrict the data collection to figures representative for the firm overall. We detail further measurement guidelines in Appendix B.

To ensure high quality and consistency across research assistants, we had weekly team meetings where we discussed specific paragraphs. Most paragraphs were read by two separate research assistants to ensure consistent entries across research assistants. All outlier observations (in levels and changes) for discount rates were checked by hand by the authors.

2.4 Measuring the Financial Cost of Capital

We amend the data from conference calls with estimates of the financial cost of capital. The financial cost of capital is the weighted average cost of debt and equity (equation 3). The cost of debt is the after-tax expected return on the firm's debt. The cost of equity, which is the long-run expected stock return, is more complicated to calculate. At the firm level, the cost of equity is the country-level cost of equity adjusted for the firm's relative riskiness. In the below, we first explain how we estimate a country-level cost of equity before explaining how we calculate the firm-level cost of equity. We note that estimating the firm-level cost of equity is associated with more uncertainty as it incorporates both uncertainty about the country-level cost of equity and the firm-level risk adjustment.

2.4.1 Financial Cost of Capital at the Country Level

We calculate the expected average equity return using the balanced growth model. For each country in our sample, we calculate average 5-year earnings (based on all firms listed in the country) and compare these trailing five-year earnings to the total market capitalization to obtained the earnings yield.[11] In the balanced growth model, long-run expected equity returns are:

$$r_t^{\text{equity, country}} = \frac{\text{Earnings}_{t+1}}{\text{Price}_t} + g_t. \tag{7}$$

We approximate g_t as 2 percent plus average inflation over the last ten years.[12] We approximate the cost of debt using the long-run (10 year) yield on government debt from the OECD and assuming a tax rate of 20 percent.

The country-level financial cost of capital is the average cost of debt and equity, weighted by average leverage in the country.

2.4.2 Financial Cost of Capital at the Firm Level

We use the Capital Asset Pricing Model (CAPM) to estimate the firm-level cost of equity. While the CAPM model does not fully explain long-run expected stock returns (Fama and French 1992), it is most commonly used by practitioners. The model says:

$$E_t^{\text{CAPM}}[r_t^{\text{equity, firm}}] = r_t^f + \beta_t^{\text{firm}} \lambda_t, \tag{8}$$

where r_t^f is the risk-free rate, β_t^{firm} is the market beta of the firm, and λ_t is the market risk premium. The market risk premium is the difference between $r_t^{\text{equity, country}}$ and the risk-free rate, which is the short-term interest rate on government debt in the country. We estimate market betas in rolling five-year regressions of weekly data.[13] We approximate the cost of

[11] In the US, we use the inverse of the CAPE ratio maintained by Robert Shiller as the earnings yield. We shrink the earnings yield towards the time series mean in each country outside the US by a shrinkage factor of 0.5.

[12] Ideally we would use expected inflation in this calculation. In the US, one can use break-even inflation as a measure of expected inflation, but such measures are not available for all countries in our sample. Using past 10-year inflation as a proxy for future inflation is common practice (e.g., the definition of Excess-CAPE by Robert Shiller). We shrink inflation towards the cross-country conditional mean with a shrinkage factor of 0.5.

[13] The use of weekly data is common among practitioners but differs from the practice in asset pricing research, where betas are often estimated using monthly data over five-year horizons. We follow Frazzini and Pedersen (2014) and Frazzini and Pedersen (2014) and shrink betas towards the cross-sectional mean of

debt using total interest expenses in Compustat divided by total debt and assuming a tax rate of 20 percent.

2.5 Summary Statistics

The new dataset contains a diverse set of listed firms, summarized in panel A of Table 1. Market value in the sample ranges from 360 million USD at the 5th percentile to 54,163 at the 95th. The data include some of the world's largest corporations, including AT&T, Bank of America, Disney, Exxon, Home Depot, Intel, JPMorgan Chase, Mastercard, Nestle, Novartis, UnitedHealth, and Visa. The total market value of firms in the data was 31.1 trillion USD in 2019, which covers 42 percent of aggregate market value in advanced economies. US firms in the sample account for 50 percent of total US investment in Compustat.

The data contain roughly 2,400 observations on discount rates, 2,500 on perceived cost of capital, 4,700 on perceived cost of debt, and 400 on perceived cost of equity. The sample includes 2,500 unique firms with at least one of these observations in the dataset. The raw average discount rate is 16 percent, the average perceived cost of capital 8.5, the average cost of debt 4.5, and the average cost of equity 10 (nominal values in Table 1). The perceived cost of capital is distributed fairly symmetrically, while discount rates are more dispersed (Figure 1).

We plot the raw data by year in Figure 2. The average perceived cost of debt and cost of capital have fallen since 2002, in line with the global decrease in interest rates. Discount rates fluctuate over time. To formally study trends over time and heterogeneity across firms, we focus on within-firm variation in the next section.

Managers have incentives to report meaningful numbers on conference calls because the calls are held regularly and analysts can compare the reported discount rates to subsequently realized outcomes. Two pieces of evidence suggest that managers indeed report accurate numbers. First, a proxy for the true average cost of debt (average interest expenses in Compustat) is almost identical to the average perceived cost of debt reported in different years. Second, we show in Section 4.1 that the relation between reported discount rates and firm-level changes in investment is quantitatively very close to the predictions of a simple model.

We study whether firms in the sample are similar to other firms in Compustat in panel B of Table 1. We measure the percentile rank of each firm relative to other Compustat firms

1. We use a shrinkage factor of 0.5. We use weekly data as this is more common among practitioners.

in the same year and country. We then calculate the average percentile rank of firms in our sample. If the sample followed the same distribution as the Compustat population, the average rank would be close to 50. We find that firms in the sample are relatively large, as their average market value rank is 83. The unconditional probability of a Compustat firm being in our sample is roughly 3 percent, while it is roughly 50 percent for the 100 largest firms in Compustat. The selection of large firms is likely driven by the fact that conference calls are more common among large firms. Firms in the sample are relatively close to the average in terms of book-to-market (average rank of 48) and investment rate (average rank of 54), while return on equity is marginally higher (average rank of 58).

3 Discount Rates, The Cost of Capital, and Wedges

In this section, we explore the relation between the financial cost of capital, the perceived cost of capital, and discount rates. A stylized theoretical view argues that they should all be equal and move in parallel (see Section 1). We present evidence that they comove, but less than one-to-one, giving rise to time-varying wedges.

3.1 The Perceived and the Financial Cost of Capital

We first analyze the association between the perceived cost of capital and standard estimates of the financial cost of capital. We use two estimates of the financial cost of capital, as discussed in Section 2.4: a country-level and a firm-level measure.

The country-level measure is the average financial cost of capital in a country and quarter. It captures aggregate variation in capital markets and interest rates over time. We regress a firm's perceived cost of capital on the country-level measure in Table 2, panel A. We include country fixed effects in column 1 and firm fixed effects in column 2, so that the variation stems entirely from aggregate time-series fluctuations in capital markets and interest rates, which may be heterogeneous across countries. The stylized view of firms suggests that the point estimates should be 1. We find point estimates around 0.8, implying that when our estimated country-level financial cost of capital rises by 1 percentage point, the average firm increases its perceived cost of capital by 0.8 percentage points. Our measure of the financial cost of capital is estimated and therefore may contain some error. As a result, we cannot reject that the estimate is close to 1 on average. However, R-squared is far from one, suggesting substantial heterogeneity in how the perceived cost of capital fluctuates across firms.

We next analyze the firm-level measure of the financial cost of capital in columns 3 and 4. This measure captures both aggregate variation and cross-sectional heterogeneity in exposure to aggregate fluctuations. We find point estimates of 0.6 and 0.5 that are, once again, statistically different from 0 and 1. The slightly lower estimates may be explained by the greater uncertainty inherent to the estimating the firm-level financial cost of capital (Section 2.4). Despite the slightly lower slope coefficient, R-squared increases slightly, since now we also capture cross-sectional variation. Nonetheless, it is far from 1, suggesting substantial heterogeneity in perceptions across firms. We find that firms incorporate variation in the cost of equity and cost of debt to a similar degree in columns 5 and 6. Since we use scaled measures, the stylized view would again suggest that both coefficients are 1.

We explore how firms form their perceived costs of debt and equity in more detail in Table 2, panel B. We find that a long-run interest rate on government debt in the country and current interest expenses of the firm (normalized by outstanding debt) have strong predictive power, while leverage and beta do not (controlling for firm fixed effects).

We also explore the perceived cost of equity in more detail. In Figure 3, we plot the perceived cost of equity along with three potential estimates for the financial cost of equity. The green line assumes a constant equity risk premium of 6 percent, which is sometimes taught to MBA students (Cochrane 2011). The two red lines use more sophisticated estimates based on the CAPE measures maintained by Robert Shiller. One of these is our baseline estimate of expected returns in the US, namely, the earnings yield plus a nominal growth rate of 4 percent (the historical average). The other estimate is the earnings yield plus a bullish expected growth rate of 6 percent. The perceived cost of equity reported by firms is most closely aligned with the estimate based on CAPE and a bullish growth rate.

Taken together, the data imply that firms incorporate changes in the financial cost of capital into their perceptions. As an example of partial incorporation, we quote a conference call of IAG (the parent company of British Airways and Iberian). IAG increased their perceived cost of equity in response to the European sovereign debt crisis in 2011, but did not lower it by as much as capital markets would have suggested after the crisis. This has implicitly raised their cost of capital wedge υ (difference between perceived and financial cost of capital):

2014-11-07, IAG, Enrique Dupuy, CFO: *"We are still keeping a cost of capital of 10 percent and this is getting very conservative. We had to make a fine tuning exercise through the* *crisis in Spain and Europe a couple of years ago (...) and we increased the figure to this 10 percent level. But I think the assumptions are now behind (...) the 15 percent cost of equity, it appears to have a big, big premium there. Maybe those figures could be brought down slightly so 10 percent, we are keeping it there as a reference. We may be having to change it through '15 and beyond.* [edited for ease of understanding]"

3.2 Discount Rates and the Perceived Cost of Capital

We examine how discount rates move with the perceived cost of capital. We first plot pooled country-level averages of discount rates against the perceived cost of capital. There is a strong positive relation, suggesting that countries where firms perceive the cost of capital to be high are also countries with high discount rates.

We examine within-country variation in Table 3. We initially use only observations where managers report both the discount rate and the perceived cost of capital on the same conference call. When using broad variation across firms and time in column 1, we find that firms whose perceived cost of capital is 1 percentage point higher have a discount rate that is 0.8 percentage points greater. The estimate is roughly 0.4 when including firm and firm plus year fixed effects. This implies that when a firm's perceived cost of capital changes by 1 percentage point, relative to other firms in the same year and relative to the firm's previous perceived cost, the firm adjusts its discount rate by 0.4 percentage points.

To explore the relation for a larger set of firms, we construct a predicted value for a firm's perceived cost of capital. The predicted value is based on a lasso procedure that allows for full interactions of all components of the financial cost of capital (risk-free interest rate, beta, equity risk premium, leverage). We find similar point estimates when using the estimates of the perceived cost of capital as regressors in columns 3 to 6, although R-squared and standard errors are larger due to the estimated first stage. One advantage of this two-stage approach is that we avoid potential concerns about attenuation bias due to measurement error in the slope coefficient.

The stylized view posits that firms passively adopt their perceived cost of capital as discount rate, so that they should move one-to-one. We can reject a slope of 1 in all specifications using within-firm variation, suggesting that firms only partially incorporate the fluctuations in the perceived cost of capital into discount rates. The following quote from a Fortune 500 CFO illustrates this behavior:

2014-09-17, Spectra Energy, John Patrick Reddy, CFO: *"We didn't lower our hurdle rates in conjunction [with the past decrease in interest rates]. We lowered them somewhat but not just all the way down with long-term rates at 2.5 percent. We didn't take our hurdle rates down to 5 percent, for example. We are still looking at returns of, say 10 percent, on average for our projects."*

This partial incorporation implies that the discount rate wedge κ (difference between discount rate and perceived cost of capital) varies over time. We illustrate the time series behavior of κ in the US by controlling for time-invariant variation across firms. To do so, we first regress firm discount rates on year and firm fixed effects. We measure the average "within-firm" discount rate in every year by adding the year fixed effect to the unconditional mean. We follow an analogous procedure to create the average "within-firm" perceived cost of capital in every year. The difference between the two series is the "within-firm" discount rate wedge κ.

