Are US firms becoming more short-term oriented? Evidence of shifting firm time horizons from implied discount rates, 1980-2013

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Research Summary:

We provide evidence that investors in US public markets are increasingly discounting firms' expected future cash flows during 1980-2013. This trend is shown not only on average across firms, but also within firms over time after alternative explanations are accounted for. To corroborate a link with firm time horizons, we estimate the relationship between an implied discount rate ('IDR') and factors relevant to firm long-term strategy. We find that IDR is correlated in expected ways with firm investments, management incentives, financial health, ownership and external pressures - measures that have been argued to correlate with firm time horizons. This paper represents one of the first attempts to document market-wide evidence of shortening firm time horizons. These changing horizons bear important implications for firm strategy. (JEL: D22, D92, G23, G32, M21; Keywords: short-termism, myopia, institutional investing, R&D investment, CEO compensation, time horizons)

Managerial Summary:

Whether US firms have become more short-term oriented remains an active debate among managers, investors, researchers, and policymakers. In this study, we report that investors have been increasingly discounting the expected future returns of public firms over the last three decades. We find that a firm's discounting rate is explained by signals of its long-term strategy, including investment decisions, ownership structure, financial health, executive compensation scheme, and short-term pressures from the external environment. Our findings indicate a market-wide contraction of firm time horizons, highlighting firm characteristics that suggest how and why firms differ in their time horizons. These demonstrated relationships may help guide firms in devising investment strategies as well as external communications to attract investors that share a firm's preferred time horizon.

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1. Introduction

In recent years, there has been increased focus on corporate short-termism by firms and academics alike. Concerns have been raised that US firms are increasingly focused on managing quarterly earnings at the expense of investments in sustained, long-term growth (e.g., Porter, 1992; Laverty, 1996). Daniel Vasella, former chairman and CEO of Novartis AG, described these short-term pressures and their implications for firm strategy (Vasella and Leaf, 2002):

> *"Once you get under the domination of making the quarter—even unwittingly—you start to compromise in the gray areas of your business, that wide swath of terrain between the top and bottom lines. Perhaps you'll begin to sacrifice things (such as funding a promising research-and-development project, incremental improvements to your products, customer service, employee training, expansion into new markets, and yes, community outreach) that are important and that may be vital for your company over the long term."*

Implicit in this quote is the notion that public firms are shifting to favor short over long-term returns and empirical research provides some support for this inference. Surveys confirm that firms apply investment hurdle rates higher than suggested by the cost of capital (Poterba and Summers, 1995; Meier and Tarhan, 2007)[1] and, thus, forgo profitable investments in order to make earnings targets (e.g., Graham, Harvey and Rajgopal, 2005). Larger scale empirical studies show that this behavior is reflected in financial markets; at the industry level, time horizons appear to be contracting (Miles, 1993; Davies, Haldane, Nielsen and Pezzini, 2014). However, there are reasons to be skeptical, despite widespread perceptions that firms are becoming more short-term oriented. For example, price earnings ratios are at historic highs (see, e.g., Kaplan 2017), suggesting greater optimism about long-term firm growth that is perhaps driven by firm behavior consistent with generating longer term returns. Within firms, R&D spending, which presumably has a longer-term payoff, is at an all-time high; R&D grew from $30.93B in 1980 to $297.28B in 2013 (NSF, 2016).

In this paper, we examine whether and how firm time horizons are changing over time. Using a market-based measure that we argue reflects firm time horizons, we seek to answer two questions:

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[1] Fortune 1000 CEOs report using an average discount rate of 12.2 percent, significantly higher than the average rate of return for equity holders (Poterba and Summers 1995). More recently, Mankins, Harris and Harding (2017) also show that firms apply investment hurdle rates higher than the cost of capital. See also the survey by the Manufacturers Alliance for Productivity and Innovation, "Lowering the Bar: Hurdle Rates," https://www.mapi.net/blog/2016/04/lowering-bar-hurdle-rates.

(1) are firms becoming more short-term oriented over time? and (2) do firm time horizons differ cross-sectionally and, if so, what explains differences between firms? Our empirical approach allows us to identify broad trends as well as address whether similar strategies are viewed by investors as equally valuable across firms.[2] Providing such evidence is critical to resolving the debate around short-termism in order to explore the implications of the role of time in firm strategy.

To answer these questions, we employ a measure of a firm's implied discount rate to capture how much investors discount future expected cash flows and values. This measure has been previously estimated at the market and industry level to examine discounting trends in the UK and, to a more limited extent, the US (Miles, 1993; Davies, Haldane, Nielsen and Pezzini, 2014). To better evaluate the firm strategic implications of time horizons, we go beyond this earlier work to estimate a firm-level measure of market discounting, which we call '*IDR'* or implied discount rate. We use this measure as an indicator of firm time horizons for all US public firms, specifically tracking how *IDR* moves over time and varies between firms.

In robustness checks, we also estimate alternative measures, including one based on analyst earnings forecasts in future periods, to ensure the validity of our reported trends. Our firm level measures allow us to not only establish market-wide trends, but also to reveal sources of firm heterogeneity in *IDR* not explained by market-wide indicators, providing richer, more fine-grained information to interpret identified trends and define implications for long-term firm strategy. Given the increasing influence of financial markets on firm strategy, understanding how markets view differences between firms and how this reflects firm time horizons is essential.

We find evidence consistent with contracting time horizons; markets are increasingly discounting firms' future prospects on average. We also observe increased discounting *within* most firms over time. While this general upward trend is persistent throughout the observation period, important shifts occur. Firms are discounted more heavily by the market following economy wide shocks, such

[2] In this sense, we examine whether strategy effectiveness depends upon the identity of the firm (see, e.g., Chung and Alcácer, 2002; Knott, 2008).

as the dot-com bubble of 1999-2000 and the financial crisis of 2007-2008. This finding is consistent with expectations around these events; broad market uncertainty is correlated with more significant, economy-wide discounting of firm future cash flows. While we do not formally unpack the sources of the overall trend, some potential explanations include rising exposure to globalization and the increasing pace of technological change that may make firms more impatient for returns and less willing to take on the risks associated with longer-term investments. This conjecture is consistent with assumptions in behavioral finance and largely consistent with 'rational' models.[3]

In addition to the general trend shown, we observe significant heterogeneity among firms in terms of how markets discount expected future returns. To explore this heterogeneity and better assess *IDR* as a measure of time horizons, we estimate the relationship of *IDR* with two categories of measures thought to proxy for firm time horizons. Specifically, we examine measures capturing: (1) a firm's behavior that signals its time orientation (e.g., long-term investments and management incentives); and (2) behavior of outside parties that signals the firm's time orientation, possibly via exerting pressure on the firm to demonstrate short-term performance (e.g., institutional investors, analysts, and activist shareholders).

With regard to firm behavior, we find that firms making more significant investments with arguably longer-term payoffs, in areas such as R&D and capital, have future cash flows that are discounted less than those firms investing less. In contrast, increasing share repurchases and dividends correlates with increased discounting, further corroborating the link between time horizons and our implied discount measure, since such spending is arguably a direct substitute for longer-term investments. Using random coefficient models, we also find that these investment effects differ meaningfully between firms; for example, firms investing more in R&D have future cash flows that are discounted by the market less, but the correlation between implied discounting

[3] The behavioral research shows that rising uncertainty exacerbates myopic loss aversion, creating a preference for short-term returns (e.g., Benartzi and Thaler, 1995), while 'rational' finance models would interpret our results as consistent with unincluded risk factors (e.g., Fama and French, 2008). We briefly discuss the assumptions that underlie our estimation in Section 2 and take up the implications for interpretation in Section 3.2.

and R&D intensity varies significantly by firm. This raises important questions about why some firms are able to pursue longer-term and sometimes more uncertain returns, while others are penalized by investors for seemingly similar decisions. One explanation is that firms differ in their R&D productivity (Knott, 2008), so optimal R&D intensity differs across firms.

With regard to the behavior of outside parties, we find long-term ownership and short-term external pressures matter; firms held by more transient institutional owners (i.e., those that are characterized by shorter holding periods)[4] and in industries where shareholder activism is more likely have more discounted future cash flows. We also find more discounted future cash flows for firms when their share prices are relatively more responsive to earnings news (i.e., a high earnings response coefficient); greater price sensitivity to news likely reflects greater information asymmetry surrounding the firm's behavior and, thus, more significant uncertainty on the firm's longer-term returns. In contrast, long-term CEO compensation packages, indicators of long-term oriented management, are correlated with lower *IDR*.

Via extensive robustness checks on a wide range of issues that could either bias results or serve as alternative explanations (including endogeneity, specific model assumptions, and industry conditions), we demonstrate that the results we observe are largely consistent with expectations from earlier research on the firm-level indicators of time horizons. This supports our central thesis that the implied discount rate, *IDR*, is a meaningful proxy for firm time horizons.

The paper proceeds as follows. We begin in Section 2 by describing the measure (i.e., implied discount rate) that we use to capture firm time horizons and the data we use to estimate this measure. In Section 3, we discuss measure constructions and descriptive statistics that highlight market wide trends. Section 4 then delves into the relationship between the implied discount rate and firm behavior and characteristics thought to correlate with firm time horizons. This analysis allows us to both explore firm heterogeneity in discounting as well as to evaluate *IDR* as a signal for

[4] These effects can be attributed to firms with short time horizons attracting investors with short-term preferences and/or investors pressuring firms to change their investment behavior. Our analysis below focuses on the first mechanism, leaving the evaluation of investor impact on firm behavior to future work.

firm time horizons. We conclude with a discussion of implications, limitations and future directions in Section 5. Empirical robustness tests, as well as theoretically developed links of our implied discounting measure with both firm hurdle rates and time horizons, are set out in online appendices.

2. Implied Discount Rate ('*IDR*') as a Proxy for Firm Time Horizons

Obtaining evidence of whether firm time horizons are shifting and how these horizons vary across firms is challenging, given that direct measures of time preferences are not readily available. Further, existing research is spread across disciplines and typically takes a highly focused approach, examining relationships among a small set of variables that bear close links with theoretically derived mechanisms but that are too circumscribed to reveal market-wide phenomena. To obtain a firm level measure that can be estimated for most publicly listed firms and reveal both market-wide trends and firm heterogeneity, we adapt a measure first used for capturing market valuation horizons by Miles (1993) and later by Davies, Haldane, Nielsen and Pezzini (2014). Both studies use a variant of a capital asset pricing model (CAPM) to estimate a discount rate, x, applied by markets to a firm's expected future cash flows and unexplained by the firm-specific risk premium.

Conceptually, we are estimating a firm's current stock price as a function of its expected future dividends and stock price, discounted by the risk-free rate and the company specific risk premium:

$$P_{jt} = \frac{E_t[D_{jt+1}]\boldsymbol{x_{jt}}}{(1+r_t+\pi_{jt})} + \frac{E_t[D_{jt+2}]\boldsymbol{x^2_{jt}}}{(1+r_t+\pi_{jt})^2} + \cdots \frac{(E_t[D_{jt+N}]+E_t[P_{jt+N}]x^N_{jt}}{(1+r_t+\pi_{jt})^N} + \varepsilon \qquad (1)$$

where P_{jt} is the stock price of firm j at time t, $E_t[D_{jt+1}]$ is the expected value of firm j's dividends in the next period, r_t is the market risk free rate, π_{jt} is the firm's risk premium and N is the number of periods used in the estimation of the current period's stock price. The estimated parameter x_{jt} (hereafter referred to as x) measures the extent to which expected future cash flows are discounted by the market.