We plot the average within-firm κ in Figure 5. The wedge has increased by roughly 2.5 percentage points between 2002 and 2021. This is a large change, relative to historical movements in equity returns, interest rates, and policy rates. Much of the divergence since 2010 is driven by the fact that the perceived cost of capital has fallen while discount rates have only partially incorporated this trend and remained relatively stable. The wedge fluctuated up and down around the financial crisis, peaking in 2008.

4 Discount Rates and Investment

In this section, we analyze how discount rates and discount rate wedges relate to investment. We first study the relation between firm-level discount rates and investment. We then highlight that time-varying discount rate wedges shed light on aggregate investment dynamics and, in particular, the recent phenomenon of "missing investment."

4.1 Firm-Level Investment and Discount Rates

We plot the average discount rate in the US, measured in the conference call data, against aggregate net investment in Figure 6. Discount rates and investment comove, suggesting that the measured discount rates can account for aggregate dynamics.

We explore the relation in more detail at the firm level. Table 4 reports regressions of firm-level net capital investment on firm-level discount rates. All regressions include firm fixed effects, so estimates are driven by within-firm variation over time. Across a range of specifications, slope coefficients are -0.8 or -0.9. The coefficients are stable when we control for year fixed effects in column 2, the financial cost of capital in columns 3 and 4, and Tobin's Q in columns 5 and 6. We therefore find that a firm that raises its discount rate by one percentage point more lowers its net investment rate by -0.8 percentage points more, relative to the same firm in previous years, other firms in the same year, and even when its financial cost of capital and Tobin's Q are unchanged. The stability with respect to the financial cost of capital and Tobin's Q implies that the financial cost of capital and discount rate wedges independently affect investment. Two other measures of investment, the change in total assets in Table A1 and net investment including intangibles in Table A2, also comove with discount rates.

The results suggest that discount rates accurately measure firms' investment demand (holding constant the cash flow of its investment opportunities). The results are also consistent with standard theory. In Appendix C, we study a simple Q-model of firm investment with discount rates. Under conservative assumptions about adjustment costs following Philippon (2009) and assuming a duration of Tobin's Q of 25 years, the model predicts a slope coefficient between -0.8 and -0.9, in line with our estimates.

4.2 Adjusted Q and "Missing Investment"

A recent literature argues that US investment has been low in recent decades relative to the falling financial cost of capital. The argument is usually made using Q-theory. Declines in the financial cost of capital have raised firms' equity market value and thereby led to high and rising values of Tobin's Q. According to standard Q-theory, investment should have risen with Tobin's Q. However, if anything, observed investment rates have been low relative to historical standards, leading researchers to argue that there is "missing investment" (Gutiérrez and Philippon 2017, Alexander and Eberly 2018).

We argue that the evolution of discount rate wedges can account for a large part of the decoupling between Tobin's Q and investment. Intuitively, large and increasing discount rate wedges imply that firms are holding back investment relative to what the financial cost of capital would suggest. To make this point precise, we first introduce a model to develop an "adjusted Q," which accurately captures firms' investment incentives in the presence of time-varying wedges. We then measure adjusted Q using our new dataset and analyze its relation to aggregate investment.

4.2.1 A Model of Adjusted Q

The firm chooses optimal investment I_t by maximizing the discounted value of future profits net of investment costs. The firm discounts cash flows using $\delta = 1 + r^{\text{fin.}} + \upsilon + \kappa$ (i.e., the sum of the financial cost of capital, a cost of capital wedge, and a discount rate wedge). The firm's problem is:

$$V_t(\upsilon + \kappa, k_t) = \max_{I_t} \sum_{t=0}^{\infty} \frac{\Pi_t(k_t) - I_t - \Phi(I_t, k_t)}{(1 + r^{\text{fin.}} + \upsilon + \kappa)^t} \tag{9}$$

$$\text{s.t.} \qquad k_{t+1} = I_t + (1 - \xi)k_t \tag{10}$$

where $\Pi_t(k_t)$ is profits earned at time t using k_t units of capital, I_t is investment at time t, ξ is the depreciation rate of capital, and $V_t(\upsilon + \kappa, k_t)$ is the discounted value of the firm. The function $\Phi(I_t, k_t)$ captures adjustment costs, which are quadratic in net investment:

$$\Phi(I_t, k_t, \xi) = \frac{\phi}{2}\left(\frac{I_t}{k_t} - \xi\right)^2 k_t,$$

where $\phi \in \mathbb{R}^+$ governs the magnitude of adjustment costs. Optimal investment (see Appendix D for derivations) is:

$$\frac{I_t}{k_t} - \xi = \frac{1}{\phi}(q_t - 1), \tag{11}$$

where q_t is the Lagrange multiplier that captures the marginal value of capital:

$$q_t = \frac{\partial V_t(\upsilon + \kappa, k_t)}{\partial k_{t+1}}.$$

The marginal value of capital q_t is not observable without additional assumptions. The literature usually follows Hayashi (1982) and assumes that the production and cost functions are homogeneous of degree one. In this case, the marginal value of capital equals the average value of capital, denoted Q_t:

$$q_t = \frac{\partial V_t(\upsilon + \kappa, k_t)}{\partial k_{t+1}} = \frac{V_t(\upsilon + \kappa, k_t)}{k_{t+1}} = Q_t. \tag{12}$$

We can thus measure q_t as the value of the firm's capital relative to its replacement value. We emphasize that $V_t(\upsilon + \kappa, k_t)$ is calculated using $1 + r^{\text{fin.}} + \upsilon + \kappa$ as the discount rate. If $\upsilon + \kappa = 0$, such that the firm uses the financial cost of capital as its discount rate, we can estimate Q_t on financial markets using Tobin's Q. Otherwise, however, one must correct Tobin's Q to obtain the marginal value of capital in the eyes of the firm, as summarized in the next proposition.

Proposition 1 (Adjusted Q). *If the production and investment cost functions are homogeneous of degree one, the shadow cost of capital can be approximated as:*

$$q_t \sim Q_t^{\text{Tobin}} \times \frac{1}{(\upsilon + \kappa) \times \text{Dur} + 1}, \tag{13}$$

where Dur is the duration of the firm's future cash flows calculated using $r^{fin.}$ as the discount rate. See Appendix D for the definition and proof.

If the wedges sum to zero ($\upsilon + \kappa = 0$), we can approximate marginal q using Tobin's Q. Intuitively, the firm and financial markets use the same discount rate in this case and therefore agree on the value of the profits produced by capital. If the wedges are non-zero ($\upsilon + \kappa \neq 0$), we need to adjust Tobin's Q downwards because the firm uses a higher discount rate than the market, causing the firm to put a lower value on capital than the market. The strength of the adjustment naturally depends on the magnitude of the wedges, but also on the duration of the cash flows. Indeed, it is well known that the impact of the discount rate on the value of an asset depends on the duration of the asset's cash flows, which is calculated as the weighted time to maturity of future cash flows. The longer the duration (i.e., the further into the future the average cash flow is earned), the larger the effect of discount rates on the value of the asset. For this reason, the effect of wedges increases with the duration of the firm's cash flows.

4.2.2 Empirical Analysis of Adjusted Q

We empirically implement the adjustment to Q for the average US firm. We calculate Tobin's Q using flow of funds data, following the method in Crouzet and Eberly (2022). We calculate adjusted Q by inserting the average observed discount rate wedge (κ_t) for every year in the adjustment factor.[14] We calculate the average duration over our sample based on the duration of the firms outstanding debt and equity (see Appendix D).

Figure 7 plots Tobin's Q along with our new adjusted Q. Tobin's Q is well above 1 and rises throughout the sample. Standard Q-theory would therefore predict high and rising investment throughout the sample. In contrast, adjusted Q is close to 1 and relatively stable. Adjusted Q thus corresponds more closely to the relatively low investment observed during this period.

We further explore whether the variation in discount rate wedges and adjusted Q is large enough to account for missing investment using the method of Gutiérrez and Philippon (2017). We first estimate the relation between aggregate investment and Tobin's Q in the years 1990 to 2002. We then predict what investment since 2002 would have been if the relation between Tobin's Q and investment had remained constant. The difference between actual investment and predicted investment is "missing investment," the cumulative shortfall in investment since 2002 due to the decoupling between Tobin's Q and observed investment. The blue line in Figure 8 shows that this shortfall reached roughly 20 percent of the capital stock in 2019.[15]

We repeat the exercise using adjusted Q. To estimate the relation between adjusted Q and investment in the pre-2002 sample, we need to estimate the discount rate wedge during this period. We exploit survey data from Poterba and Summers (1995) to calculate a discount rate wedge of around 3.5 percent in 1990 and linearly interpolate between this estimate and our observed wedge in 2003.[16] The red line shows that the investment shortfall relative to adjusted Q is relatively smaller and close to zero.[17] Hence, the investment behavior of firms is consistent with standard investment models, once we recognize that firms use discount

[14]We set the cost of capital wedge (υ_t) equal to zero for this exercise, so that different perceptions about the financial cost of capital do not affect the results.

[15]An important literature, reviewed in Crouzet et al. (2022), finds that mismeasurement of intangible capital may explain around 30 percent of the investment shortfall in traditional data. Accordingly, we use a BEA measure of aggregate investment that already includes intangible investment and our adjusted Q therefore accounts for wedges on both intangible and tangible investment. The BEA measure may still not capture intangibles fully, which could account for any remaining investment shortfall unexplained by adjusted Q in Figure 8.

[16]Poterba and Summers report an average real discount rate of 12.2 percent in 1990, which is approximately 1 percentage point lower than the real discount rate we observe in 2003. We further estimate that the real financial cost of capital fell by approximately 2 percentage points between 1990 and 2003. Taken together, these estimates suggest that the wedge in 1990 was 3 percentage points lower than in 2003 (where we observe a wedge of 6.5). Summers (1986) documents an average real discount rate of 10 percent in 1986, consistent with low discount rate wedges around 1990.

[17]In Table A3, we show the underlying regressions. There is no statistically significant investment shortfall after 2002 conditional on adjusted Q.

rates that deviate from the perceived cost of capital.

Taken together, the analysis suggests that the evolution of discount rate wedges is sizable enough to account for a large part of missing investment in the 21$^{\text{st}}$ century. Understanding why discount rate wedges exist and why they have expanded in recent times is therefore likely to be fruitful for our understanding of seemingly low investment in recent years. We study this question in depth in Section 5 but before doing so, we analyze the sensitivity of investment to the financial cost of capital more generally.

4.3 Adjusted Q and the Sensitivity of Investment to the Financial Cost of Capital

Going beyond the recent phenomenon of missing investment, discount rate wedges have implications for the general sensitivity of investment to the financial cost of capital and therefore for the real effects of a range of shocks (including stock market fluctuations, monetary policy, credit provision, etc.). We use the model of adjusted Q from Section 4.2.1 to calculate the effect of the financial cost of capital on net investment in the presence of discount rate wedges (following Proposition 2) as:

$$\frac{\Delta\left(\frac{I_t}{k_t}-\delta\right)}{\Delta r^{\text{fin.}}}=\frac{\Delta\left(\frac{I_t}{k_t}-\delta\right)}{\Delta\delta}\frac{\Delta\delta}{\Delta r^{\text{fin.}}}\sim\frac{\Delta\delta}{\Delta r^{\text{fin.}}}\times\frac{1}{\phi}\times\frac{\text{Dur}}{(\upsilon+\kappa)\times\text{Dur}+1}. \tag{14}$$

Two channels dampen the investment sensitivity when wedges are positive: the wedge channel and the duration channel. First, the wedge channel is related to the ratio $\frac{\Delta\delta}{\Delta r^{\text{fin.}}}$, which measures how strongly firms incorporate changes in the financial cost of capital into discount rates. This ratio is smaller than one in the data (see Section 3) and therefore reduces the investment sensitivity. Second, to understand the duration channel, imagine that firms incorporate changes in the financial cost of capital one-to-one into discount rates $\left(\text{i.e., } \frac{\Delta\delta}{\Delta r^{\text{fin.}}}=1\right)$. In this case, positive wedges still affect the firm because they shorten the firm's duration of cash flows. In turn, a shorter duration lowers the sensitivity of investment to movements in discount rates (and thus in the financial cost of capital), as shown by the term $(\upsilon+\kappa>0)$ in the denominator.

We explore the sensitivity of investment to the the financial cost of capital under different assumptions in Figure A3. Here, we calculate the sensitivity as the semi-elasticity, in line with much of the literature (i.e., the percentage change in gross investment relative to a 1 percentage point increase in the financial cost of capital).[18] In a model with zero wedges, the semi-elasticity is 0.25. It falls to 0.12 when we incorporate the average observed discount rate wedge of 8 percentage points in the data. It further drops to 0.05 if we also add the duration channel. These numbers suggest that discount rate wedges have first-order impact on the investment sensitivity.

5 Drivers of Discount Rates and Wedges

We have so far established that there exist time-varying wedges between the perceived cost of capital and discount rates that are large enough to have quantitatively important implications for investment dynamics. In this section, we discuss and test theories explaining why there exist positive wedges and then show which factors have driven changes in wedges since 2002.

5.1 Theoretical Explanations for Discount Rate Wedges

5.1.1 Market Power and Value Creation

In frictionless models, market power on its own leads to positive discount rate wedges if firms do not correctly account for cash flow effects in their NPV calculations. Market power implies that new investments may cannibalize the profits of existing investments but this effect operates through cash flows. Managers should therefore incorporate the cannibalization of profits into the cash flows of their NPV calculations, rather than their discount rates. In practice, however, firms may choose to incorporate the cannibalization effect into discount rate, which would imply that firms with higher market power use higher discount rate wedges.

In models with information frictions or non-standard beliefs, managers may want to set positive discount rate wedges, for two reasons explained below. However, such wedges are not sustainable in a perfectly competitive market equilibrium, where one firm can profitably deviate by lowering its discount rate to the perceived cost of capital. This deviation would increase investment, output, and profits of the deviating firm and lower the product market price. All other firms in the market would then have to follow suit and lower their discount rates to survive. Market pressures should therefore limit the extent to which positive discount rate wedges persist under perfect competition. In contrast, firms with market power do

[18] We assume a cash flow duration of 25 years (see Appendix D) and set $\phi = 10$, following Philippon (2009).

not face the same competitive pressure and can more easily maintain positive wedges in equilibrium.

Two factors may incentivize managers to maintain positive discount rate wedges in the first place.

Signaling Prudence A key principle of modern management is that firms should be diligent in their capital allocation process and ensure that new investments do not destroy shareholder value (Jensen 1986). Business schools accordingly teach that that the expected return on investments must at least equal the cost of capital. Investors carefully monitor whether managers adhere to this principle. Firms may thus want to signal prudence by using high, "conservative" wedges and communicating this to investors. By using high wedges, firms also decrease the risk that realized returns fall below the perceived cost of capital, which would raise concerns among investors that managers are overinvesting and destroying value. Appendix E contains a number of quotes from conference calls signaling such prudence.

Signaling High Returns There is a widely held belief among managers and investors that discount rate wedges raise firm value. We systematically categorize all conference calls where managers discussed or justified why they maintained positive wedges. The most common type of explanation, mentioned on 59 percent of relevant calls, was that discount rates above the cost of capital contribute to firm value.[19] While projects earning a higher return naturally create more value, setting a discount rate above the perceived cost of capital risks leaving value-adding projects on the table. A high discount rate may nonetheless send a signal of profitability and value creation, to which investors respond favorably. Similarly, managers may also be reluctant to decrease discount rates to avoid sending a negative signal to investors. Formally, a firm's return (i.e., its discount rate) may act as a salient stimulus that attracts investors (Bordalo et al. 2022) and investors may rely on a simplified, sparse set of firm characteristics to guide investment (Gabaix 2014).

Taken together, a testable implication of the above theories is that firms with market power have higher discount rate wedges and that firms with market power maintain high discount rates even when their perceived cost of capital falls.

[19]The total number of calls where managers justified a positive discount rate wedge was 123. The second most common explanation after value was risk and uncertainty, discussed below, with 33 percent.

5.1.2 Risk and Uncertainty

A firm's financial cost of capital should generally capture the compensation for risk required by investors. However, there are a number of reasons why firms might incorporate risk into their discount rates over and above the financial cost of capital. First, real option theory shows that when investment projects are risky and (fully or partially) irreversible, the optimal investment decision depends on the uncertainty of the cash flows (Ingersoll Jr. and Ross 1992, Dixit and Pindyck 1994, Abel and Eberly 1996, Décaire 2021). The more uncertainty, the longer the firm should postpone investing. While in theory, the optimal investment decision uses the financial cost of capital as discount rate, a firm can approximate optimal behavior by increasing its wedge in the face of uncertainty (McDonald 2000). Real options theory therefore implies that firms with more uncertain projects have higher wedges in the cross section.

Second, if a firm's new projects are systematically riskier than its current projects, the firm should use positive discount rate wedges when evaluating new projects. Third, if equity is mispriced, managers may want to adjust discount rates by incorporating corrected risk factors (Stein 1996). Finally, if certain investors are imperfectly diversified, it may be in their interest to use high discount rate wedges. An imperfectly diversified investor cares about both the systematic and idiosyncratic risk in firms' cash flows. Firms' investments are therefore riskier in the eyes of an underdiversified investor than in the eyes of the market, and such investors would therefore want to use higher discount rates than the overall market would.

The 2020 Association of Finance Professionals Survey finds that close to half of respondents increase discount rates in the face of increased uncertainty. Similarly, 33 percent of managers who justified a positive discount rate wedge on their conference call argue that a positive discount rate wedge is needed to account for risk and uncertainty. The following quote gives an example of such behavior:

2016-11-10, Halyard Health Inc., Steve Voskuil, CFO: *"...So that's kind of how we come to the 9 percent [hurdle rate]. We start with the capital markets' rates and look at our capital structure, and then we add a little bit to that to reflect risk in the portfolio and execution."*

5.1.3 Financial and Organizational Constraints

Firms may face constraints that are not normally included in NPV analyses. Firms can incorporate these constraints by adding the shadow price of constraints to their discount rate. For instance, Jagannathan and Meier (2002) argue that firms facing organizational constraints should include the shadow cost of managerial attention in their discount rates. Similarly, firms facing financial frictions should include a shadow cost of capital over and above their financial cost of capital.

This theory predicts that firms with more constraints are more likely to have higher discount rates and wedges. The following quote illustrates how financial constraints can affect discount rates:

2016-10-19, Kinder Morgan, Kim Dang, CFO: *"We are living within our cash flow, meaning that we want to be able to fund our CapEx and our dividend from our cash flow. And so that is the constraint, and so, because we have a limited amount of capital, that is why we have the hurdle rate set at 15 percent IRR for projects."*

5.1.4 Cash Flow Inflation

Managers may worry that internal cash flow forecasts are excessively optimistic. By using higher discount rates, they can correct for such inflation. However, investors and analysts generally expect firms to earn their discount rate on their marginal project, and managers are often asked to compare their realized returns to their discount rate. Adjusting for earnings inflation through the discount rate may apply more frequently to private firms or small firms that do not hold regular conference calls. Large firms that frequently face interactions with investors can counteract cash flow inflation by adjusting expected cash flow growth rates instead of discount rates.

5.2 Testing Cross-Sectional Variation in Discount Rates and Wedges

The theories above predicted that, in the cross section, firms with higher market power, risk, and financial constraints maintain greater discount rates and greater wedges. We measure firm-level market power using the accounting method in Baqaee and Farhi (2020), risk using one-year option implied equity volatility, and financial constraints using the index by Hadlock and Pierce (2010).[20] Since we are initially interested in cross-sectional variation, we average

[20] We find similar results using the measure of market power by De Loecker et al. (2020).

these variables for the period 2000 to 2002 and include country and year fixed effects in the regressions. Variables are standardized, so that coefficients estimate the impact of a one standard deviation increase.

In Table 5, we find that firms with greater market power have higher discount rates (column 1), higher discount rate wedges (column 2), and higher total wedges (discount rate wedge plus cost of capital wedge, column 3). The coefficients are statistically significant and economically large. Similarly, riskier firms also have statistically and economically higher discount rates and wedges. The coefficients on financial constraints are all positive and economically significant, but only the association with the total wedge is statistically significant. Together, the variables explain 18 percent of total variation in discount rates.

5.3 The Drivers of Changes in Discount Rates and Wedges

We next study time variation in discount rates and wedges. We show that variation in market power across firms accounts for which firms have driven the secular increase in discount rate wedges since 2002. Moreover, we argue that changes in risk likely explain short-run fluctuations in discount rate wedges.

5.3.1 Market Power and The Secular Increase in Discount Rate Wedges

Firms with high market power are less likely to adjust discount rates when the financial cost of capital falls as they face less competitive pressure to do so (see Section 5.1.1). Consistent with this argument, we find that firms with high market power have kept their discount rates steady in recent decades while firms with low market power have decreased their discount rates as the financial cost of capital has fallen.

We first illustrate this finding using a simple sample cut. We split the sample into two groups based on firms' average market power between 2000 and 2002. We measure market power using accounting profits, as in Baqaee and Farhi (2020), but the results are robust to using the measure in De Loecker et al. (2020). We calculate calculate the average discount rate in each year separately for each group. We do so in firm-year panel regressions that include firm fixed effects, such that the results are driven by within-firm variation in discount rates (as in Section 3.2).

Figure 9 plots the resulting time series of discount rates for the high- and low-market power groups. Discount rates of firms with high market power are relatively stable since 2002 and, if anything, increase slightly, even though the financial cost of capital has trended downward over this period. In contrast, discount rates of firms with low market power have fallen. These patterns are consistent with the view that competitive pressures force firms to adjust discount rates with decreases in the financial cost of capital.

We test these dynamics formally in Table 6. We regress firm-level discount rates and wedges on a series of interaction terms. We include firm fixed effects so results are again driven by within-firm variation in discount rates and wedges over time. We first interact market power with a time trend. The results show that firms with higher market power in 2002 increased their discount rate (column 1) and their wedges (columns 4 and 7) by significantly more between 2002 and 2021. The point estimate implies that a standard deviation increase in market power is associated with a 2.5 percentage point increase in the discount rate wedge over the sample.

We next interact market power with the country-level average perceived cost of capital, finding that firms with higher market power also reacted significantly more to changes in the perceived cost of capital (columns 2, 5, and 8). The magnitude is such that a firms whose market power is one standard deviation higher incorporates a percentage point shock to the perceived cost of capital by 0.43 percentage points less. The interaction of market power with the firm-level perceived cost of capital also supports this conclusion, although estimates are less precise (columns 3, 6, and 9).

Taken together, these results support the view that market power has limited the extent to which firms have incorporated the secular decline in the financial cost of capital into discount rates.

5.3.2 Time-Varying Risk and Fluctuations in Discount Rate Wedges

Real options theories suggest that increases in risk raise discount rate wedges, as explained in Section 5.1.2. According to these theories, time variation in risk should influence wedges more strongly for firms with more irreversible projects. To test this prediction, we interact a firm's option-implied volatility in a given year with a time-invariant measure of asset irreversibility at the industry level (Kim and Kung 2017).[21] We also include firm fixed effects. In Table 7, we report that changes in volatility affect firms with high irreversibility more strongly. The interaction effect is statistically significant for the discount rate wedge (column 2) and the total wedge (column 3). These results support the view that time variation in risk leads to time variation in wedges through the real options channel.

[21] We measure asset irreversibility as the average between 2000 and 2002.

Different measures of risk have fluctuated significantly in recent years, implying that short-run variation in discount rate wedges may be explained by changes in risk and uncertainty. Specifically, aggregate option-implied volatility, the probability of a rare disaster (Barro 2006, Martin 2017), and policy uncertainty (Baker et al. 2016) increased before and during the financial crisis of 2008 and fell thereafter. Hence, these factor may have contributed to the peak in discount rate wedges around 2008. Moreover, to the extent that disaster risk and economic policy uncertainty have increased in recent decades, risk may have also contributed to the upward trend in the wedge.[22]

6 Conclusion

This paper presents a new dataset on firms' discount rates and perceived cost of capital, augmented with measures of the financial cost of capital and investment. We find that firms partially incorporate changes in the financial cost of capital into their perceived cost of capital. In addition, discount rates move with the perceived cost of capital, but significantly less than one-to-one. These patterns leads to large and time-varying wedges between discount rates and the financial cost of capital. Moreover, we find that discount rates are strongly negatively related to investment.

Discount rate wedges have trended upward substantially in recent decades. The average firm in our sample has increased its discount rate wedge by 2.5 percentage points between 2002 and 2021. This pattern affects our understanding of aggregate investment dynamics. The large and growing wedge suggests that firms have invested less relative to what we would expect given the financial cost of capital. The magnitude of this effect is large. Using a new adjusted Q-model, we show that the increase in the average wedge is large enough to account for the low levels of aggregate investment (relative to valuations in financial markets) observed in recent decades.