To facilitate more intuitive interpretation of the measure in our analyses below, we transform x as follows:

***Implied discount rate* (*IDR*)** $= 1 - x$

Larger values of *IDR* suggest greater discounting of a firm's future cash flows by the market, while smaller values imply lower discounting as compared to the benchmark CAPM estimates. To answer the central questions of this paper, we examine whether *IDR* varies non-randomly over time as well as whether (and how) *IDR* varies systematically across firms.[5] Before describing our estimation approach, however, we first evaluate the link between x (i.e., the foundation of *IDR*) and firm time horizons via an example and analytic exercise and briefly consider the implications of estimating a model that deviates from standard finance theory (i.e., via inclusion of x).

To illustrate how x and, by extension, *IDR*, translates into firm time horizons, consider the following example. Assume a firm can make one of three possible investments of equal cost but differing payoffs as set out in Figure 1. Using a WACC of 9% for the firm, the NPV is calculated over the useful life of the investment (i.e., ten years) and the projects ranked. Without the addition of x, the firm prefers investment A, which has both the highest NPV and cumulative cash flow. Investment C, with the lowest, but nearest term, payoffs, is ranked last. Adding x to the NPV calculation with a value of 0.95 (which translates to greater discounting of future cash flows), leads to a reversal of preference ordering of the investments. The near-term payoffs of investment C are the most preferred, even though these payoffs are the smallest cumulatively. In this sense, we think of additional discounting by the market as reflecting shorter time horizons within the firm; increased discounting translates directly into preference ordering for timing on investment payoffs.

We can also evaluate what x and *IDR* represent for a firm theoretically by restating x as a function of the internal firm hurdle rate (i.e., the rate of return used by a firm to evaluate its investments) and cost of capital, where increasing hurdle rates indicate shorter time horizons for payoffs. As shown in Appendix A (Eq.A7), x can be restated as: $x = \frac{1+C}{1+R}$

[5] To the extent that the asset pricing model we use precisely values firms, the estimate of x based on the population should not be significantly different from one (or IDR should not be significantly different from zero) in a cross section or over time. Given the debate surrounding the precision of CAPM in estimating firm values, however, we do not attempt to make assertions about absolute values of x or *IDR*, instead focusing on changes over time and comparisons between firms in the cross section. See Fama and French (2008) and Shleifer and Vishny (1997) for discussions of the mixed empirical support for CAPM and implications of limits to arbitrage for the CAPM.

where *C* is the firm's cost of capital, determined by the risk-free rate and firm specific risk premium, and *R* is the firm's investment hurdle rate. The key assumption for this derivation is that a firm's stock price reflects the present value of the firm as an investment project. Note that *x* equals one (and *IDR* equals zero) when the firm's cost of capital is equivalent to the firm's internal hurdle rate, implying that there is no additional discounting by the market beyond the risk-free rate and firm specific risk premium. We discuss the fuller implications in Appendix A but point out here that, as a firm's investment hurdle rate increases (i.e., *R* increases), *x* decreases, *IDR* increases and expected future cash flows are more heavily discounted. Thus, *IDR* represents the wedge between a firm's hurdle rates and its cost of capital. Conceptually, a higher hurdle rate relative to the cost of capital, which is consistent with firm strategies favoring short-term performance, is reflected in greater discounting of expected future payoffs, or lower *x* and thus higher *IDR*. In this sense, firm discounting and market discounting of expected future payoffs are tightly linked.

Note that the model we use to estimate *x* relaxes a key assumption in the finance literature: that discount rates applied by investors to generate stock prices reflect systematic firm risk and, thus, not time horizons per se. By including *x* in Equation (1) above, we relax this assumption and allow discount rates to be determined by factors beyond defined systematic firm risk. Empirical evidence supports this; the 'anomalies' literature, including both the rational finance literature, such as Fama and French (2008), as well as the behavioral literature, such as Shleifer and Vishny (1997), rely on the empirical observation that actual stock pricing diverges from standard finance models based solely on systematic firm risk.[6]

Within the firm, discount rates also deviate from what finance models predict, namely that firm hurdle rates should match the firm's weighted average cost of capital (WACC). In practice, however, several studies show that firm hurdle rates used for investment decisions deviate from the cost of capital (e.g., Poterba and Summers, 1995; Meier and Tarhan, 2007; MAPI, 2016; Mankins, Harris

[6] There are differences in assumptions underlying these two literatures as to why market pricing deviates from standard finance models, but it is sufficient for our purposes here that the deviation occurs empirically.

and Harding 2017). Across these studies, hurdle rates used by CEOs and CFOs significantly exceed the cost of capital, consistent with *IDR* being greater than zero.

Once we allow discount rates to deviate from systematic firm risk (for investors) and WACC (for firms), then the discount rates used by investors and firms have implications for time horizons. A deeper discount rate applied by firms to investment decisions (i.e., one that exceeds the cost of capital) will lead the firm to prefer investments with more near term-payoffs, as illustrated in Fig.1. This is not to imply that pricing is random or that investors and firms are irrational, but rather that there are unincluded factors in the pricing models that are relevant to determining preference ordering on investments. We do not rely solely on our arguments here, however, to evaluate whether *IDR* captures firm time horizons, but also estimate the relationship between *IDR* and previously used proxies for firm time horizons in extensive empirical analyses below (Section 4 and the appendices).

3. Estimating the Implied Discount Rate (*IDR*)

3.1. Data, sample, and empirical approach

To estimate the implied discount rate, *IDR*, our proxy for firm time horizons, we use all public firms listed on major US stock exchanges (NYSE/AMEX and NASDAQ) over 1980-2013, excluding over-the-counter stocks. We choose 1980 for the start of our study since several important variables were not available until the late 1970s.[7] We combine this security data with several firm-level datasets to construct variables of interest set out in Table 1 and discussed below.

Equation (1) above is a dividend capitalization model (e.g., Easton, 2007), whereby a firm's stock price is assumed to be equal to the discounted value of its future dividends and terminal stock price, with the addition of the discount term, x.[8] To empirically estimate this model, we use current

[7] To account for confounding effects of newness of a listing and major changes in a security, we further exclude public firms that have been listed on the stock exchange for fewer than five years and those which have undergone significant changes in the prior five years. These changes are those that trigger a change in CUSIP identifier, which include name change, (reverse) stock split, and restructuring (FINRA, 2016). We also drop outlier cases where stock price is higher than 1000. Such cases represent approximately 0.05% of the whole sample.

[8] The terminal stock price is the price at the end of the time horizon, which in our case is set to the standard five-year window.

dividends and the current stock price to proxy for the current expectation of future dividends and stock price.[9] Further, we follow Miles (1993) and substitute the following expression for the firm's risk premium:

$$\pi_{jt} = \alpha_1 \beta_{jt} + \alpha_2 Z_{jt} \quad (2)$$

Two well-established, risk-related factors are used to estimate a firm-specific risk premium in Equation (2). β_{jt} is firm *j*'s beta in year *t*, which measures the volatility of firm *j*'s stock price compared with the market, and Z_{jt} is firm *j*'s gearing (i.e., debt/equity), which measures the firm's risk associated with financial leverage.[10] We obtain the company beta from CRSP, which calculates annual betas for public companies using the methods set out in Scholes and Williams (1977). A firm's debt and equity are obtained from COMPUSTAT. a_1, a_2 are coefficients associated with the firm specific risk factors and are estimated by the model below.

Substituting the proxies and Equation (2) into Equation (1), we obtain the following equation for non-linear empirical estimation:

$$P_{j0} = \frac{(D_{j0})\boldsymbol{x_{j0}}}{(1+r_0+\alpha_1\beta_{j0}+\alpha_2 Z_{j0})} + \frac{(D_{j0})\boldsymbol{x_{j0}^2}}{(1+r_0+\alpha_1\beta_{j0}+\alpha_2 Z_{j0})^2} + \cdots \frac{(D_{j0}+P_{j0})\boldsymbol{x_{j0}^N}}{(1+r_0+\alpha_1\beta_{j0}+\alpha_2 Z_{j0})^N} + \varepsilon \quad (3)$$

where at time 0, P_{j0} is the stock price of firm *j*, D_{j0} is firm dividends, r_0 is the risk-free rate and β_{j0} and Z_{j0} are the firm's beta and gearing, respectively. We set *N* equal to 5, so use five periods of future expected dividends and the expected stock price in year 5 to estimate P_{j0}.[11] The annual average yield to maturity of a one-year government bond (averaged over daily quotes) is our risk-free rate. The parameters a_1, a_2 and x_{j0} are simultaneously estimated by the model and x_{j0} captures the extent to

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[9] Using current values of prices and dividends per share as instruments gives consistent parameter estimates provided that the extent to which future prices and dividends, "deviate from expected values over and above the average degree of over (or under) stock market performance do not depend on past performance," (Miles, 1993, p. 1386). To the extent that current prices (dividends) are a noisy measure of future prices (dividends), such noise adds to measurement error, making our estimates more conservative. Any such noise is assumed to be unsystematic; any systematic under or overestimation of future price (dividend) by current price (dividend) should be transient and arbitraged away. Note, however, that we also estimate a measure based on analyst forecasted earnings, which does not rely on expected dividends.

[10] In our robustness appendices, we take up alternative specifications of this formula, including the addition of additional factors from Fama and French (1992). We also estimate *x* with the addition of share repurchases to expected dividends as a source of cash flows. Results reflect those reported in the paper below and are described in Appendix C.

[11] Brochet et al (2014) find that there is a negative and significant relationship between firm short-termism (measured via earnings conference call transcripts) and both stock returns and accounting performance that holds for one to five years in the future. We have also estimated (3) using a three-year or seven-year window, obtaining similar patterns to those reported below.

which the actual discount rate of expected future cash flows in the stock price deviates from the theoretical rate predicted by the CAPM.[12]

Both Miles (1993) and Davies et al (2014) use market and industry level estimates of x to argue that, for many industries in the UK and some in the US, markets are more heavily discounting future cash flows now than in years past. While informative, these earlier analyses do not examine whether some firms are discounted more or less than others within the same time period and industry and, if so, why. To estimate x at the firm level, we use a non-linear random coefficient model (RCM). Conceptually, random coefficient models offer flexible parameter estimates that incorporate both the baseline of the whole population, thus taking advantage of the information contained in the entire sample of firms, and the variance of the specific firm. Estimates that vary across firms are computed from this information and provide insight as to whether discount rates (represented by x) are firm-specific and time-varying. This is an important point of departure from earlier work, allowing for further insights into the implications of firm strategy for time horizons.

To estimate time varying, firm specific coefficients of x, we group firm-year observations by a 5-year rolling window, since multiple years of data are required per firm to obtain firm specific estimates.[13] For example, for firm j in year t, the estimation of x_{jt} is based on the observations of firm j in year t-4 to year t. We choose a 5-year window since previous simulation work reveals that five observations per firm yields estimates that are accurate (i.e., the true firm-specific estimate falls within the 95% confidence interval) more than 94% of the time in RCMs with samples that have one hundred firms or greater (Alcácer et al., 2018:549).[14] Theoretically, if our estimated x is less than one and thus *IDR* exceeds zero, it indicates that the market is discounting expected future cash flows of firm j at a steeper rate than the sum of the risk-free rate and estimated firm-specific risk premium. In other words, higher values of *IDR* suggest more short-term time horizons. However, as

[12] As robustness checks, we re-estimate x with different specifications as well as different samples. More precisely, we re-estimate Equation (3) above with an intercept term, which allows some heterogeneity to load on terms other than x, α_1 and α_2. While not shown here, overall trends (as shown in Figure 2) exhibit highly consistent patterns to those exhibited here.

[13] While it is possible to estimate the model with quarterly data, we use annual data to reduce the noise from dividend frequency, since some firms do not pay dividends every quarter, and other seasonal fluctuations in the analysis.

[14] The *IDR* estimated from seven years of observations is highly correlated with our main measure.

mentioned above, we place less weight on the absolute values of *IDR* and instead focus on changes over time and comparisons across firms in the cross section. Systematic differences between firms capture variance in shareholder expectations around a firm's future prospects and, we argue, reflect a firm's time horizons.

3.2. Implied discount rate (*IDR*) trends from 1980 to 2013

Average implied discount estimates over time, along with estimates at the 5^{th} and 95^{th} percentiles and the number of sample firms are set out in Figure 2.

[Figure 2 here.]

Figure 2 shows *IDR* increasing over time, despite fluctuations. All means shown in Figure 2 are statistically different from zero with a p-value of 0.001 or less. In early time windows, there is little evidence of systemic short-termism; values of *IDR* are negative. An increase in implied discounting occurs around the dot-com bubble (i.e., 1999-2000) as well as the financial crisis (2007-2008). To put these trends in perspective, assuming consistent cash flows, the estimated *IDR* over a five-year return period has risen 20.66% over the last three decades. Given the same profile of risk factors and cash flows, a stock would be priced 17.38% lower in the most recent sampling period compared to the earliest one due to the higher discounting rate applied.

This trend is broadly consistent with results previously shown at the industry level in other samples (i.e., Miles, 1993; Davies et al., 2014), demonstrating that increasing discounting has not only occurred around the time when management scholars started to systematically examine the short-termism phenomenon (Porter, 1992; Laverty, 1996), but also persisted in the ten years beyond the most recent sample considered by Davies et al. (2014).[15] Further, *IDR* moves in expected ways following various unexpected economy-wide shocks; both the 1999-2000 dot-com bubble and the 2007-2009 financial crisis mark sharp upticks in *IDR* that likely reflect the increased market uncertainty following these events. In contrast, *IDR* appears to take a downward turn around 2004;

[15] Consistent with Davies et al. (2014), we also find a similar declining trend of x over 1985-2004 in our sample.

Google announcing in 2004 that it would not give earnings guidance in order to take a long-term focus, with many other firms following suit, is one possible explanation.[16]

Note that, while there is both significant industry variance and firm variance within industry on mean values of *IDR*, the increasing trend is largely consistent across industries. Appendix B graphs *IDR* over time, split by industry (here, 2-digit NAICS codes), followed by similar graphs of *IDR* mean values, overlaid by the range of firm estimates within industry. All industries reveal a positive *IDR* (i.e., increased discounting) at the end of the period. The firm heterogeneity within industry revealed in the second set of graphs demonstrates the value of generating firm specific estimates.

These trends suggest that investors are discounting firms listed on US exchanges increasingly over time. However, they do not address whether this effect is due to the changing composition of firms on these exchanges or, alternatively, due to the average being pulled by a few firms that are more strongly discounted. To examine these questions, we graph the intra-firm movement in *IDR* over three comparison periods in Figure 3. To remove any trends that may be driven by a small set of influential outliers, we exclude the top 5% and bottom 5% of firms in terms of *IDR* within a given time period.

[Figure 3 here.]

IDR is represented for the earlier of the two comparison periods on the horizontal axis and for the later period on the vertical. Each mark represents a single firm, capturing how *IDR* has changed over time for that firm between two periods. Any marks above the 45-degree line reveal individual firms that are more discounted over time, with marks below the line revealing the opposite. Two key observations emerge from this graph. First, the bulk of the marks are above the diagonal, providing evidence that firms are being discounted more over time and that our earlier observations cannot be attributed to changing composition of firms on the markets or by a few highly discounted firms

[16] While required earnings reporting frequency hasn't changed since 1970 in the US, the choice to offer earnings guidance may impact firm time horizons that are reflected by the market. Google's announcement, via the "Letter from the Founders" in Google's Form S-1, is contemporaneous with a broader market trend around the same time to cease earnings guidance (see, e.g., https://www.sec.gov/Archives/edgar/data/1288776/000119312504073639/ds1.htm#toc16167_1, *The Economist*, 27 April 2006; Hsieh, Koller and Rajan, 2006).

pulling the average. Second, the three sequential comparison periods moving up the diagonal illustrate that, overall, *IDR* has increased not only within firms but also with each successive period. For example, while firms in the most recent cohort (i.e., 2004-2008 vs. 2009-2013) are more discounted in 2009-2013 than in 2004-2008, these firms are also more discounted than those firms in earlier cohorts (e.g., the cohort of 1984-1988 vs. 1989-1993).[17]

That *IDR* is significantly different from zero and that there is a positive time trend point to 'mispricing' or an 'anomaly' according to finance literature. Both rational and behavioral explanations are possible, implying either omitted risk factors relevant to the standard asset pricing model (i.e., Fama and French, 2008) or behavioral patterns that violate standard finance assumptions. These violations include preference inconsistency (e.g., Loewenstein and Thaler, 1989) or myopic loss aversion (e.g., Benartzi and Thaler, 1995) along with limits to arbitrage that leave any mispricing uncorrected in the market (e.g., Shleifer and Vishny, 1997). While full exploration of the sources of our observed trends is beyond the scope of the paper, it is possible that rising uncertainty over technology change, globalization exposure and other market-wide shifts point to less optimism for long-term returns, shortened investment cycles and, we conjecture, rising impatience around investment payoffs. This makes pricing of long-term investments more difficult and may increase the risk associated with such investments (and, consequently, the implied discount rate). Increased uncertainty may also heighten myopic loss aversion, where individuals are more sensitive to losses than gains and will not hold long-term assets if evaluation periods are frequent (e.g., Benartzi and Thaler, 1995).[18] Put differently, firms may be unwilling to invest in long-term assets if they evaluate

[17] We conduct additional robustness checks around changing composition of firms, including replotting Figure 2 using an unchanging group of firms over time, and find the same upward trend in *IDR*, as noted in Appendix C.

[18] An evaluation period is the length of time over which an investor aggregates returns. If an investor (a firm in our case) evaluates returns over a one-year period, even if the true planning horizon is thirty years, the investor behaves as if the planning horizon is one year. This collapse of the planning time horizon to the evaluation period has been shown in a variety of theoretical, experimental and empirical work in the behavioral economics and finance literatures (see, e.g., Benartzi and Thaler, 1995; Gneezy and Potters, 1997; Thaler et al., 1997; Benartzi and Thaler, 1999; Gneezy, Kapteyn, and Potters, 2003; Haigh & List, 2005; Fellner and Sutter, 2009).

investment performance frequently, leading to a preference for short over long-term returns and a consequent reflection in share prices.[19]

Our empirical analyses in Section 4 explore the firm correlates with *IDR,* helping to inform the source of the mispricing we observe. In these analyses, we evaluate systematic, firm-level drivers of *IDR* by examining correlations with firm specific variables that proxy for time horizons and undertaking robustness checks to rule out other explanations for rising *IDR*. Before exploring these potential patterns, however, we directly address several potential critiques of the model used to estimate *IDR*.

The first concern is the sensitivity of our results to inclusion of dividend-issuing firms, as in Miles (1993) and Davies et al. (2014). We take several approaches to evaluate this concern as well as how to interpret *IDR* for firms that do not issue dividends. These details are set out in Appendix C, but we note that our robustness checks yield substantively similar results to those reported here, even when removing firms that do not issue dividends and when expanding the definition of cash flows to include stock repurchases as well as dividends.[20] This is true both for our reported trends in this section as well as the analysis examining the correlates with *IDR*, suggesting that our findings are unlikely to be an artifact of dividend-based models.

We also estimate two alternative measures of *IDR*: 1) an adaptation of our existing model to include additional factors relevant to firm valuation, as identified by Fama and French (1992); and 2) an entirely different valuation model based on residual income calculated from analyst earnings forecasts (Abarbanell and Bernard, 2000; Gebhardt, Lee and Swaminathan, 2001). The first approach addresses whether the trend we observe can be attributed to other sources of risk that are

[19] The standard counter to the above logic is that the market will correct any inefficient mispricing through arbitrage. The rational finance models assume that the prices are, in fact, efficient, including all relevant risk information, even if not yet discovered by the standard finance models. In this sense, rational models assume that any necessary arbitrage is occurring, and prices are constantly being corrected. Behavioral models, however, acknowledge that prices may be inefficient (for example, not reflecting relevant information about long-term value) such that investors are making irrational decisions from an economic standpoint. Thus, behavioral models require a second assumption that there are limits to arbitrage, as set out by Shleifer and Vishny (1997), else any such mispricing from behavioral biases would be automatically corrected by investors (assuming that arbitraging investors do not hold the same behavioral bias).

[20] We thank an anonymous reviewer for this suggestion.

not included in Equation (3), while the second proxies for expected cash flows via analyst earnings forecasts. Estimation details and graphs for these alternatives are set out in Appendix D. The graphs reveal very similar time trends between our original model based on Equation (3) and modifications that include either additional Fama-French factors or an estimate based on analyst expectations. Thus, *IDR*, whether employing alternate specifications or entirely different sources of information on future firm expectations, shows an unambiguous, overall increase from 1980 to 2013.

Overall, the above descriptive statistics display the broad trend that markets are increasingly discounting the future dividends and stock prices of firms. While these details reveal the market level phenomenon (i.e., trend changes over time), they do not directly answer whether and how *IDR* is linked to firm behavior. We expect that how individual firms are discounted by the market reflects past firm behavior, time preferences and broad market factors, such as changes in market-wide uncertainty. To explore whether there are systematic differences between firms in *IDR*, we now estimate correlations with firm specific variables that proxy for firm time horizons as well as those that suggest alternative explanations (unrelated to time horizons) for observed differences in *IDR* both between firms and over time. We also use these analyses to evaluate the extent to which *IDR* captures firm time horizons.

4. Exploring and Explaining Time Horizon Heterogeneity between Firms

4.1. Signals of firm time horizons from literature

We next investigate the relationship between *IDR* and five categories of variables that are related to firm time horizons: firm investment, institutional ownership, financial health, management incentives, and external pressures. Our general premise is that by examining the correlation of these firm level variables with *IDR*, we can assess the extent to which *IDR* captures firm time horizons as well as reveal the characteristics of firms that have shorter (longer) time horizons. We also reveal the relationship between *IDR* and the behavior of outside parties (i.e., investors and analysts) that signal the firm's time horizon and that may also exert influence on firms to demonstrate short-term performance.[21]

All variable constructions, data sources and expected signs from prior literature are set out in Table 1. A negative expected sign indicates our prior that the variable is correlated with lower *IDR* (i.e., relatively longer time horizons). To the extent that correlations are as expected and statistically different from zero, they suggest that firm time horizons are reflected in *IDR*. Table 2 contains descriptive statistics for all measures. Before describing our empirical analysis, we briefly discuss the literature that drives our priors on these variables.

[Tables 1 and 2 here.]

Our firm investment measures capture a combination of investments that are characterized by long-term payoffs, including durable goods as well as intangibles, such as R&D and branding. Flammer and Bansal (2017) find that firms are more likely to pursue investments with longer term payoffs, such as R&D, when the firm has a longer-term orientation, proxied via adoption of long-term CEO compensation packages. This is consistent with earlier research; managers increase capital investments after firms adopt long-term compensation schemes (Larcker, 1983). DesJardine (2015) similarly finds that firms make greater investments in durable assets when they are better able to take a longer-term perspective, in that analysis captured via loss of analyst coverage.