In exploring the drivers of discount rate wedges, we find important roles for both market power and risk. Riskier firms add higher wedges to their cost of capital, consistent with theories based on real options. Firms with high market power also add higher wedges. In addition, we find that the upward trend in discount rate wedges has been driven by firms with high market power. While firms with high market power have increased their wedges

[22]This finding is distinct from increasing risk premia studied by Farhi and Gourio (2018). Risk premia influence discount rates through the financial cost of capital, whereas in our analysis, risk generates a distinct, and potentially larger, impact on discount rates through wedges chosen by managers.

over the sample, firms with low market power have decreased their discount rates almost one-to-one with the change in the financial cost of capital, implying that their wedges have been relatively constant over time. These results suggest that market power has limited the extent to which the secular decline in the financial cost of capital has been incorporated into discount rates.

References

Abel, A. B. and J. C. Eberly (1996): "Optimal Investment With Costly Reversibility," *Review of Economic Studies*, 63, 581–593.

Alexander, L. and J. C. Eberly (2018): "Investment Hollowing Out," *IMF Economic Review*, 66, 5–30.

Baker, M., J. C. Stein, and J. Wurgler (2003): "When Does the Market Matter? Stock Prices and the Investment of Equity-Dependent Firms," *Quarterly Journal of Economics*, 118, 969–1005.

Baker, S. R., N. Bloom, and S. J. Davis (2016): "Measuring Economic Policy Uncertainty," *Quarterly Journal of Economics*, 131, 1593–1636.

Baqaee, D. R. and E. Farhi (2020): "Productivity and misallocation in general equilibrium," *Quarterly Journal of Economics*, 135, 105–163.

Barro, R. J. (1990): "The Stock Market and Investment," *Review of Financial Studies*, 3, 115–131.

——— (2006): "Rare Disasters and Asset Markets in the Twentieth Century," *Quarterly Journal of Economics*, 121, 823–866.

Bauer, M. D. and G. D. Rudebusch (2020): "Interest Rates under Falling Stars," *American Economic Review*, 110, 1316–54.

Blanchard, O., C. Rhee, and L. H. Summers (1993): "The Stock Market, Profit, and Investment," *Quarterly Journal of Economics*, 108, 115–136.

Bond, P., A. Edmans, and I. Goldstein (2012): "The Real Effects of Financial Markets," *Annual Review of Financial Economics*, 4, 339–360.

Bordalo, P., N. Gennaioli, and A. Shleifer (2022): "Salience," *Annual Review of Economics*, 14, 521–544.

Bruner, R. F., K. M. Eades, R. S. Harris, and R. C. Higgins (1998): "Best Practices in Estimating the Cost of Capital: Survey and Synthesis," *Financial Practice and Education*, 8, 13–28.

Campbell, J. Y. and S. B. Thompson (2008): "Predicting Excess Stock Returns Out of Sample: Can Anything Beat the Historical Average?" *Review of Financial Studies*, 21, 1509–1531.

Cieslak, A. and A. Vissing-Jørgensen (2021): "The Economics of the Fed Put," *Review of Financial Studies*, 34, 4045–4089.

Cochrane, J. H. (1991): "Production-Based Asset Pricing and the Link Between Stock Returns and Economic Fluctuations," *Journal of Finance*, 46, 209–237.

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

Crouzet, N. and J. C. Eberly (2022): "Rents and Intangible Capital: A Q+ Framework," *Journal of Finance – forthcoming*.

Crouzet, N., J. C. Eberly, A. L. Eisfeldt, and D. Papanikolaou (2022): "The Economics of Intangible Capital," *Journal of Economic Perspectives – forthcoming*.

De Loecker, J., J. Eeckhout, and G. Unger (2020): "The Rise of Market Power and the Macroeconomic Implications," *Quarterly Journal of Economics*, 135, 561–644.

Décaire, P. H. (2021): "Capital Budgeting and Idiosyncratic Risk," .

Dessaint, O., J. Olivier, C. A. Otto, and D. Thesmar (2021): "CAPM-Based Company (Mis)valuations," *Review of Financial Studies*, 34, 1–66.

Dixit, R. K. and R. S. Pindyck (1994): *Investment Under Uncertainty*, Princeton University Press.

Eisfeldt, A. L. and D. Papanikolaou (2014): "The Value and Ownership of Intangible Capital," *American Economic Review*, 104, 189–94.

Fama, E. F. and K. R. French (1992): "The Cross-Section of Expected Stock Returns," *Journal of Finance*, 47, 427–465.

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

Farhi, E. and F. Gourio (2018): "Accounting for Macro-Finance Trends: Market Power, Intangibles, and Risk Premia," *Brookings Papers on Economic Activity*, Fall, 147–223.

Frankel, R., M. Johnson, and D. J. Skinner (1999): "An Empirical Examination of Conference Calls as a Voluntary Disclosure Medium," *Journal of Accounting Research*, 37, 133–150.

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

Gabaix, X. (2014): "A Sparsity-Based Model of Bounded Rationality," *Quarterly Journal of Economics*, 129, 1661–1710.

Gilchrist, S., C. P. Himmelberg, and G. Huberman (2005): "Do Stock Price Bubbles Influence Corporate Investment?" *Journal of Monetary Economics*, 52, 805–827.

Gilchrist, S. and E. Zakrajšek (2012): "Credit Spreads and Business Cycle Fluctuations," *American Economic Review*, 102, 1692–1720.

Gomes, J. F., L. Kogan, and L. Zhang (2003): "Equilibrium Cross Section of Returns," *Journal of Political Economy*, 111, 693–732.

Gormsen, N. J. and K. Huber (2022): "Equity Factors and Firms' Perceived Cost of Capital," .

Gormsen, N. J. and E. Lazarus (2022): "Duration-Driven Returns," *Journal of Finance – forthcoming.*

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.

Gutiérrez, G. and T. Philippon (2017): "Investment-Less Growth: An Empirical Investigation," NBER Working Paper 22897.

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.

Hall, R. E. (2017): "High Discounts and High Unemployment," *American Economic Review*, 107, 305–30.

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.

Hayashi, F. (1982): "Tobin's Marginal Q and Average Q: A Neoclassical Interpretation," *Econometrica*, 213–224.

Hennessy, C. A., A. Levy, and T. M. Whited (2007): "Testing Q Theory With Financing Frictions," *Journal of Financial Economics*, 83, 691–717.

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

Ingersoll Jr., J. E. and S. A. Ross (1992): "Waiting to Invest: Investment and Uncertainty," *Journal of Business*, 1–29.

Jagannathan, R., J. Liberti, B. Liu, and I. Meier (2017): "A Firm's Cost of Capital," *Annual Review of Financial Economics*, 9, 259–282.

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

Jagannathan, R. and I. Meier (2002): "Do We Need CAPM for Capital Budgeting?" .

Jeenas, P. and R. Lagos (2022): "Q-Monetary Transmission," .

Jensen, M. C. (1986): "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," *American Economic Review*, 76, 323–329.

Jorgenson, D. (1963): "Capital Theory and Investment Behavior," *American Economic Review*, 53, 247–259.

Kim, H. and H. Kung (2017): "The asset redeployability channel: How uncertainty affects corporate investment," *Review of Financial Studies*, 30, 245–280.

Krishnamurthy, A. and A. Vissing-Jørgensen (2011): "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy," *Brookings Papers on Economic Activity*, 2, 215–265.

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.

Martin, I. (2017): "What is the Expected Return on the Market?" *Quarterly Journal of Economics*, 132, 367–433.

McDonald, R. L. (2000): "Real Options and Rules of Thumb in Capital Budgeting," in *Project Flexibility, Agency, and Competition*, ed. by M. J. Brennan and L. Trigeorgis, Oxford University, 13–33.

Meier, I. and V. Tarhan (2007): "Corporate Investment Decision Practices and the Hurdle Rate Premium Puzzle," .

Morck, R., A. Shleifer, and R. W. Vishny (1990): "The Stock Market and Investment: Is the Market a Sideshow?" *Brookings Papers on Economic Activity*, 1990, 157–215.

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

Pflueger, C., E. Siriwardane, and A. Sunderam (2020): "Financial Market Risk Perceptions and the Macroeconomy," *Quarterly Journal of Economics*, 135, 1443–1491.

Philippon, T. (2009): "The Bond Market's Q," *Quarterly Journal of Economics*, 124, 1011–1056.

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.

Sharpe, S. A. and G. A. Suarez (2021): "Why Isn't Business Investment More Sensitive to Interest Rates? Evidence from Surveys," *Management Science*, 67, 720–741.

Stein, J. C. (1996): "Rational Capital Budgeting in an Irrational World," *Journal of Business*, 69, 429–455.

Summers, L. H. (1986): "Investment Incentives and the Discounting of Depreciation Allowances," NBER Working Paper 1941.

Swanson, E. T. (2011): "Let's Twist Again: A High-Frequency Event-Study Analysis of Operation Twist and Its Implications for QE2," *Brookings Papers on Economic Activity*, 1, 151–188.

Tobin, J. (1969): "A General Equilibrium Approach to Monetary Theory," *Journal of Money, Credit and Banking*, 1, 15–29.

Trahan, E. A. and L. J. Gitman (1995): "Bridging the Theory-Practice Gap in Corporate Finance: A Survey of Chief Financial Officers," *Quarterly Review of Economics and Finance*, 35, 73–87.

van Binsbergen, J. H. (2020): "Duration-Based Stock Valuation: Reassessing Stock Market Performance and Volatility," NBER Working Paper 27367.

van Binsbergen, J. H. and C. C. Opp (2019): "Real Anomalies," *Journal of Finance*, 74, 1659–1706.

Welch, I. and A. Goyal (2008): "A Comprehensive Look at the Empirical Performance of Equity Premium Prediction," *Review of Financial Studies*, 21, 1455–1508.

Zhang, L. (2005): "The Value Premium," *Journal of Finance*, 60, 67–103.

Zwick, E. and J. Mahon (2017): "Tax Policy and Heterogeneous Investment Behavior," *American Economic Review*, 107, 217–48.

Table 1
Summary Statistics

Panel A reports summary statistics for variables extracted from the conference calls. The sample includes all firm-quarter observations for which we can extract from the conference calls at least one of the perceived cost of capital, debt, equity, and discount rate. Market value and the return on equity are from Compustat. Panel B reports the average percentile rank of firms in the sample relative to the universe of firms in Compustat in the same year and country of listing.

	(1)	(2)	(3)	(4)
VARIABLES	N	Mean	P5	P95
Panel A: Summary statistics				
Perceived cost of debt	4,668	0.045	0.016	0.083
Perceived cost of equity	373	0.10	0.053	0.15
Perceived cost of capital	2,548	0.085	0.041	0.12
Discount rate	2,398	0.16	0.080	0.29
Market value (million USD)	6,612	13,521	360	54,163
Return on equity	5,780	0.10	-0.063	0.28
Panel B: Characteristics of included firms (percentile of all Compustat firms)				
Market value (percentile)	6,612	82.5	45.0	99.3
Book-to-market (percentile)	5,480	47.7	5.63	91.1
Return on equity (percentile)	6,360	58.4	17.6	91.3
Physical capital (percentile)	6,177	61.6	8.66	96.9
Investment rate (percentile)	5,636	53.5	10.6	87.5

Table 2
The Perceived and the Financial Cost of Capital

This table reports results of panel regressions of the firm-quarter level perceived cost of capital on measures of the financial cost of capital at the firm and country level (see Section 2.4 for definitions). Standard errors are double-clustered by year and country. The sample runs from 2002 to 2021. The left- and right-hand side variables are in percentage points.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A			Perceived Cost of Capital			
Financial WACC (country-level)	0.88***	0.67***				
	(0.14)	(0.19)				
Financial WACC (firm-level)			0.64***	0.49***		
			(0.11)	(0.13)		
Delevered Cost of Equity (firm)					0.72***	0.47***
					(0.12)	(0.16)
Delevered Cost of Debt (firm)					0.51***	0.54***
					(0.14)	(0.16)
Constant	4.28***	5.24***	4.88***	5.65***	4.69***	5.70***
	(0.63)	(0.90)	(0.59)	(0.71)	(0.59)	(0.76)
Observations	1,968	1,448	2,058	1,520	2,058	1,520
R-squared	0.097	0.803	0.128	0.801	0.131	0.801
FE	Country	Firm	Country	Firm	Country	Firm
Within R2	0.047	0.070	0.088	0.092	0.091	0.093

Panel B			Perceived Cost of Debt			
Long-Term Rates (country-level)	0.34***	0.26***	0.044	0.34***	0.27***	0.047
	(0.062)	(0.064)	(0.068)	(0.061)	(0.063)	(0.066)
Interest expense (firm-level)	0.32***	0.25***	0.18***	0.31***	0.25***	0.18***
	(0.051)	(0.039)	(0.038)	(0.049)	(0.039)	(0.038)
Leverage ratio				0.87***	-0.13	-0.036
				(0.21)	(0.39)	(0.33)
Beta				0.34	0.16	0.19
				(0.23)	(0.34)	(0.33)
Constant	2.03***	2.50***	3.28***	1.46***	2.38***	3.10***
	(0.22)	(0.24)	(0.28)	(0.30)	(0.42)	(0.37)
Observations	3,114	2,735	2,735	3,114	2,735	2,735
R-squared	0.550	0.834	0.857	0.564	0.834	0.857
FE	Country	Firm	Firm/year	Country	Firm	Firm/year
Within R2	0.41	0.32	0.087	0.43	0.32	0.088

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

Table 3
Discount Rates and the Perceived Cost of Capital

This table reports results of panel regressions of firm-quarter level discount rates on the perceived cost of capital,

$$\text{Discount rate}_t^i = \beta_0 + \beta_1 \text{Perc. cost of capital}_t^i + \upsilon_t^i,$$

where i denotes firm and t denotes time. Columns 1 to 3 use the perceived cost of capital (WACC) measured in conference calls on the right-hand side. Columns 4 to 6 use a predicted perceived cost of capital (WACC) based on the financial cost of capital. The predicted perceived cost of capital is calculated based on inputs into the financial cost of capital using a lasso procedure, as explained in the text. The sample runs from 2002 to 2021. Standard errors are double-clustered by firm and year. The left- and right-hand side variables are measured in percentage points.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			Discount Rate			
Perceived WACC (firm-level)	0.79***	0.44***	0.38***			
	(0.076)	(0.12)	(0.12)			
Predicted perc. WACC (Lasso)				1.10**	0.44	0.40*
				(0.42)	(0.26)	(0.23)
Constant	4.61***	7.75***	8.20***	6.42*	12.3***	12.6***
	(0.81)	(1.01)	(1.01)	(3.60)	(2.21)	(1.93)
Observations	217	132	127	1,873	1,388	1,388
R-squared	0.324	0.982	0.984	0.104	0.965	0.967
FE	Country	Firm	Firm/year	Country	Firm	Firm/year
P(slope = 1)	0.014	0.00012	0.00010	0.81	0.044	0.016
Within R2	0.24	0.41	0.27	0.023	0.025	0.012

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

Table 4
Investment and Discount Rates

This table reports results of panel regressions of firm-level net investment rates on discount rates. Net investment is from Compustat and measured as $I_t = (\text{CAPEX}^i_{t+1} - \text{Depreciation}^i_{t+1})/\text{PPEN}^i_t$. Right-hand side variables are all measured at time t, as detailed in the text. The financial WACC is the financial cost of capital estimated using the CAPM. Tobin's Q is the book-to-market value of debt and equity. Standard errors are double-clustered by firm and date. The left- and right-hand side variables are measured in percentage points. The sample runs from 2002 to 2021 and excludes firms in the financial sector.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Dependent variable: Net Investment					
Discount rate	-0.90***	-0.84***	-0.90***	-0.86***	-0.82**	-0.75**
	(0.27)	(0.25)	(0.29)	(0.27)	(0.36)	(0.35)
Financial WACC (firm-level)			0.69	0.78	1.42	1.20
			(0.75)	(0.91)	(0.98)	(1.16)
Tobin's Q					1.13**	1.01*
					(0.44)	(0.51)
Observations	1,004	1,004	957	957	794	794
R-squared	0.791	0.811	0.801	0.820	0.810	0.833
FE	Firm	Firm/year	Firm	Firm/year	Firm	Firm/year
Cluster	Firm/year	Firm/year	Firm/year	Firm/year	Firm/year	Firm/year
Within R^2	0.039	0.034	0.043	0.041	0.062	0.050

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

Table 5
Differences in Discount Rates and Wedges Across Firms

This table reports results of panel regressions of firm-level discount rates, discount rate wedges, and discount plus cost of capital wedges on three variables. The discount rate wedge κ_t is measured as the discount rate minus the perceived cost of capital (predicted as in Table 3). The first is market power, measured using the accounting method in Baqaee and Farhi (2020). The second is risk, measured using option-implied volatility of equity. The third is financial constraints, measured using the index by Hadlock and Pierce (2010). The right-hand side variables are average values between 2000 and 2002. The sample runs from 2002 to 2021. All right-hand side variables are standardized.

VARIABLES	(1) Discount rate	(2) κ	(3) $\kappa + \upsilon$
Market Power (2002)	1.30*	1.18*	1.23*
	(0.63)	(0.60)	(0.60)
Risk (2002)	2.14***	1.72***	1.47***
	(0.57)	(0.53)	(0.50)
Fin. Constraints (2002)	0.83	0.97	1.05*
	(0.56)	(0.57)	(0.55)
Observations	799	799	799
R-squared	0.184	0.169	0.163
FE	Country/year	Country/year	Country/year
Cluster	Firm/year	Firm/year	Firm/year
Within R^2	0.12	0.10	0.095

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

Table 6
The Role of Market Power in the Evolution of Discount Rates and Wedges

This table reports results of panel regressions of firm-level discount rates, discount rate wedges, and discount plus cost of capital wedges on market power in 2002 interacted with three different variables: calendar year, perceived cost of capital at the country level, and the perceived cost of capital at the firm level (predicted as in Table 3). The discount rate wedge κ_t is measured as the discount rate minus the (predicted) perceived cost of capital. Standard errors are clustered by firm and year. Market power is standardized and measured using the accounting method in Baqaee and Farhi (2020). The sample runs from 2002 to 2021. The table reports the slope coefficients for the interaction terms.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Discount rate (δ)			Discount rate wedge (κ)			Both wedges ($\kappa + \upsilon$)		
Market Power (2002)*Year	0.13**			0.12**			0.13**		
	(0.061)			(0.054)			(0.055)		
Market Power (2002)*Country perc. WACC		-0.43**			-0.38**			-0.40**	
		(0.19)			(0.18)			(0.19)	
Market Power (2002)*Predicted perc. WACC			-0.30			-0.30			-0.24
			(0.21)			(0.21)			(0.24)
Observations	723	720	723	723	720	723	723	720	723
R-squared	0.963	0.960	0.963	0.959	0.958	0.961	0.943	0.941	0.951
FE	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Within R^2	0.11	0.044	0.035	0.056	0.023	0.035	0.049	0.021	0.041

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

Table 7
The Role of Risk in the Evolution of Discount Rates and Wedges

This table reports results of panel regressions of firm-level discount rates, discount rate wedges, and discount plus cost of capital wedges on firm-level implied volatility interacted with the irreversibility of assets in 2002. The discount rate wedge κ_t is measured as the discount rate minus the perceived cost of capital (predicted as in Table 3). Irreversibility is the negative of asset redeployability from Kim and Kung (2017). The sample runs from 2002 to 2021. All right-hand side variables are standardized.

VARIABLES	(1) Discount rate	(2) κ	(3) $\kappa + \upsilon$
Risk	1.27	0.027	-0.90
	(1.88)	(1.86)	(1.59)
Risk*Irreversibility	3.99	8.29*	12.1**
	(3.79)	(4.09)	(4.86)
Observations	581	581	581
R-squared	0.957	0.953	0.941
FE	Firm	Firm	Firm
Cluster	Firm/year	Firm/year	Firm/year
Within R^2	0.0013	0.025	0.055

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

Figure 1
Histograms of the Perceived Cost of Capital and Discount Rates

This figure plots histograms for the perceived cost of capital and discount rates, both extracted from conference calls.

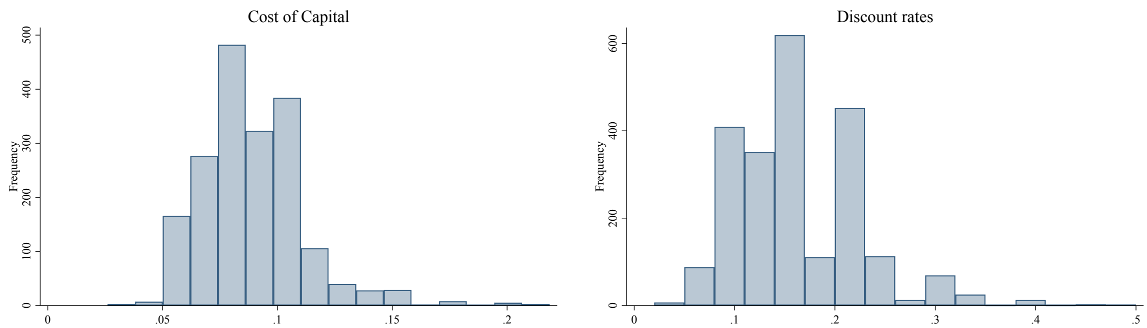


Figure 2
The Time Series of Corporate Discount Rates

This figure plots the average discount rate, perceived cost of capital, and perceived cost of debt by year for US firms.

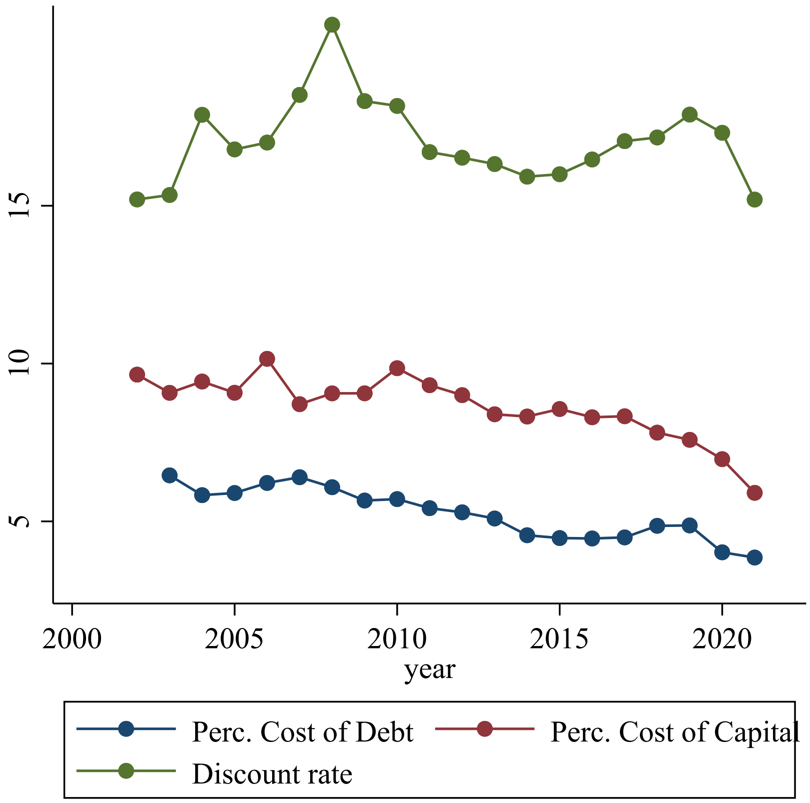


Figure 3
The Perceived Cost of Equity

This figure plots the perceived cost of equity along three different estimates of expected stock returns. We estimate the average perceived cost of equity in each year in a firm-year panel that includes firm fixed effects. The figure plots three-year moving averages. We include two measures based on the earnings yield, one which assumes a real growth of 2 percent and one which assumes a real growth of 4 percent. The "constant risk premium" measure is the risk-free rate plus a long-run market risk premium of 6 percent, as in the example by Cochrane (2011). Panel A plots expected stock returns/cost of equity. Panel B plots expected stock returns/cost of equity in excess of the risk-free interest rate.