We also include a measure of whether firms offer a short-term return of cash to shareholders via share repurchase and dividend programs. A firm may decide to return cash to shareholders when it has few good long-term investment prospects. However, firms also use these programs to boost stock prices in the short-term, which may come at the expense of investments and jobs in the longer term (Almeida, Fos and Kronlund, 2016).[22]

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[21] We do not explore this potentially causal relationship between outside parties and firm time horizons here, maintaining our current focus on identifying correlates from prior literature that form empirical signals of a firm's time horizons. We leave exploration of whether and how outside parties influence a firm's time horizons to future work.

[22] Additionally, we include dividends in our regressions below because they are a key element in the estimation of *IDR*. For this reason, if dividends are omitted as a right-hand side variable in regressions examining correlates with *IDR,* one might argue that failure to control for dividend policy will bias coefficients on the other variables. We note that our results reported in Tables 3 and 4 below are robust to exclusion of dividend policy, however.

Measures to capture a firm's financial health and maturity are included, since they capture the firm's future prospects and, consequently, should be reflected in market expectations. Financial slack, for instance, captures whether the firm faces financing constraints that affect its ability undertake longer-term investments and buffer against unforeseen adversity. Using investments with distinctly different payback periods for cable television operators, Souder and Shaver (2010) find that firms with greater financial slack are more likely to make long-term investments. To the extent that past sales growth is a reasonable predictor of future firm growth, our sales growth measure controls for speculation on future prospects that may be embedded in implied discounting. Recognizing that more mature firms may experience lower growth rates, which would be reflected in diminished market expectations (and higher discounting), we also include a measure of firm age.

Another relevant proxy for manager (and thus firm) time orientation is management incentives. Mizik (2010) and Kothari (2001) show that the more CEO compensation is tied to short-term performance metrics, the more earnings will be managed, typically via cuts to longer-term investments like R&D, since negative earnings 'surprises' lead to significant stock devaluations. The performance metrics that compensation is most commonly tied to are earnings or total shareholder return in the near term (Bettis et al, 2018). Our measure of compensation, LTIP (long-term incentive plans) for CEOs captures how well incentives of top managers are aligned with the long-term performance of the firm, typically considered as three years (e.g., Aggarwal, 2008; Flammer and Bansal, 2017). We also include a measure of a firm's CEO turnover, since some prior research shows that shorter CEO tenure creates incentives for CEOs to engage in short-term behaviors, such as earnings manipulation (e.g., Kaplan and Minton, 2012). Others suggest that long tenure may lead to cognitive rigidity and performance decline (Hambrick and Fukutomi, 1991), which may induce short-term behavior.

Beyond firm characteristics, the behavior of institutions that own a firm's shares have been shown to reflect the firm's time horizon. Institutional ownership variables capture the extent to which these owners have long-term horizons, which has implications for the behavior and time horizons of the firms that they own. For example, a firm with more stable investors may reflect the firm's longer-term perspective and, thus, have future cash flows that are less discounted by the market. When a firm's institutional owners hold shares for a longer period of time, the firm maintains R&D even in the face of earnings pressure (Bushee, 1998).[23] These effects may reinforce firm behavior, since once low turnover institutional investors are in place, Aghion, Van Reenen and Zingales (2013) argue they reduce career concerns for managers, facilitating further investment (and subsequent productivity) in uncertain projects like R&D. High turnover institutional investors, on the other hand, invest in firms that have greater short-term earnings (Bushee, 2001). We follow Bushee (2001), who develops a comprehensive method to classify institutional owners based on their portfolio turnover and diversification.

We also include three measures of external pressures from prior literature that may reflect or induce a firm's short-term orientation, via encouraging the firm to focus on short over long-term returns (e.g., via earnings management). Analyst coverage increases visibility of whether a firm conforms to market expectations and thus may pressure firms to focus on or reflect firm short-term goals (DesJardine, 2015; Graham et al, 2005). Pressure to meet analysts' presumed preferences for short-term investments or those with more certain payoffs is the hypothesized reason for why analyst coverage may shape firm preferences around time horizons (e.g., Benner, 2010). Note, however, that Barth, Kasznik and McNichols (2001) find that analyst coverage is positively correlated with R&D spending.[24] The earnings response coefficient ('ERC'), proposed by Ball and Brown (1968), also captures market pressure in the form of price volatility around earnings announcements, which has been argued to lead firms to respond to short-term expectations and invest less overall (Asker et al, 2015).

Finally, the threat of shareholder activism has been shown to lead firms to focus on short-term returns (Fos, 2017; Qi, 2015). Given that a common objective of activists is to increase stock prices

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[23] For a more recent example in the context of airline pricing, see Zhang and Gimeno (2016).
[24] We take up this apparent inconsistency in our discussion of results in Section 4.2 below.

in the near term, this often leads to cost cutting and divestitures that grow stock prices in the short-term at the expense of longer-term investment and revenue growth (see, e.g., Bratton, 2010). Stock price returns, cash payouts to shareholders, operating performance, and CEO turnover increase in the two years following hedge fund activism. These shorter-term effects are consistent with the observed median holding period by hedge funds of 22 months (Brav, Jiang, Partnoy and Thomas, 2008).[25] Shareholder activism is relatively rare, however, occurring in only 0.8% of US listed firms in any year (Norli, Ostergaard and Schindele, 2015), but the threat of activism impacts a larger number of firms. Fos (2017) shows that, when the likelihood of shareholder activism increases (i.e., the threat of a proxy contest), firms change their behavior, increasing leverage, dividend and share repurchases while decreasing cash reserves as well as investment in R&D and capital. Firm performance appears to be affected as a result; Qi (2015) finds that an increasing shareholder activism threat dampens firm innovative outcomes. Whether activists become engaged because a firm is underperforming or because activists are seeking a short-term payoff, the threat of activism strongly points to firm preferences for short-term payoffs.

4.2. Empirical results: How and why firms vary on ***IDR***

To examine the validity of *IDR* as a proxy for firm time horizons as well as to better understand the sources of heterogeneity between firms in *IDR*, we estimate *IDR* as a function of firm level factors, both internal and external. We run both fixed effect models and random coefficient models (RCM), where the firm investment variables and intercept are 'free' parameters that vary across firms (i.e., firm specific betas are estimated for these variables in addition to the full sample mean betas).[26]

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[25] While news reports suggest a largely negative impact of activism on firm performance, research on these impacts is more equivocal and depends on both the measure of performance used as well as the time horizon considered. There is a large body of research on the impact of activists on firm performance that is beyond the scope of this paper to review, including Brav, Jiang and Kim (2015) and Greenwood and Schor (2009). Recently, deHaan, Larcker and McClure (2019) demonstrated that findings of positive, long-term effects of activism on performance are driven by the smallest twenty percent of firms and that the remaining eighty percent of firms experience insignificant performance effects from shareholder activism.

[26] RCMs have greater flexibility in modeling variance in response to firm-specific investment strategies, which is an effective way to deal with unobserved firm heterogeneity (Knott, 2008; Alcácer, Chung, Hawk and Pacheco-de-Almeida, 2018). For example, two firms with the same level of R&D intensity might face different levels of discounting due to differences in the nature of their R&D projects. RCMs allow us to capture both the mean and variance of the relationship of R&D intensity with *IDR* across firms.

For the RCM, we free parameter estimates on variables where we expect the market to have heterogeneous responses across firms. Specifically, we expect that the market will respond differently to firm investment decisions, depending on the firm's recent history, track record with past such investments and other contingencies not specified in the model. Thus, for our RCM regressions in Tables 3 and 4 reported below, we free the coefficients estimated on firm investment variables: *R&D Intensity, Advertising Intensity, Capital Expenditure, Share Repurchase*, and *Dividends*.

Note that we have also estimated the regression constant as a free parameter in the RCM. With a free constant, the RCM has the advantage of both controlling for time invariant firm unobservables as well as allowing the relationship between dependent and independent variables to differ by firm (i.e., both the intercept and the slope can vary by firm).[27] While the RCM is less restrictive than fixed effects models in this sense, we still include fixed effect models in our Tables 3 and 4 as a reference benchmark and to alleviate concerns that our findings are dependent on RCM assumptions.

Note that *IDR* is captured from *t+1* to *t+5*, while independent variables (set out in Table 1) are captured in period *t* to establish temporal precedence. An exception to this is *Sales Growth*, which is measured in the two years prior to *IDR* (i.e., *t* and *t-1*). Non-overlapping time-period dummies are included for all specifications and are based on the range of the dependent variable calculation. Results for the first three groups of variables - firm investment, institutional ownership and financial health - are set out in Table 3.

[Table 3 here.]

Columns (1), (3) and (5) report fixed effect estimations, while columns (2), (4) and (6) report RCM estimations. Note that all 'a' columns for RCMs report mean betas for the sample, while the 'b' columns report the estimated standard deviation on these betas. A significant standard deviation

[27] Allowing the intercept to vary across firms as a 'free' parameter in RCMs controls for the potential between-firm baseline differences in *IDR*. In this sense, the free intercept is a 'quasi-fixed effect', which follows a specific distributional form, while the traditional firm fixed effect can follow any distributional pattern. In practice, this means that any firm 'quasi-fixed' effects that are further from the mean of the distribution are estimated via a shrinkage estimator to make them consistent with the distribution. See Alcácer et al (2018) for more details.

indicates that the marginal effects of an independent variable on the dependent variable differ meaningfully between firms.

Firm investment variables are correlated in expected ways with *IDR*. In the three fixed effects models, *R&D Intensity* is not significantly different from zero. However, in all three RCM estimations, *R&D Intensity* is negatively correlated with *IDR*, has a value significantly different from zero (p = 0.000) and the 95% confidence interval does not include zero. Further, the standard deviation on *R&D Intensity* is significant, suggesting that the same level of R&D spending is viewed differently by investors depending upon the firm. This idea is consistent with the notion of 'organizational IQ' espoused by Knott (2008), who finds that returns to R&D differ between firms. Markets may also perceive differences in these returns and, thus, value R&D investments differently between firms.[28] This effect is precisely the reason to use the RCM; the significant negative relationship between *R&D Intensity* and *IDR* is obscured with a fixed effect model.[29]

A similar finding exists for *Advertising Intensity*; fixed effect models show a null effect, while two of the three RCM reveal a significantly negative, but heterogeneous, relationship with *IDR* (e.g., p = 0.002 in (2a)). The negative mean effect suggests that firms that advertise more are discounted less by the market. From the highly significant standard deviation, it appears that the marginal effect of increased advertising spending is much more important for some firms than others.

Capital Expenditure (p = 0.000) bears a negative correlation with *IDR* across specifications, suggesting that firms investing more in capital are discounted less by the market than their peers investing less. However, with the significant standard deviation reported in the (b) columns, the magnitude of this effect also depends on the firm.

[28] See, for example, Knott (2019) and Knott and Vieregger (2019).

[29] When the coefficient estimated via the fixed effect model is not significantly different from zero, but both the mean and variance are significant under the RCM, this suggests that there are firms at both tails of the distribution with significant relationships between *R&D Intensity* and *IDR*. When there is such underlying heterogeneity between firms in the relationship between the dependent and independent variable, FE models are mis-specified. The consequences of this misspecification are biased results and potentially spurious significance regarding the joint significance of the firm fixed effects (Alcácer, Chung, Hawk and Pacheco-de-Almeida, 2018). The varied approaches in how firm heterogeneity is treated likely explain the difference in coefficient significance that we observe between the FE and RCM in some cases.

Firm spending on both *Share repurchases* and *Dividends* is significantly positively correlated with *IDR* (p-value = 0.000 for both). We note also the significant standard deviation on both of these effects reported by the RCM. These effects are strong and robust across specifications, suggesting that firms that spend on buying back shares or issuing dividends may be doing this in lieu of other investments such as R&D or capital equipment that would generate longer term returns.[30] That such firms are more heavily discounted by the market, while firms investing more in either intangibles (R&D and/or advertising) or capital are less discounted by the market, are observations consistent with interpreting *IDR* as a proxy for firm time horizons and that also suggest how firm behavior reveals heterogeneity in underlying time horizons.