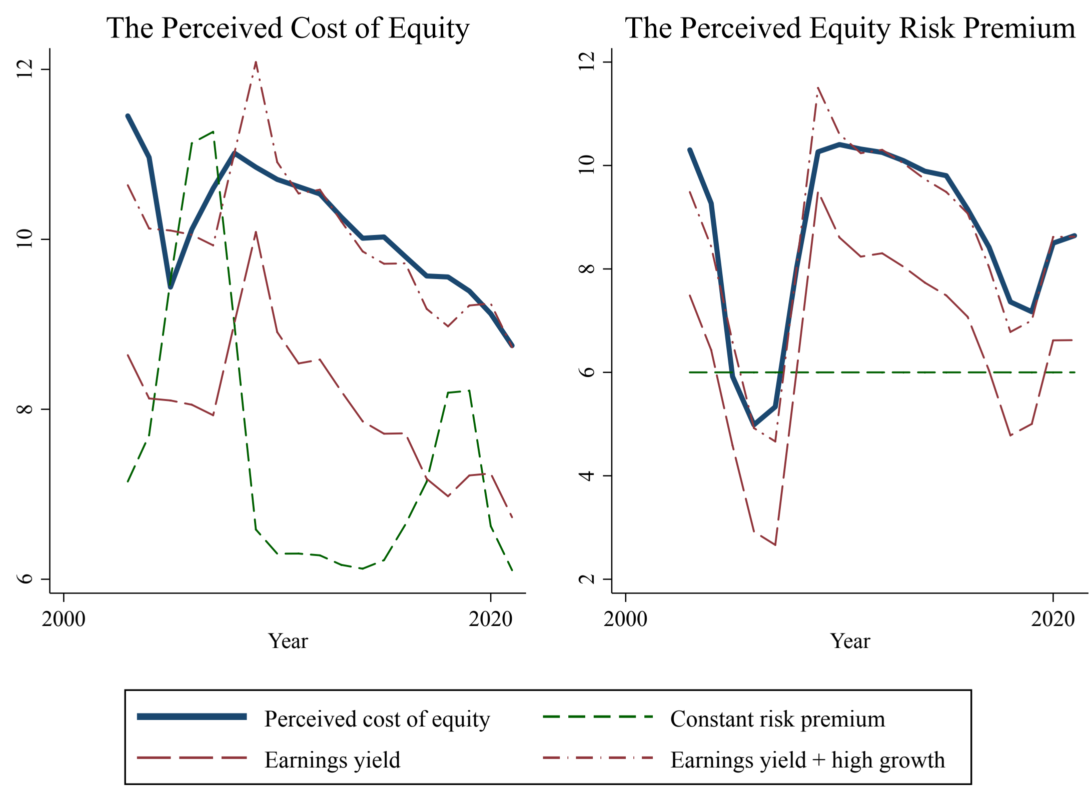


Figure 4
Discount Rates and Perceived Cost of Capital in Different Countries

This figure plots the average discount rates and perceived cost of capital for different countries in the sample. Data are from 2002 to 2021.

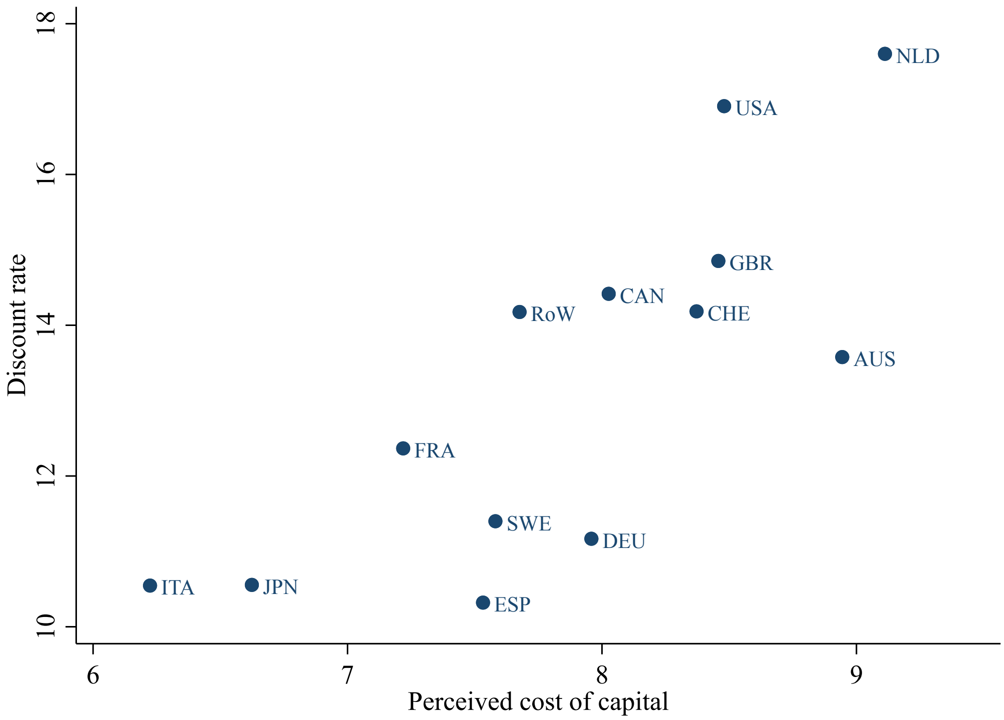


Figure 5
The Discount Rate Wedge in the US

This figure plots the average discount rate wedge (difference between discount rate and perceived cost of capital) in the sample of US firms. We isolate variation over time by controlling for time-invariant differences across firms. Specifically, we regress firm discount rates on year and firm fixed effects. We then measure the average "within-firm" discount rate in every year by adding the estimated year fixed effect to the unconditional mean. We follow an analogous procedure to create the average "within-firm" perceived cost of capital in every year. The difference between the two series is the "within-firm" discount rate wedge κ.

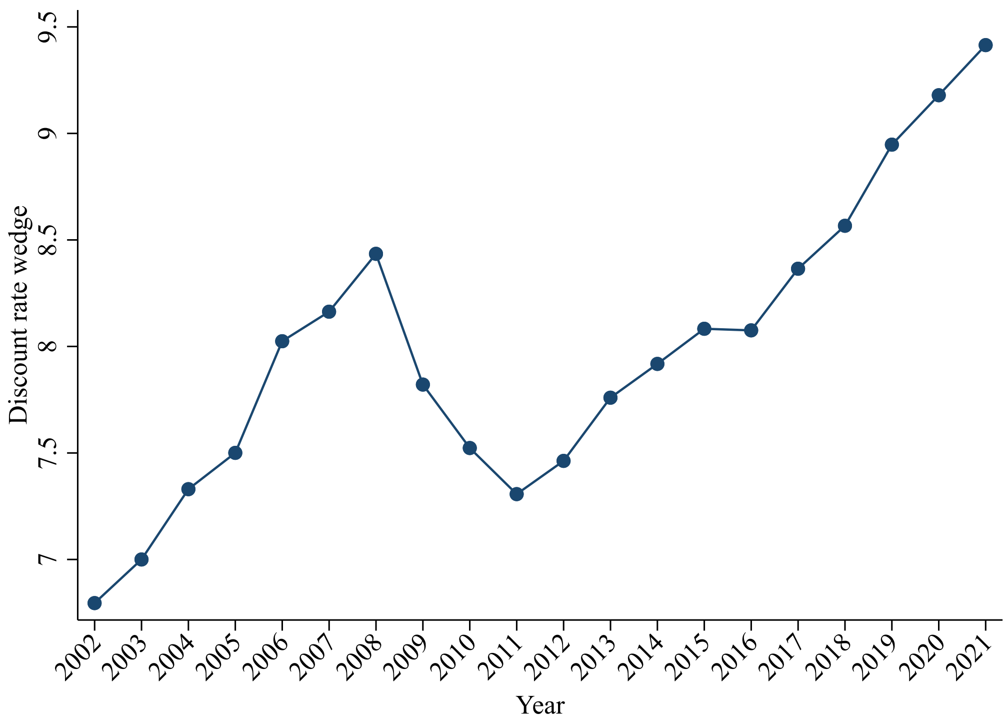


Figure 6
Discount Rates and Investment in the US

This figure plots the time series of average discount rates and aggregate net investment in the US. Investment is one year ahead relative to discount rates. Net investment is from the BEA.

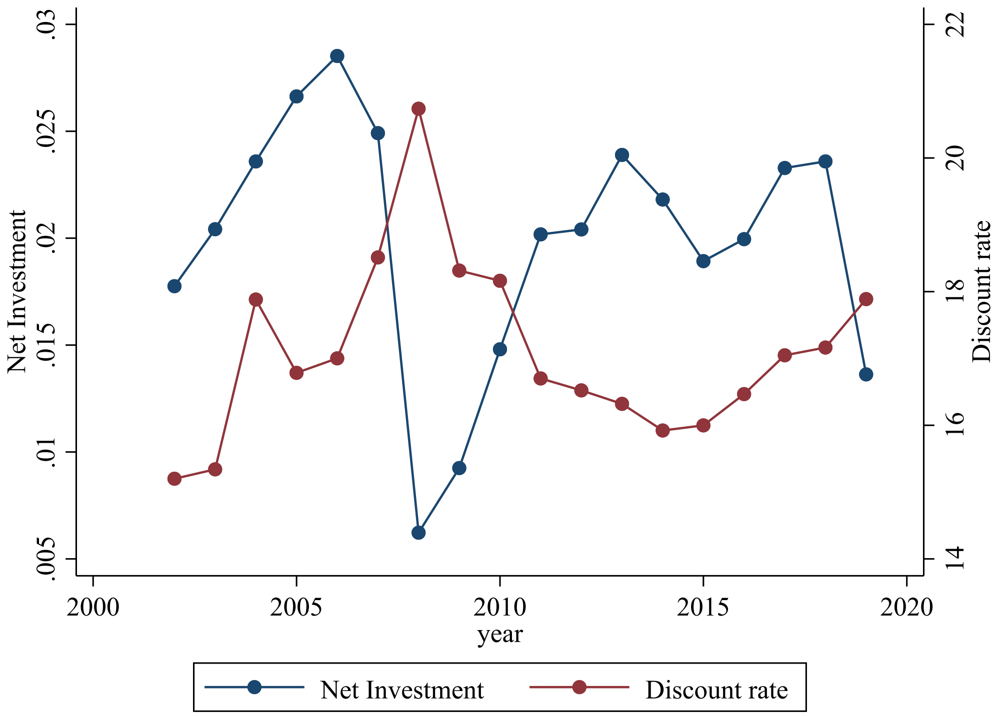


Figure 7
Adjusted Q

This figure plots Tobin's Q and the new adjusted Q. Tobin's Q is calculated using flow of funds data for the United States as in Crouzet and Eberly (2022). Adjusted Q is calculated by adjusting Tobin's Q for the average wedge between discount rates and the perceived cost of capital, as explained in the text.

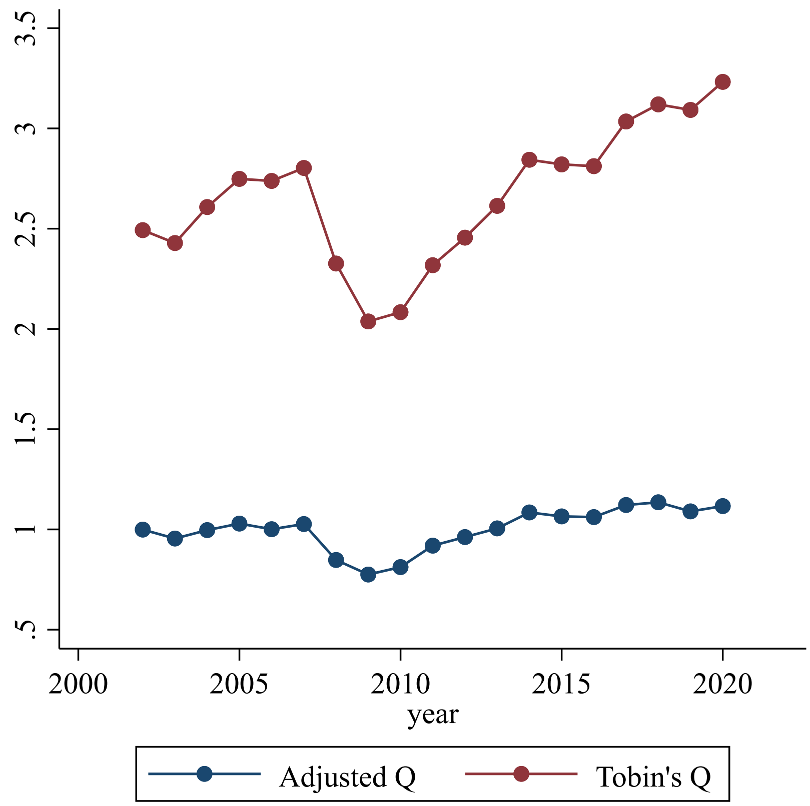


Figure 8
Adjusted Q and Missing Investment

This figure plots the cumulative investment shortfall in percent relative to the capital stock, calculated using Tobin's Q and adjusted Q. Tobin's Q is calculated using flow of funds data as in Crouzet and Eberly (2022). Adjusted Q is calculated by correcting Tobin's Q for the wedge between discount rates and the perceived cost of capital, as explained in the text. We estimate the relation between investment and Q using the 1990-2002 sample, separately for each type of Q. We then calculate cumulative residuals between observed investment and the predicted values for the years after 2002. The pre-2002 adjusted Q is based on backwards extrapolated discount rate wedges (see text for details). Investment is aggregate investment from the BEA, which includes intangibles. The sample is the United States.

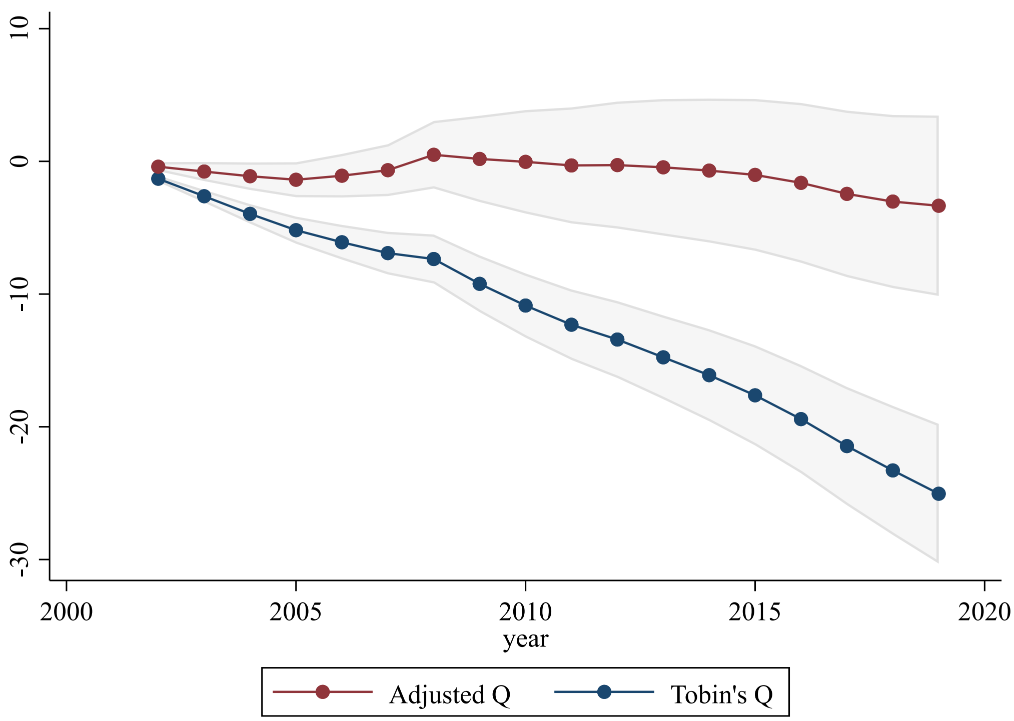
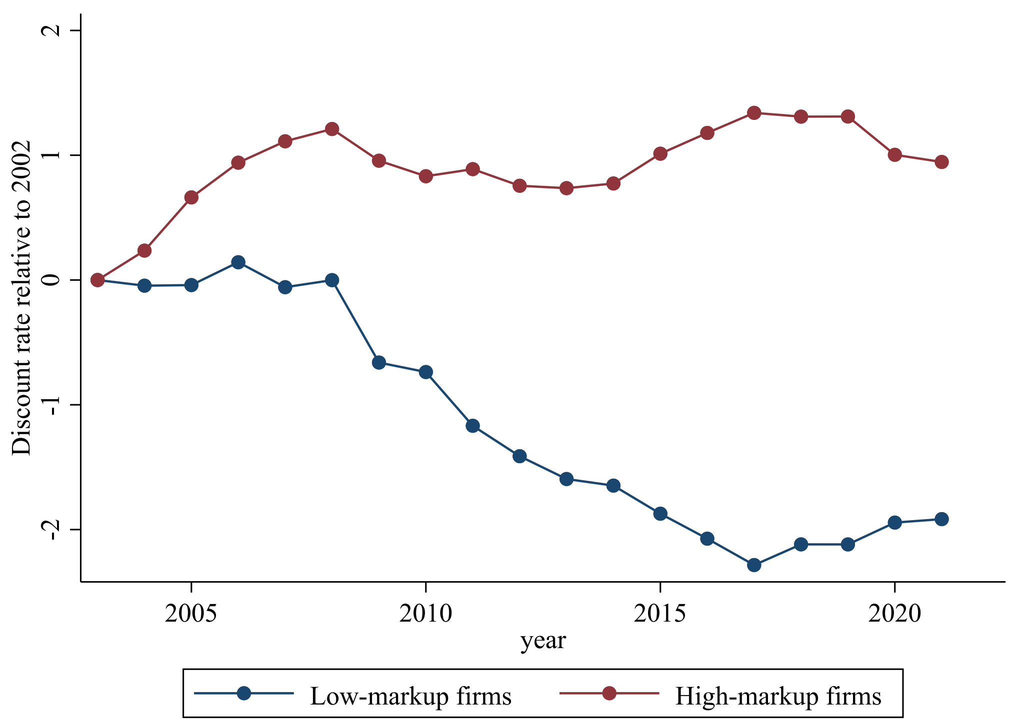


Figure 9
Market Power and Discount Rates

This figure plots the discount rates for high- and low-markup firms over time. We group firms into high- and low-markup firms based on the average markup of the firm in the 2000-2002 period. For each group we estimate the average annual discount rate in panel regression that include firm fixed effects. We smooth the resulting time series for discount rates over three years and normalize both series to start at 0 in 2003. Markups are measured using as accounting profits using the method in Baqaee and Farhi (2020).



Online Appendix to "Corporate Discount Rates"

Appendix A Tables and Figures

Table A1
Asset Expansion and Corporate Discount Rates

This table reports results of panel regressions of firm-level asset expansion, measured as $I_t = \text{Assets}^i_{t+1}/\text{Assets}^i_t$, on discount rates. Right-hand side variables are measured at time t, as detailed in the text. The financial WACC is the financial cost of capital estimated using the CAPM. Tobin's Q is the book-to-market value of debt and equity. Standard errors are double-clustered by firm and date. The left- and right-hand side variables are measured in percentage points. The sample runs from 2002 to 2021 and excludes firms in the financial sector.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Dependent variable: Asset Expansion					
Discount rate	-0.59*	-0.60**	-0.74***	-0.74**	-0.96**	-0.82**
	(0.28)	(0.25)	(0.25)	(0.27)	(0.37)	(0.37)
Financial WACC (firm-level)			0.61	1.03	1.42*	1.31
			(0.56)	(1.06)	(0.82)	(1.07)
Tobin's Q					3.07***	3.51***
					(0.80)	(0.72)
Observations	1,063	1,063	1,009	1,009	809	809
R-squared	0.432	0.476	0.446	0.492	0.552	0.600
FE	Firm	Firm/year	Firm	Firm/year	Firm	Firm/year
Cluster	Firm/year	Firm/year	Firm/year	Firm/year	Firm/year	Firm/year
Within R^2	0.0040	0.0042	0.0080	0.0095	0.081	0.10

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

Table A2
Investment Including Intangibles and Corporate Discount Rates

This table reports regressions of firm-level net investment rates (in tangible and intangible capital) on discount rates. We measure investment in intangible capital as R&D expenditures plus adjusted Selling and General Administrative expenses, as described in Eisfeldt and Papanikolaou (2014). We measure investment in tangible capital as in Table 4. Right-hand side variables are measured at time t, as detailed in the text. The financial WACC is the financial cost of capital estimated using the CAPM. Tobin's Q is the book-to-market value of debt and equity. Standard errors are double-clustered by firm and date. The left- and right-hand side variables are measured in percentage points. The sample runs from 2002 to 2021 and excludes firms in the financial sector.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Dependent variable: Net Investment Including Intangibles					
Discount rate	-0.27	-0.30**	-0.29	-0.32***	-0.50**	-0.45***
	(0.17)	(0.11)	(0.18)	(0.11)	(0.18)	(0.14)
Financial WACC (firm-level)			0.035	-0.26*	0.18	-0.17
			(0.19)	(0.14)	(0.23)	(0.16)
Tobin's Q					0.42***	0.47***
					(0.15)	(0.14)
Observations	956	956	911	911	764	764
R-squared	0.874	0.889	0.873	0.889	0.878	0.896
FE	Firm	Firm/year	Firm	Firm/year	Firm	Firm/year
Cluster	Firm/year	Firm/year	Firm/year	Firm/year	Firm/year	Firm/year
Within R^2	0.032	0.040	0.035	0.050	0.095	0.10

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

Table A3
Missing Investment

This table reports results of annual time series regressions of net investment on Tobin's Q, Adjusted Q, and variables capturing trends. The construction of adjusted Q is described in the text. We consider calendar year and a post-2002 dummy as trend variables. Net investment is calculated from the BEA tables. The sample runs from 1990 to 2021. Standard errors are calculated using the Newey-West method adjusted for 5 lags.

	(1)	(2)	(3)	(4)
VARIABLES	Netinvestment	Netinvestment	Netinvestment	Netinvestment
Tobin's Q	2.02***	1.33***		
	(0.18)	(0.28)		
Adjusted Q			4.95***	4.72***
			(0.64)	(0.75)
Year	-0.09***		-0.02	
	(0.01)		(0.02)	
Post-2002 dummy		-1.28***		-0.31
		(0.26)		(0.29)
Observations	30	30	30	30
R-squared	0.77	0.67	0.74	0.72

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure A1
Within-Firm Variation in Discount Rates and the Perceived Cost of Capital

This figure plots the within-firm standard deviation of the perceived cost of capital (left) and discount rates (right). The sample runs from 2002 to 2021. We exclude firms with less than 4 quarterly observations and firms for which discount rates and cost of capital are always constant.

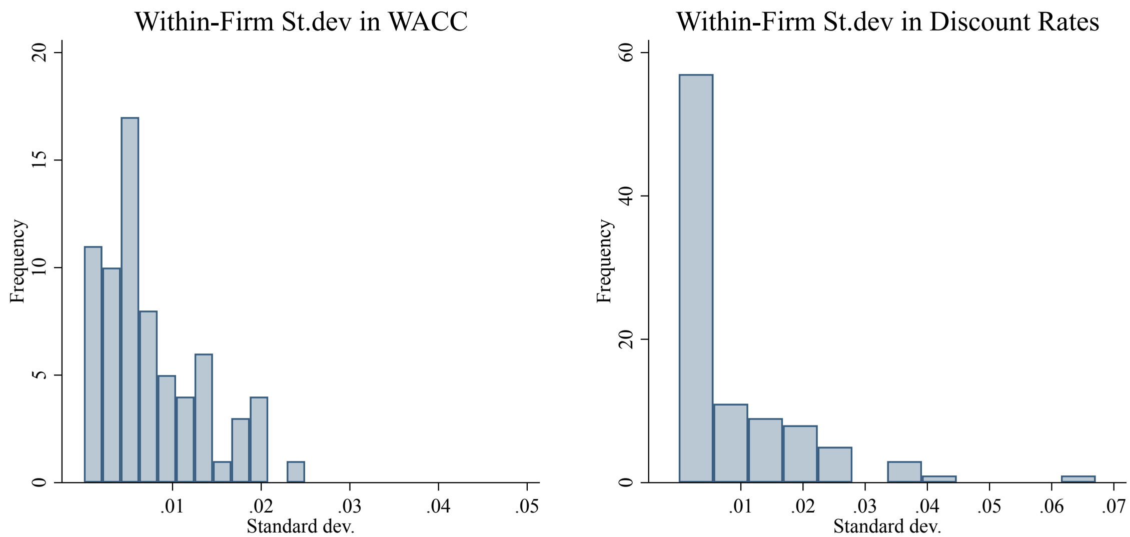


Figure A2
Tobin's Q, Adjusted Q, and Net Investment

This figure plots Tobin's Q and Adjusted Q along with the net investment rate. The construction of adjusted Q is described in the text. Net investment is calculated from the BEA tables. The sample runs from 1990 to 2021.