We then add measures of a firm's financial health and maturity in the final three columns of Table 3. *Financial Slack*, capturing the ability of firms to invest as well as being a proxy for the financial health and future prospects of a firm, is negatively and significantly correlated with *IDR* (p = 0.013 and 0.000 for the fixed effect and RCM, respectively). *Sales Growth* bears a negative and significant relationship with *IDR* across specifications (p = 0.000 for both). Since *Sales Growth* is a proxy for future growth expectations, this negative relationship suggests that *IDR* captures, at least in part, shareholder expectations about future opportunities for the firm. In contrast, *Firm Age* is positively correlated with *IDR* (p = 0.000 for both). This variable is included as a control for lower growth rates we might expect to see in more mature firms. In such cases, increased *IDR* may be a rational market response to expectations around diminished future growth.

Measures of a firm's institutional ownership are added in columns (3) and (4), all of which are statistically significant at conventional levels. The coefficient estimate on *Transient* is as expected; as the percentage of a firm's shares held by transient institutional investors increases, *IDR* decreases (p = 0.000 for all specifications). This result is consistent with prior research that shows firms cut investments in order to make earnings targets when they have more transient ownership (i.e.,

[30] This effect is also consistent with the argument that such returns of cash to shareholders may be due to lack of investment opportunities for the firm. In either case, however, we expect a firm's long term returns to be discounted more by the market.

institutional owners with high portfolio turnover (Bushee, 1998)). *Dedicated* institutional ownership has the opposite effect; as ownership by institutions with low portfolio turnover increases, *IDR* decreases (p-value = 0.000 for all specifications). One possible interpretation is that, when investors hold stocks for longer periods of time in a firm, pressures to sacrifice long-term gains to make short-term earnings targets decrease. This is correlated with a compensating decrease in discounting of the firm's future cash flows.

Institutional ownership by *Quasi-indexers* has a positive relationship with firm *IDR* (p = 0.000, all specifications), suggesting that pressure for short-term payoffs increases with rising investment by quasi-indexers. While we did not have specific priors on the effect of *Quasi-indexers*, our result is consistent with Porter (1992), who argues that quasi-indexers increase pressures for short-term investment behavior because these investors have fragmented ownership; this reduces monitoring of firms and managers. We also did not have priors on unclassified institutional investors, *Unknown Category*, which is significantly negatively correlated with short-termism (p = 0.000, all specifications).[31] Because the FE model is identified on firms that have changes in the levels of transient or dedicated institutional ownership and to the extent that some of those changes may be exogenous to the focal firm, estimates on these variables can be thought of as explaining to some extent *why* a firm's *IDR* changes, not simply an explanation of what changes correlate with firm *IDR*.[32] Overall, our estimates in Table 3 show that *IDR* is correlated in largely expected ways with measures that have been previously argued to be indicators of firm time horizons, even controlling for firm heterogeneity on expected future growth. They also reveal how firm behavior explains heterogeneity in time horizons as well as to a more limited extent explain why firm *IDR* levels change over time (e.g., around increases in transient institutional investor holdings).

[31] These investors tend to be dedicated investors, but have few holdings and insufficient information to categorize (per discussions with Brian Bushee in March, 2016).
[32] This will also be true for FE models estimating the relationships between *IDR* and *Activism Threat* and *Analyst Coverage*, as discussed below.

Management incentives as well as sources of external pressure (such as analyst coverage) are also thought to be correlated with firm time horizons; we estimate these effects in Table 4. Note that the sample size is significantly reduced in these estimations, since data on several measures is only available for a limited number of firms.

[Table 4 here.]

Long-term compensation *(LTIP - CEO)* has a significantly negative relationship with *IDR*, as expected (p values range from 0.018 to 0.075). In contrast, *CEO Turnover* shows mixed effects. Column (1) shows a significant positive relationship with *IDR* (p = 0.002), consistent with expectations that shorter tenure is indicative of shorter time horizons. However, this effect reverses in the RCM and when we add measures of external pressure in (5) and (6); shorter average tenure (i.e., higher turnover) dampens *IDR*.[33] For the RCM, the coefficient on *CEO Turnover* falls outside of traditional significance levels (p = 0.201), likely due to the firm variance that is picked up by the free investment parameters (i.e., R&D intensity, etc.). Simple explanations for the significant negative relationship in columns (5) and (6) are elusive, but likely includes the change of sampling, since our sample size drops when we add external pressure measures. It's possible that changing CEOs is a strong signal that a firm is making necessary changes to adapt to market conditions and explore new opportunities, for example. This would be consistent with Hambrick and Fukutomi (1991), who argue that CEOs with very long tenure may tend toward shorter time horizons, due to personal considerations such as more imminent retirement. Further exploration is required, however, to draw conclusions on the relationship between CEO turnover and *IDR*.

The effects of two of the three measures of external pressure behave as expected and largely consistently across specifications. The *Earnings Response Coefficient* (ERC) and *Activism Threat* have significantly positive relationships with *IDR* (p = 0.002 and 0.000 in column (3), respectively),[34] suggesting when a firm's stock prices are more sensitive to earnings news or there is significant

[33] We also introduce a squared term of CEO tenure in unreported models, similar to Hambrick and Fukutomi (1991), but do not find significant curvilinear relationship between tenure and *IDR*.

[34] The relationship between ERC and *IDR* is outside conventional significance levels in (6), where p = 0.145.

shareholder activism in the industry that may affect the firm in future, then the firm plausibly emphasizes short-term returns and future cash flows are more heavily discounted. Results on the fixed effect models specifically suggest that when the activist threat increases in a firm's industry, an effect largely exogenous to firm specific behavior, the firm's time horizons contract, captured via increasing *IDR*.

The effects of *Analyst Coverage* are more challenging to interpret; the coefficients are largely significant but change sign according to the sampling. In the larger sample, *Analyst Coverage* shows a positive correlation with *IDR* ($p = 0.104$ and 0.000 for the fixed effect and RCM, respectively), suggesting that greater attention from analysts may lead firms to conform to analyst preferences, which often favor short-term, less risky investments (e.g., Benner, 2010). However, it's not clear what conclusions we can draw from this, since the sign of the coefficient flips when we constrain the sample by adding management incentive measures in columns (5) and (6). Since the incentive measures are only available for S&P 1500 firms, which tend to be larger, older firms, it's possible that increasing analyst coverage provides greater transparency on entrenched CEOs. This finding appears consistent with Barth et al. (2001), who find a positive correlation between R&D spending and analyst coverage among the larger, publicly listed firms in the first decade of our sample frame (1983-1994). For our purposes here, however, we focus on the overall pattern presented by the variables and leave resolution of this specific puzzle to future exploration.

Note that our coefficient on *Quasi-indexer* becomes negative in the smaller sample represented in Table 4. Compared to the sample in Table 3, firms in Table 4 tend to be older (i.e., median age of 18 years in Table 4, versus 8 years in Table 3) and have more significant ownership by quasi-indexer institutional owners (median of 29.5% and 4.2% for Tables 4 and 3, respectively). Splitting the sample according to the median quasi-indexer holdings reveals that the effect of *Quasi-indexer* depends on the level of ownership; those firms with above median holdings by quasi-indexers show a negative relationship between increased institutional ownership and *IDR*, while those with below median holdings show a positive relationship between *Quasi-indexer* and *IDR*, irrespective of sample (i.e., in either Table 3 or 4).[35] Thus, the true effect of *Quasi-indexer* institutional ownership appears to be negative; *IDR* is less for firms that have significant holdings by *Quasi-indexers*, perhaps due to the low turnover that characterizes such institutional investors. This finding runs counter to the hypothesis put forth by Porter (1992).

In addition to our main analyses reported above, we also conducted extensive robustness checks, summarized and reported in Appendix C. We note what we deem the most critical tests here. First, a limitation of our analysis is that we cannot rule out the possibility that *IDR* is a driver of future firm actions and opportunities as opposed to a response to past firm behavior. While firm-level characteristics are correlated in largely expected directions with future *IDR*, it is challenging to pin down the direction of causality without an experiment. We argue here that firm behavior affects market perceptions and, thus, later *IDR*, but it's also possible that investor preferences around time horizons (included in *IDR*) also affect subsequent firm behavior. Since we focus in this paper on the first relationship, that is, *IDR* as a dependent variable, we examine whether firm behavior and characteristics affect later *IDR* in a sample where reverse causality is less plausible. Specifically, we estimate column (1) from Table 3 for 2280 newly listed firms in their first period since IPO (1980 or later). In a sense, we treat IPOs as imperfect, one-off experimental events and examine how the market evaluates firms with varying initial investment strategies and ownership structures. By focusing on the period immediately after IPO only, we alleviate some concerns that firm behaviors are solely a response to past movement in stock price.

In Table C.1, we include only a single observation per firm that captures investment and institutional ownership in the window immediately after IPO and *IDR* in the following time period. We exclude remaining variables because these other variables either require more than one year of data or show little variance for newly listed firms.[36] We find that results are largely consistent with our main analysis; higher levels of R&D, advertising and capital investments in the first period since

[35] These results are available upon request.
[36] This includes share repurchases, which are very rare for newly listed firms.

IPO are associated with lower discounting in the subsequent period, while dividends are associated with higher discounting. We also find that transient and dedicated ownership predicts discounting as expected, though not always within conventional significance levels. These two variables are significant, however, with a high-dimensional fixed effects model that accounts for industry by time effects, with robust standard errors. This model helps to control for the IPO market environment at the time of listing. While R&D intensity is less significantly correlated, the effects of advertising, capital expenditures and dividends are robust to the inclusion of these industry-time fixed effects. Overall, these results support our conjecture that the market incorporates information from firm behavior and characteristics in its evaluation of time horizons for firm returns.

A related concern is that the firm-level effects shown in Tables 3 and 4 may not be robust to inclusion of relevant industry-level factors. To control for industry factors, we again construct a high-dimensional fixed-effects model with fixed industry by period effects, which capture any environmental influence specific to an industry at a given time, in addition to firm fixed effects for our full sample. The cost of employing such models is that we lose statistical power as well as the flexibility to model heterogeneous market responses, since any effect estimated cannot vary across firms. Nevertheless, in Table C.2 we observe results consistent with those already reported in the fixed effects models above with some exceptions. As reported in the fixed effects models in Tables 3 and 4 above, we observe null R&D and advertising effects here, likely due to our inability to estimate firm level heterogeneity in these models.

Overall, these results as a whole show that *IDR* reflects firm investment behavior, financial position, institutional ownership as well as other external market pressures and executive compensation in largely expected ways. Since these variables, suggested by earlier research, are thought to be correlated with short or long-term firm behavior, the results provide corroboration that *IDR* captures market expectations of firm time horizons. Thus, we argue that *IDR* reflects investor perceptions of past firm behavior related to the timing of returns.

5. Discussion & Conclusion

In this paper, we introduce a measure, *IDR* or a firm's implied discount rate, which is drawn from asset pricing theory, and then use this measure to explore whether firms have become more short-term oriented over the past thirty years. Put differently, we use market observations of firm behavior and the expectations that follow, which are incorporated into stock prices and, consequently, our measure, to capture whether firms are becoming more short-term oriented. Our results here suggest they are.