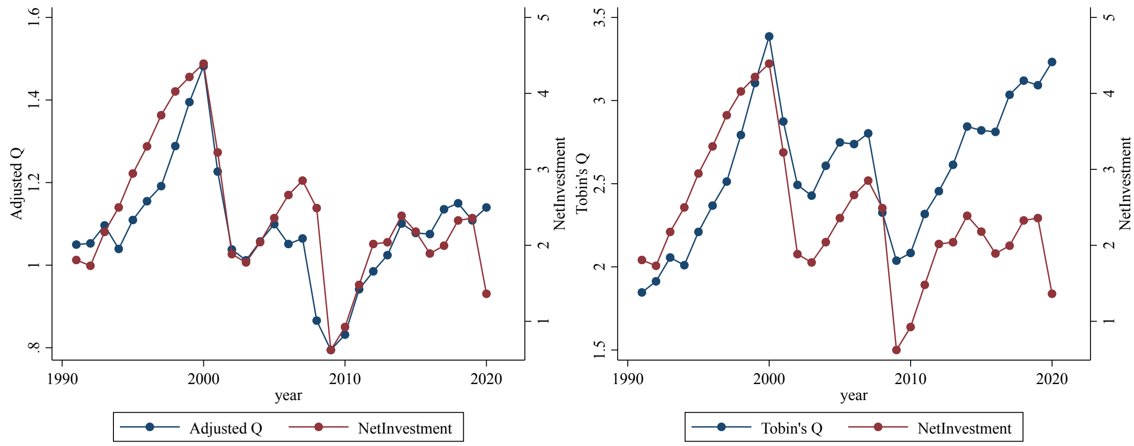
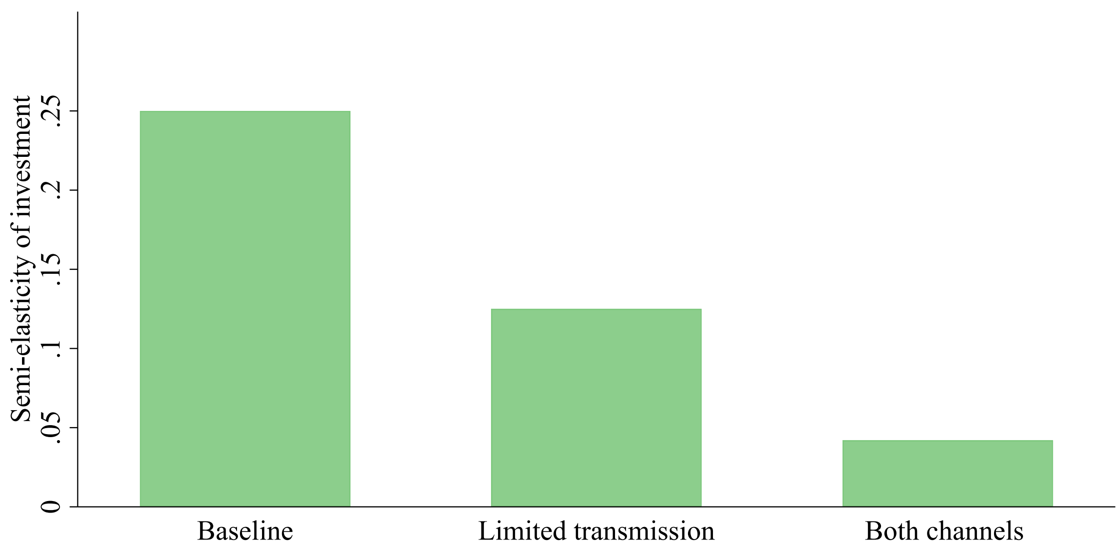


Figure A3
The Impact of Discount Rate Wedges on Investment Sensitivities

This figure plots the investment sensitivity: the percentage change in gross investment due to a 1 percentage point increase in the financial cost of capital, calculated using a standard Q-model. We assume a cash flow duration of 25 years (see Appendix D) and set $\phi = 10$, following Philippon (2009). The leftmost bar shows the sensitivity when the cost of capital and discount rate wedges are zero. The middle bar shows the sensitivity when accounting for the limited incorporation of changes in the financial cost of capital to the discount rate, as estimated in the new data. The right bar shows the sensitivity when also incorporating the effect of discount rate wedges on the duration of cash flows.



Appendix B Details on Measurement

Appendix B.1 Extraction of Paragraphs from Conference Calls

The Thomson One database contains transcripts of conference calls held since January 2002. We download all calls in English that were available on September 9, 2021. Using an automatic text search algorithm, we identify relevant paragraphs in all 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 cost of capital, discount rates, and investment. 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, IRR. We identify roughly 74,000 of such paragraphs.

We match the firm name listed on Thomson One to Compustat by using a fuzzy merge algorithm, checking each match by hand. Ultimately, we link 88 percent of paragraphs to a Compustat firm. We combine the relevant paragraphs into data entry sheets of 500 paragraph each. To facilitate manual data entry, we include the date of the call, firm name, and blank columns for all financial figures of interest in the sheet. These figures are:

- 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

Appendix B.2 Data Entry Team

We read through each paragraph and enter the figures into the sheets. A total of 15 outstanding undergraduate research assistants contributed over the past two years. The average team size at any point in time was 5. Our research team met on a weekly basis to discuss individual cases and notes taken by the assistants and to coordinate on consistent guidelines.

We train each assistant. They learn about the basics of NPV methods and firm investment and read roughly 2,000 randomly selected paragraphs for training, which we then check and discuss manually. About two-thirds of the paragraphs were read twice, by different assistants, to minimize errors. The authors checked all outlier observations in the distribution of discount rates and changes in discount rates.

Appendix B.3 Guidelines for Manual Data Entry

We establish clear rules for which figures should be recorded. For the main analysis of this paper, we are interested in various ways that managers express discount rates (as hurdle rate, premium or fudge factor over the cost of capital, or required IRR) and their internally calculated, perceived cost of capital (as OCC or WACC). However, we include the larger set of terms listed above among the keywords and in the data entry sheets to ensure that our team differentiates required from expected and realized IRR as well as from various types of other returns. (The difference between how managers use the terms IRR and ROIC in practice is noteworthy. IRR usually refers to the marginal return on an individual project, while ROIC refers to operating profits relative to the entire value of capital on the firm's balance sheet.)

We do not record hypothetical numbers (e.g., "we may use a discount rate of x percent" or "for illustrative purposes, 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 used 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 general investment rules of the firm, as opposed to specific figures related to individual projects. For instance, we do not record the cost of capital for a particular bond issuance. The paragraphs in the data entry sheets are sorted by firm and date, 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 for 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 unlevered, after-tax discount rate and cost of capital. We note when managers refer to levered and pre-tax discount rates (1.7 and 0.7 percent of discount rate observations, respectively) and to levered and pre-tax cost of capital (0 and 1.9 percent of cost of capital observations, respectively). We convert all observations into unlevered, after-tax values by estimating the average percentage point difference between levered and unlevered as well as after- and pre-tax observations, controlling for country-by-year fixed effects, and adjusting the values for the average 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 percent ROIC over the last 5 years and a 10 percent ROIC over the last 10.") 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 Adjusted Q and the Effect of Discount Rates on Investment

We use the model of adjusted Q in Section 4.2.1 to derive the relation between investment and discount rates, given that there are wedges. We analyze how a change in the discount rate, which is exogenous to the cash flow of investment projects and adjustment costs, affects investment:

Proposition 2 (Investment and Discount Rates). *At the steady state, we observe the following relation between investment and an exogenous shock to the discount rate:*

$$\frac{\Delta\left(\frac{I_t}{k_t}-\delta\right)}{\Delta(r^{\text{fin.}}+\upsilon+\kappa)} \sim \frac{-1}{\phi} \times \frac{\text{Dur}}{(\upsilon+\kappa)\times\text{Dur}+1}. \tag{A1}$$

Proposition 2 follows from inserting Proposition 1 into equation 11 and taking the derivative with respect to the discount rate. It says that an increase in the discount rate decreases the value of future profits, the marginal value of capital, and thereby the incentive to invest. Two channels determine the strength of the effect. First, the duration of cash flows plays a role. If wedges are zero ($\upsilon+\kappa=0$), the denominator of the right-hand side of Proposition

2 is equal to 1 and the effect solely depends on the duration relative to adjustment costs. Intuitively, investment is more responsive to discount rates if the duration is longer. The second channel plays a role if wedges are non-zero. With positive wedges, the duration is effectively shortened, which decreases the sensitivity of investment to discount rates.

To compare the model to the estimates, we assume a cash flow duration of 30 years, as is approximately the case for an unlevered firm (Gormsen and Lazarus 2022, van Binsbergen 2020), and that $\phi = 10$.[A1] The observed average discount rate wedge of 8 percentage points implies that the effect of discount rates on net investment is:

$$\frac{\Delta\left(\frac{I_t}{k_t} - \delta\right)}{\Delta(r^{\text{fin.}} + \upsilon + \kappa)} \sim \frac{-1}{10} \times \frac{30}{0.08 \times 30 + 1} \sim -0.88,$$

which is in line with our empirical estimates that lie between -0.8 and -0.9.

Appendix D Details on Theory

Appendix D.1 Proof of Proposition 1

We know from (12) that

$$q_t = \frac{\partial V_t(\upsilon + \kappa, k_t)}{\partial k_{t+1}} = \frac{V_t(\upsilon + \kappa, k_t)}{k_{t+1}} = Q_t.$$

To estimate Q, we must calculate $V_t(\upsilon + \kappa, k_t)$. Note that $V_t(\upsilon + \kappa, k_t)$ is the value of the future profits produced by capital, calculated using $r^{\text{fin.}} + \upsilon + \kappa$ as the discount rate. If we set $\upsilon = \kappa = 0$, we get the value of these profits calculated using the cost of capital as the discount rates, $V_t(0, k_t)$, which is the value of the firms in the financial markets. We can approximate both using the Gordon growth model

$$V_t(0, k_t) \sim \frac{CF_{t+1}}{r - g}$$
$$V_t(\upsilon + \kappa, k_t) \sim \frac{CF_{t+1}}{r^{\text{fin.}} + \upsilon + \kappa - g}$$

where g is the long-run growth rate of free cash flows and CF_{t+1} is the free cash flow next period. Both of these variables are unobserved.

[A1] The assumption of $\phi = 10$ is based on Philippon (2009) who discusses various estimates used in the literature.

We can calculate the value of $V_t(\upsilon + \kappa, k_t)$ as

$$V_t(\upsilon + \kappa, k_t) = V_t(0, k_t)\frac{r - g}{r^{\text{fin.}} + \upsilon + \kappa - g} = V_t(0, k_t)\frac{1}{x \times \text{Dur} + 1} \tag{A2}$$

where Dur is the weighted average of the firms future cash flows, which in the Gordon growth model is given by:

$$\text{Dur} = \frac{1}{r - g}$$

(Gormsen and Lazarus 2022).

We can then calculate Q by inserting (A2) into (12) and using that

$$Q^{\text{Tobin}} = \frac{V_t(0, k_t)}{k_{t+1}}.$$

Alternative Formulation Without Duration

We can replace Dur in 13 with Tobin's Q and return on equity. Under the assumption that the firm is fully equity financed,

$$\frac{1}{\text{Dur}} = r - g = \frac{E}{P} = \frac{B}{M}\text{ROE} = \frac{\text{ROE}}{Q^{\text{Tobin}}}$$

such that

$$Q_t = Q^{\text{Tobin}}\frac{V_t(\upsilon + \kappa, k_t)}{V_t(0, k_t)} = Q^{\text{Tobin}}\frac{\text{ROE}}{x \times Q^{\text{Tobin}} + \text{ROE}}. \tag{A3}$$

Appendix E Examples of Conference Calls Signaling Prudence

2013-05-23, Kinder Morgan, Kim Dang, CFO: *"We do not do projects close to our cost of capital. (...) Our cost of capital is 9 percent, we are not going to go out and do a project in 9.5 percent or 10 percent because there are just too many potential for changes in what you expect to happen. (...) We're not going to take the risk that we have a project come in at or below our cost of capital."*

2009-07-30, Lincoln National Corporation, Fred Crawford, CFO: *"As a matter of being conservative in our approach, we've been hiking up those discount rates quite considerably on our businesses (...). Example being variable business is up into the mid teens with life businesses in and around the 10 percent range, even 11 percent range, depending on the business. But* *that's for purposes of being conservative."*

2009-01-14, Ryland Group, Inc., Larry Nicholson, President & COO: *"Our hurdle rates have always been 30 percent as long as I've been with the Company – that's 14 years – and Chad, as long as he's been with the Company, has maintained that. I think that's served us well, kept us from doing some things maybe that would have hurt us in the downturn. I think it kept us out of a lot of trouble. So I think the strategy's been good. I think it's been prudent."*