Despite fluctuations, we observe an unequivocal increase in discounting of expected future firm cash flows across the market between 1980 and 2013. Alternative measures of *IDR* confirm this trend, including one based on analyst earnings forecasts. Further, we show that *IDR* within firms has increased over time for the majority of firms in our sample, though we also expose significant between firm heterogeneity. Inter-firm heterogeneity in *IDR* is tied to firm investment strategy and variables that capture exposure to external market pressures, such as analyst coverage and the threat of shareholder activism in an industry. Being previously used as proxies for firm time horizons, we use these variables to evaluate whether our measure, *IDR*, captures a firm's time orientation.

Further, our analysis allows us to identify how *IDR* varies across firms within the same time period. Fixed effect models also allow us to examine why *IDR* changes within a firm over time to a more limited extent; changes in external pressures that are largely exogenous to firm behavior, such as shareholder activism in an industry and analyst coverage, are suggestive of a causal relationship between changes in these external pressures and changing firm time horizons. These relationships imply that investor and analyst behavior may pressure firms to demonstrate earnings in the near term, influencing firm strategy choices. Because we cannot definitively rule out selection effects in our analysis here, we focus on confirming that firm time horizons are correlated as expected with many markers of external pressures. This suggests that investors may select firms that match a preferred time horizon, rather than exerting influence over firm time horizons. However, earlier research also illustrates that shortening investor time horizons pressure firms to focus more on short-term returns. An examination of how investors may change firm investment behavior and how investors levy this pressure is an important follow on from this work. Such work would help guide firms in devising their strategies not only for investment, but also guide their external communications in order to attract investors that share their time horizons.

Our results can be explained by increasing economic uncertainty facing firms that exacerbates myopic loss aversion. They can also be explained by the inability to arbitrage away mispricing around risky investments, due to lack of definitive information on the source of the mispricing. Such a behavioral mispricing would lead to a preference for short over long-term investment payoffs, as suggested by the strong correlations we observe between *IDR* and firm specific characteristics that proxy for time horizons. Alternatively, rising *IDR* may capture unmeasured risk that may be rising over the past thirty years. We have, however, ruled out that most indicators of risk, such as market volatility, implied equity risk premium or any time variant risk that correlates with a firm's industry, explain our results. From this, we conclude that there may well be unidentified risk factors that affect *IDR*, but that these factors appear to both affect the market broadly and correlate with firm proxies for time horizons.

These findings must be taken with important caveats; much work remains to be done. Our measure, *IDR,* has limitations; not all agree that asset-pricing models precisely predict asset values and, thus, in our case, discount rates. For these reasons, despite the correlations we observe with alternative discount models estimated, we do not make inferences about the meaning of isolated values of *IDR*. Accordingly, care must be taken with placing too much weight upon single firm estimates or outside a comparison with other firms in the same time frame. While the imperfections of our measure challenge interpretation of single values, they do not prevent inference from the time trend or the relative differences in the discounting measure between firms in the cross section and correlations with established signals of firm time horizons.

The above discussion implies that we cannot determine what is an optimal discount rate on average across the market or for a specific firm. Such a determination is required to better understand whether a short-term orientation is helpful or harmful to specific firms.[37] This is challenging, given the inability to observe a firm's investment opportunities. However, with a more complete understanding of sources of firm and market systematic risk, as well as firm specific cost of capital, it may be possible to analyze whether an increase in *IDR* improves or hinders long term firm performance. Observing firm levels of investment relative to sub-industry technology development cycles in conjunction with firm strategy (e.g., whether the firm is an industry leader or fast follower) may also offer some clues as to whether short-term perspectives are sub-optimally altering a firm's investment portfolio and, consequently, expected future growth. We leave the challenge of identifying how firm discount rates should vary according to firm potential and past track record as well as vary over time to future research.

The implications of our results are far reaching. Our implied discount rate measure provides a mechanism for evaluating whether firm time horizons have shifted and our results above point to contracting time horizons on average, with clear heterogeneity between firms. This heterogeneity helps explain the apparent inconsistency between the existence of firms with a long-time horizon (e.g., firms willing to make risky, long-term bets such as Apple or Google) and the market-wide trend of increased short-termism by firms noted in the press and this empirical work.

If firms on average are becoming more short-term oriented, they will seek investment opportunities that yield short-term returns. This is of little consequence if these types of investments are the best opportunities for the firm when evaluated not only on timing of payoffs but also in conjunction with the need to ensure long-term growth and survival. Firms, however, may not pursue profitable strategies if payoffs are less transparent (e.g., R&D investment) or spread over a longer term. It's difficult to underestimate what this implies for longer-term firm productivity. If firms change their strategy to favor short-term payoffs, long-term firm growth and performance may suffer. While we cannot currently identify for which firms shortening time horizons are most

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[37] In some cases, short-term pressures likely cause the firm to deviate from optimal strategy, while in others such actions may be desirable. For example, younger firms that need to attract more capital may emphasize short-term results optimally (e.g., Gompers, 1996; Baker, 2000).

problematic, since we do not observe alternative strategies available to the firm, it is likely that increasing impatience is not ideal for at least some publicly listed firms, even if it may be a rational response to increased economic uncertainty.

The implications of our analysis extend beyond firm performance, however, to the economy as a whole. The potentially changing nature of R&D investment is one illustration. If firms are changing their R&D strategies and choosing projects more likely to yield short-term returns over those that may yield long-term and more significant payoffs, then contracting time horizons could profoundly affect long-term productivity and economic growth. While it is possible that private firms and start-ups will take up any profitable investment opportunity left behind by publicly listed firms, it is difficult for private equity held firms or VC funded startups to take on certain large-scale projects with steep capital requirements, such as aircraft or materials science. As such, whether and how changing time horizons are affecting both the level and nature of firm investment, particularly in R&D, is a vital area for future research.

Ultimately, this paper represents a market-wide assessment of the change in how markets discount firms over time as well as analysis and discussion of what these observed trends imply for firm time horizons and strategy. While our work sheds light on an important phenomenon for firms, markets and policy makers, these results raise as many questions as they answer. Our objective is to start a more specific dialogue that focuses on how firm time horizons are shifting and the heterogeneous implications for firm strategy.

References

Abarbanell, J., & Bernard, V. (2000). Is the US stock market myopic? *Journal of Accounting Research*, *38*(2), 221-242.

Aghion, P., Van Reenen, J., & Zingales, L. (2013). Innovation and institutional ownership. *American Economic Review*, *103*(1), 277-304.

Aggarwal, R. (2008). Executive compensation and incentives. In B.E. Eckbo (Eds.), *Handbook of Empirical Corporate Finance Vol.2* (pp. 497-538). Amsterdam, Netherlands: Elsevier.

Alcácer, J., Chung, W., Hawk, A., & Pacheco-de-Almeida, G. (2018). Applying random coefficient models to strategy research: Identifying and exploring firm heterogeneous effects. *Strategy Science*, *3*(3), 533-553.

Almeida, H., Fos, V., & Kronlund, M. (2016). The real effects of share repurchases. *Journal of Financial Economics*, *119*(1), 168-185.

Asker, J., Farre-Mensa, J., & Ljungqvist, A. (2015). Corporate investment and stock market listing: A puzzle? *Review of Financial Studies*, *28*(2), 342-390.

Baker, M. (2000). Career concerns and staged investment: Evidence from the venture capital industry. *Working paper*.

Ball, R., & Brown, P. (1968). An empirical evaluation of accounting income numbers. *Journal of Accounting Research*, Supplement, 159-178.

Barth, M. E., Kasznik, R., & McNichols, M. F. (2001). Analyst coverage and intangible assets. *Journal of Accounting Research*, *39*(1), 1-34.

Benartzi, S., & Thaler, R. H. (1995). Myopic loss aversion and the equity premium puzzle. *Quarterly Journal of Economics*, *110*(1), 73-92.

Benartzi, S., & Thaler, R. H. (1999). Risk aversion or myopia? Choices in repeated gambles and retirement investments. *Management Science*, *45*(3), 364-381.

Benner, M. J. (2010). Securities analysts and incumbent response to radical technological change: Evidence from digital photography and internet telephony. *Organization Science*, *21*(1), 42-62.

Bettis, J. C., Bizjak, J., Coles, J. L., & Kalpathy, S. (2018). Performance-vesting provisions in executive compensation. *Journal of Accounting and Economics*, *66*(1), 194-221.

Bratton, W. (2010). Hedge funds and governance targets: Long-term results. *University of Pennsylvania Institute for Law and Economics Working Paper, #10-17*.

Brav, A., Jiang, W., & Kim, H. (2015). The Real Effects of Hedge Fund Activism: Productivity, Asset Allocation and Labor Outcomes. *NBER Working Paper #17517*.

Brav, A., Jiang, W., Partnoy, F., & Thomas R. (2008). Hedge fund activism, corporate governance and firm performance. *Journal of Finance, 63*(4), 1729-1775.

Brochet, F., Loumioti, M., & Seraphim, G. (2014). Short-termism, investor clientele and corporate performance. *HBS Working paper, #12-072*.

Bushee, B. J. (1998). The influence of institutional investors on myopic R&D investment behavior. *Accounting review*, 305-333.

Bushee, B. J. (2001). Do institutional investors prefer near-term earnings over long-run value? *Contemporary Accounting Research*, *18*(2), 207-246.

Chung, W., & Alcácer, J. (2002). Knowledge seeking and location choice of foreign direct investment in the United States. *Management Science*, *48*(12), 1534-1554.

Davies, R., Haldane, A. G., Nielsen, M., & Pezzini, S. (2014). Measuring the costs of short-termism. *Journal of Financial Stability*, *12*, 16-25.

deHaan, E., Larcker, D., & McClure, C. (2019). Long-term economic consequences of hedge fund activist interventions. *Review of Accounting Studies*, *24*(2), 536–569.

DesJardine, M. R. (2015). Under pressure: The causal effect of financial analyst coverage on long-term capital. In *Academy of Management Proceedings* (Vol. 2015, No. 1, p. 15031). Briarcliff Manor, NY 10510: Academy of Management.

Easton, P. (2007). Estimating the cost of capital implied by market prices and accounting data. *Foundations and Trends in Accounting*, *2*(4), 241-364.

The Economist. The sound of silence. (2006). *The Economist*, 27 April.

Fama, E. F., & French, K. R. (1988). Permanent and temporary components of stock prices. *Journal of Political Economy*, *96*(2), 246-273.

Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. *Journal of Finance*, *47*(2), 427-465.

Fama, E. F., & French, K. R. (2008). Dissecting anomalies. *Journal of Finance*, *63*(4), 1653-1678.

Fellner, G., & Sutter, M. (2009). Causes, consequences, and cures of myopic loss aversion–An experimental investigation. *Economic Journal*, *119*(537), 900-916.

Financial Industry Regulatory Agency. (2016). UPC General FAQ. Retrieved from https://www.finra.org/industry/faq-upc-general-faq

Flammer, C., & Bansal, P. (2017). Does a long-term orientation create value? Evidence from a regression discontinuity. *Strategic Management Journal*, *38*(9), 1827-1847.

Fos, V. (2017). The disciplinary effects of proxy contests. *Management Science*, *63*(3), 655-671.

Gebhardt, W. R., Lee, C. M., & Swaminathan, B. (2001). Toward an implied cost of capital. *Journal of Accounting Research*, *39*(1), 135-176.

Gneezy, U., Kapteyn, A., & Potters, J. (2003). Evaluation periods and asset prices in a market experiment. *Journal of Finance*, *58*(2), 821-837.

Gneezy, U., & Potters, J. (1997). An experiment on risk taking and evaluation periods. *Quarterly Journal of Economics*, *112*(2), 631-645.

Gompers, P. A. (1996). Grandstanding in the venture capital industry. *Journal of Financial Economics*, *42*(1), 133-156.

Graham, J. R., Harvey, C. R., & Rajgopal, S. (2005). The economic implications of corporate financial reporting. *Journal of Accounting and Economics*, *40*(1-3), 3-73.

Greenwood, R., & Schor, M. (2009). Investor activism and takeovers. *Journal of Financial Economics*, *92*(3), 362-375.

Haigh, M. S., & List, J. A. (2005). Do professional traders exhibit myopic loss aversion? An experimental analysis. *Journal of Finance*, *60*(1), 523-534.

Hambrick, D. C., & Fukutomi, G. D. (1991). The seasons of a CEO's tenure. *Academy of Management Review*, *16*(4), 719-742.

Hsieh, P., Koller, T., & Rajan, S. (2006). The misguided practice of earnings guidance. *McKinsey on Finance*, Spring 2006. Retrieved from http://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-misguided-practice-of-earnings-guidance

Kaplan, S. N., & Minton, B. A. (2012). How has CEO turnover changed? *International Review of Finance*, *12*(1), 57-87.

Kaplan, S. (2017). Are U.S. companies too short-term oriented? Some thoughts. *Working paper.*

Knott, A. M. (2008). R&D/returns causality: Absorptive capacity or organizational IQ. *Management Science*, *54*(12), 2054-2067.

Knott, A.M. (2019). The Record on R&D Outsourcing. *Center for Economic Studies Working Paper #16-19*, Retrieved from: https://ssrn.com/abstract=2756220.

Knott, A.M. & Vieregger, C. (2019). Does R&D Drive Growth. *SSRN Working paper*, Retrieved from: https://ssrn.com/abstract=2382885.

Kothari, S. P. (2001). Capital markets research in accounting. *Journal of Accounting and Economics*, *31*(1-3), 105-231.

Larcker, D. F. (1983). The association between performance plan adoption and corporate capital investment. *Journal of Accounting and Economics*, *5*, 3-30.

Laverty, K. J. (1996). Economic “short-termism”: The debate, the unresolved issues, and the implications for management practice and research. *Academy of Management Review*, *21*(3), 825-860.

Loewenstein, G., & Thaler, R. H. (1989). Anomalies: intertemporal choice. *Journal of Economic Perspectives*, *3*(4), 181-193.

Mankins, M., Harris, K., & Harding, D. (2017). Strategy in the Age of Superabundant Capital. *Harvard Business Review,* March-April.

Mannix, E. A., & Loewenstein, G. F. (1994). The effects of interfirm mobility and individual versus group decision making on managerial time horizons. *Organizational Behavior and Human Decision Processes*, *59*(3), 371-390.

Manufacturers Alliance for Productivity and Innovation (2016) Lowering the Bar: Hurdle Rates. https://www.mapi.net/blog/2016/04/lowering-bar-hurdle-rates

Meier, I. & Tarhan, V. (2007). Corporate investment decision practices and the hurdle rate premium puzzle. *SSRN Working Paper*, Retrieved from http://dx.doi.org/10.2139/ssrn.960161

Miles, D. (1993). Testing for short termism in the UK stock market. *Economic Journal*, *103*(421), 1379-1396.

Mizik, N. (2010). The theory and practice of myopic management. *Journal of Marketing Research*, *47*(4), 594-611.

National Science Foundation, National Center for Science and Engineering Statistics. (2016). National Patterns of R&D Resources. Retrieved from https://www.nsf.gov/statistics/2016/nsb20161/#/data

Norli, Ø., Ostergaard, C., & Schindele, I. (2014). Liquidity and shareholder activism. *Review of Financial Studies*, *28*(2), 486-520.

Porter, M. E. (1992). Capital disadvantage: America's failing capital investment system. *Harvard Business Review*, *70*(5), 65-82.

Poterba, J. M., & Summers, L. H. (1995). A CEO survey of US companies' time horizons and hurdle rates. *MIT Sloan Management Review*, *37*(1), 43.

Qi, J. (2015). The threat of shareholder intervention and firm innovation. *Working paper.*

Shleifer, A., & Vishny, R. W. (1997). The limits of arbitrage. *Journal of Finance*, *52*(1), 35-55.

Scholes, M., & Williams, J. (1977). Estimating betas from nonsynchronous data. *Journal of Financial Economics*, *5*(3), 309-327.

Souder, D., & Shaver, J. M. (2010). Constraints and incentives for making long horizon corporate investments. *Strategic Management Journal*, *31*(12), 1316-1336.

Thaler, R. H., Tversky, A., Kahneman, D., & Schwartz, A. (1997). The effect of myopia and loss aversion on risk taking: An experimental test. *Quarterly Journal of Economics*, *112*(2), 647-661.

Vasella, D., & Leaf, C. (2002). "Temptation is all around us" Daniel Vasella of Novartis talks about making the numbers, self-deception, and the danger of craving success. *Fortune*, 18 November.

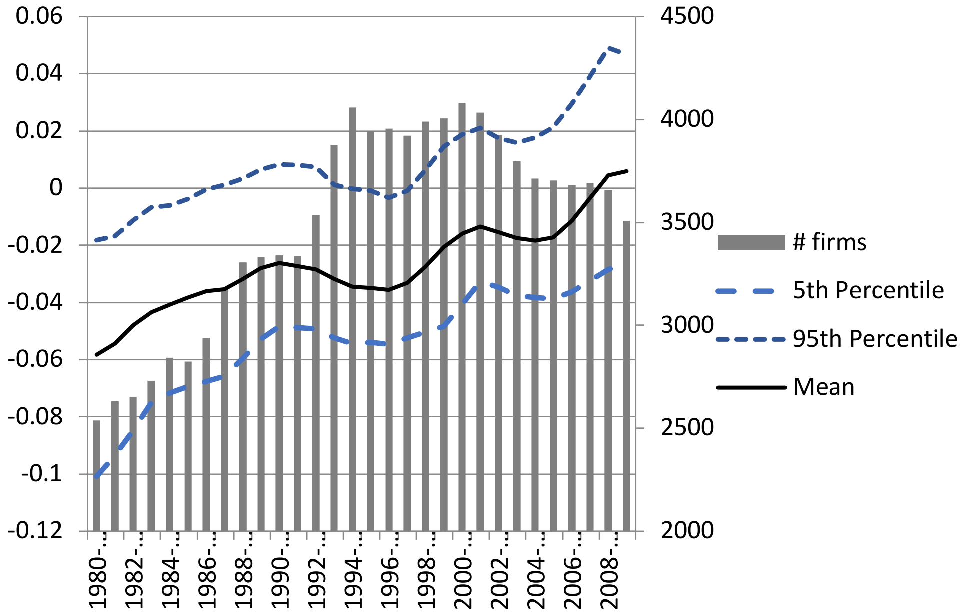
Zhang, Y., & Gimeno, J. (2016). Earnings pressure and long-term corporate governance: Can long-term-oriented investors and managers reduce the quarterly earnings obsession? *Organization Science*, *27*(2), 354-372.

Figure 1: Illustration of the Relationship between *x* and Investment Preferences

	A	**B**	**C**
Investment Cost	$60	$60	$60
Cash Flows	$28pa, years 6-10	$10pa, annually	$16pa, years 1-5
Cumulative CF	$140	$100	$80
NPV	$70.78	$64.18	$62.23
Ranking	**1**	**2**	**3**
NPV w/ *x*	$47.50	$50.70	$53.97
Ranking w/ *x*	**3**	**2**	**1**

WACC set at 9% for all NPV calculations and x is set to 0.95 in the last two rows. Note that $IDR = 1 - x$.

Figure 2: Implied Discount Rate (*IDR*), Mean Values 1980-2013



Average, 5th percentile and 95th percentile *Implied Discount Rate* (i.e., 1-*x*) for firms, with number of sample firms shown in histogram.

Figure 3: Within Firm Movement of Implied Discount Rate (*IDR*)

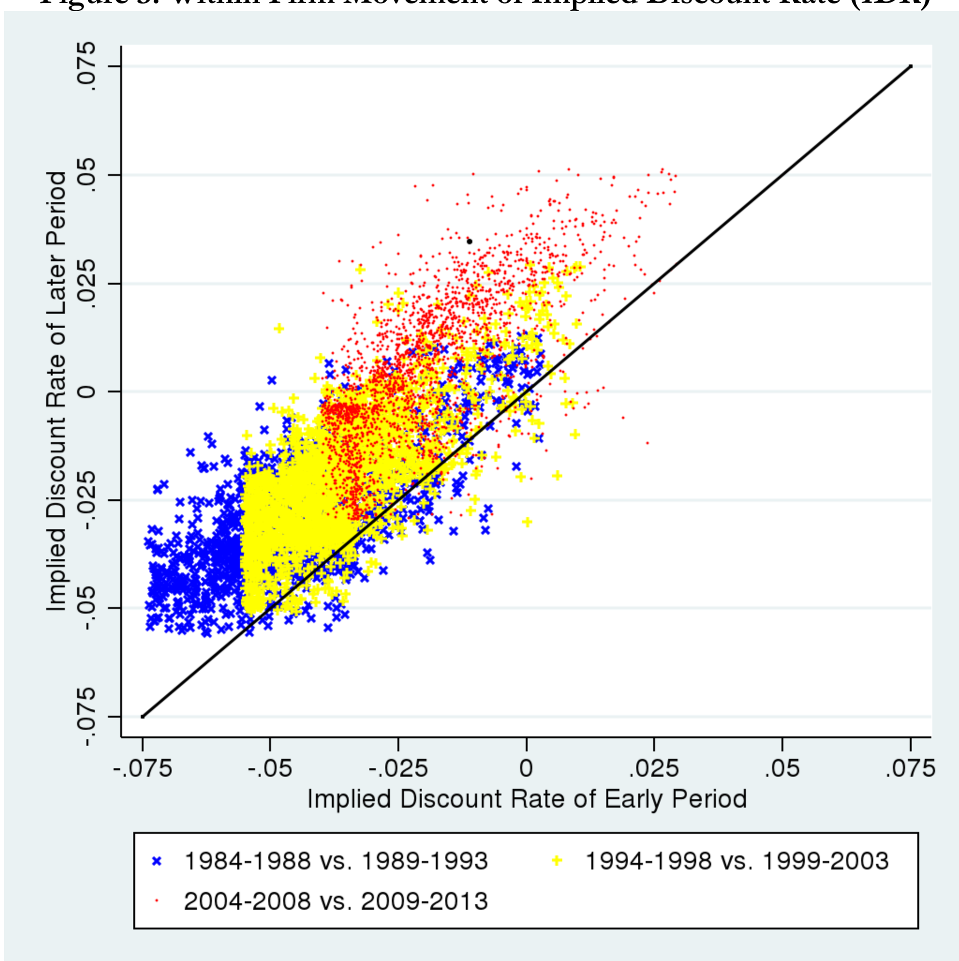


Table 1: Variable Construction, Expected Signs & Data Sources

Variable	Expected Sign[38]	Construction	Source
Firm Investment:			
R&D Intensity	-	R&D spending scaled by total firm assets in a given year.	COMPUSTAT
Advertising Intensity	-/+	Advertising spending, scaled by total firm assets	COMPUSTAT
Capital Expenditure	-	Ratio of capital spending to total assets	COMPUSTAT
Share Repurchase	+	Log difference between the current and previous year's treasury stock. A firm's treasury stock is shares that it holds in itself, held either by repurchase/buyback or because the stock had not been issued to the public. Where treasury stock is missing, we use the difference between purchase and sales of common stock in the current year instead. Negative and missing values are set to zero.	COMPUSTAT
Dividends	+	Log (total dividends issued in the current year + 1)	COMPUSTAT
Institutional Ownership:			
Transient	+	Percentage of shares owned by transient institutional investors in the focal firm (i.e., number of shares held by institution type divided by total shares outstanding each year). Transient investors are institutions with high portfolio turnover and diversification.[39]	Thomson Reuters Institutional (13F) Holdings matched to the classification in Bushee (2001)[40]
Dedicated	-	Percentage of shares owned by dedicated institutional investors in the focal firm (i.e., number of shares held by institution type divided by total shares outstanding each year). Dedicated investors are institutions with low portfolio turnover and concentrated holdings.	As above.
Quasi-indexer	NA	Percentage of shares owned by quasi-indexer institutional investors in the focal firm (i.e., number of shares held by institution type divided by total shares outstanding each year). Quasi-indexer investors are institutions that are widely diversified, but with lower turnover relative to transient investors.	As above.
Unknown category	NA	Percentage of shares owned by uncategorized institutional investors in the focal firm (i.e., number of shares held by institution type divided by total shares outstanding each year). Uncategorized investors are institutions that tend to be dedicated investors but have few holdings and insufficient information to categorize (per discussions with Brian Bushee, March, 2016).	As above.
Financial health:			
Financial Slack	-	The difference between current assets and current liabilities, divided by total firm assets	COMPUSTAT

[38] Negative signs imply lengthening time horizons (i.e., lower *Implied discount rate)*, while positive signs imply contracting time horizons (i.e., greater *Implied discount rate)*.
[39] We drop observations where a firm's ownership among all types adds to more than 100% in a year.
[40] Classification data taken from: http://acct.wharton.upenn.edu/faculty/bushee/IIclass.html. Bushee (2001) changes the classification scheme from his 1998 paper, dropping momentum trading from the classification scheme. In our analysis below, we use the earnings response coefficient (ERC) as a partial control for the extent of momentum trading in the focal firm.

Sales Growth	-	Firm sales in the current period, less sales in the prior period, scaled by total sales in the prior period. We winsorize Sales Growth at the 1st and 99th percentile but note that this does not affect estimates of other variables.	COMPUSTAT
Firm Age	+	Count of years since the firm was listed on a public exchange (or 1980, whichever is later)	COMPUSTAT
Management incentives:			
LTIP - CEO	-	CEO compensation in the form of restricted stock grants, new stock options and other long-term incentive plan payoffs, normalized by total compensation. Total compensation is the total of current compensation and other compensation.	Standard & Poor's ExecuComp, available for S&P 1500 firms from 1992-2006 only
CEO Turnover	+	Number of unique CEOs from IPO (or 1992, when the CEO data become available, whichever is later) to the observation year, divided by the years since IPO (or 1992, whichever is later).	Standard & Poor's ExecuComp & COMPUSTAT
External pressure:			
Analyst Coverage	+	Log (number of analysts covering a firm + 1)	IBES from Thomson Financial
Earnings Response Coefficient (ERC)	+	ERC is estimated by regressing: $CAR_i = \beta_0 + \beta_1 UE_i + \varepsilon_i$ Where CAR_i *is* the cumulative abnormal return for firm i (i.e., firm return less market return) on the day of the quarterly earnings announcement (Ball and Brown, 1968). UE_i is the firm's unexpected quarterly earnings per share deflated by the share price at the beginning of the quarter. Unexpected quarterly earnings per share are the difference between actual earnings announced and expected earnings, captured via quarterly earnings per share one year earlier. The regression is run for each firm's quarterly earnings announcements for three years (i.e., 12 quarters) to estimate, β_1, the firm's earnings response coefficient, ERC. Since we expect that market pressures operate on firms irrespective of the direction of the market response to unexpected earnings announcements, we take the absolute value of ERC for our regressions.	CRSP
Activism Threat	+	Number of activist filings in an industry (3 digit NAICS), normalized by the number of public firms in that industry in a year. Activist filings include any of eight types of SEC filings by shareholders, including contested solicitations and proxy contests. We follow Norli, Ostergaard and Schindele, (2015) and include all filings of the following SEC forms: PREC14A, PREN14A, PRRN14A, DEFC14A, DEFN14A, DFRN14A, DFAN14A, and DEFC14C.	SEC Filings on WRDS (SEC Analytics Suite), available from 1994 onwards.

Table 2: Descriptive Statistics

Variable	N	Mean	Median	SD	Min	Max
Dependent Variable						
Implied Discount Rate (*IDR)*	71676	-0.0278	-0.0322	0.0263	-0.1175	0.6493
Firm Investment						
R&D Intensity	71676	0.0466	0.0000	0.1290	-0.0039	11.1647
Advertising Intensity	71676	0.0144	0.0000	0.0475	0.0000	1.6603
Capital Expenditure	71676	0.0692	0.0482	0.0737	-0.0321	1.4631
Share Repurchase	71676	0.3991	0.0000	1.2093	0.0000	10.4464
Dividends	71676	1.1935	0.0000	1.8221	-1.3243	10.5178
Institutional Ownership						
Transient	71676	0.0719	0.0156	0.1093	0.0000	0.9264
Dedicated	71676	0.0451	0.0002	0.0784	0.0000	0.8295
Quasi-Indexer	71676	0.1379	0.0544	0.1780	0.0000	0.8838
Unknown Category	71676	0.0105	0.0000	0.0272	0.0000	0.7257
Financial Health						
Financial Slack	71676	0.2774	0.2631	0.2610	-3.9595	1.0000
Sales Growth	71676	0.2616	0.1047	0.8245	-0.9879	7.1644
Firm Age	71676	10.0785	8.0000	6.7989	2.0000	30.0000
Management Incentives						
LTIP - CEO	11512	0.0956	0.0000	0.4994	0.0000	31.2767
CEO Turnover	11512	0.2506	0.2000	0.1687	0.0667	1.0000
External Pressure						
Analyst Coverage	24346	1.4979	0.6931	1.7783	0.0000	6.7991
Earnings Response Coefficient	24346	2.1825	0.8672	4.4008	0.0000	151.8398
Activism Threat	24346	0.0324	0.0018	0.0852	0.0000	2.1111

Table 3. Explaining Implied Discount Rate (*IDR*): Firm Investment, Ownership and Financial Health

DV = *IDR*	**FE**	**RCM**		**FE**	**RCM**		**FE**	**RCM**	
		beta	sd		beta	sd		beta	sd
	(1)	(2a)	(2b)	(3)	(4a)	(4b)	(5)	(6a)	(6b)
Firm Investment									
R&D Intensity	0.00002	-0.00397	0.00266	0.00044	-0.00345	0.00236	-0.00104	-0.00396	0.00213
	(0.96306)	(0.00000)	(0.00000)	(0.36793)	(0.00000)	(0.00000)	(0.17830)	(0.00000)	(0.00000)
Advertising Intensity	-0.00528	-0.01358	0.08793	-0.00548	-0.01435	0.08948	-0.00314	-0.00718	0.13556
	(0.44735)	(0.00234)	(0.00000)	(0.43574)	(0.00140)	(0.00000)	(0.65858)	(0.19085)	(0.00000)
Capital Expenditure	-0.00984	-0.01313	0.02265	-0.00990	-0.01318	0.02256	-0.00575	-0.00808	0.02655
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00022)	(0.00000)	(0.00000)
Share Repurchase	0.00097	0.00136	0.00396	0.00086	0.00123	0.00395	0.00084	0.00125	0.00480
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Dividends	0.00361	0.00499	0.00613	0.00345	0.00487	0.00611	0.00336	0.00412	0.00554
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Institutional Ownership									
Transient				0.01042	0.00827		0.00816	0.00706	
				(0.00000)	(0.00000)		(0.00000)	(0.00000)	
Dedicated				-0.00963	-0.01065		-0.00922	-0.01230	
				(0.00000)	(0.00000)		(0.00000)	(0.00000)	
Quasi-Indexer				0.01079	0.00787		0.00351	0.00249	
				(0.00000)	(0.00000)		(0.00194)	(0.00015)	
Unknown category				-0.02309	-0.02519		-0.01627	-0.01287	
				(0.00000)	(0.00000)		(0.00001)	(0.00000)	
Financial Health									
Financial Slack							-0.00135	-0.00384	
							(0.01337)	(0.00000)	
Sales Growth							-0.00029	-0.00028	
							(0.00025)	(0.00076)	
Firm Age							0.00181	0.00065	
							(0.00000)	(0.00000)	
N (observations)	94377	94377		94377	94377		71676	71676	
N (groups)	10756	10756		10756	10756		8210	8210	
R-squared	0.25775			0.26459			0.29520		
Log likelihood		237137.55			237465.85			187208.55	
p-value (LR test vs. linear regression)		0.0000			0.0000			0.0000	
Chi-square		23175.63			23954.49			20368.21	

p-values in parentheses
All models include time period fixed effects.
FE = Fixed Effects Models; RCM = Random Coefficient Models.
Standard errors are clustered at the firm level in the fixed effects models.

Table 4. Explaining Implied Discount Rate (*IDR*): Management Incentives & External Pressure

	FE	RCM		FE	RCM		FE	RCM	
DV = *IDR*		beta	sd		beta	sd		beta	sd
	(1)	(2a)	(2b)	(3)	(4a)	(4b)	(5)	(6a)	(6b)
Management Incentive									
LTIP - CEO	-0.00041	-0.00043					-0.00051	-0.00050	
	(0.04041)	(0.07481)					(0.01842)	(0.03864)	
CEO Turnover	0.00457	-0.00141					-0.02463	-0.02366	
	(0.00243)	(0.20074)					(0.00000)	(0.00000)	
External Pressure									
Earnings Response Coefficient				0.00008	0.00005		0.00006	0.00004	
				(0.00156)	(0.00768)		(0.02245)	(0.14500)	
Activism Threat				0.00359	0.00306		0.00439	0.00309	
				(0.00000)	(0.00131)		(0.00005)	(0.03581)	
Analyst Coverage				0.00026	0.00065		-0.00077	-0.00023	
				(0.10394)	(0.00000)		(0.00620)	(0.10113)	
Firm Investment									
R&D Intensity	-0.00550	-0.01197	0.00338	-0.00063	-0.00378	0.00000	-0.00463	-0.01435	0.00382
	(0.02042)	(0.00003)	(0.00104)	(0.56384)	(0.00031)	(0.00000)	(0.22114)	(0.00002)	(0.00670)
Advertising Intensity	-0.02370	0.01429	0.12054	-0.01933	0.00158	0.13799	-0.02107	0.02989	0.18504
	(0.35186)	(0.20121)	(0.00000)	(0.14055)	(0.85672)	(0.00000)	(0.44432)	(0.06258)	(0.00000)
Capital Expenditure	-0.00569	-0.01289	0.01391	-0.00067	-0.00575	0.03583	-0.00367	-0.01293	0.03405
	(0.17411)	(0.00004)	(0.00000)	(0.80830)	(0.01555)	(0.00000)	(0.47479)	(0.00130)	(0.00000)
Share Repurchase	0.00058	0.00068	0.00269	0.00077	0.00081	0.00128	0.00057	0.00062	0.00174
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Dividends	0.00226	0.00322	0.00434	0.00227	0.00381	0.00415	0.00180	0.00295	0.00318
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00001)	(0.00000)	(0.00000)
Institutional Ownership									
Transient	0.00508	0.00703		0.00828	0.00781		0.00755	0.00713	
	(0.00406)	(0.00000)		(0.00000)	(0.00000)		(0.00000)	(0.00000)	
Dedicated	-0.01894	-0.02228		-0.01293	-0.01877		-0.01476	-0.01904	
	(0.00000)	(0.00000)		(0.00000)	(0.00000)		(0.00000)	(0.00000)	
Quasi-Indexer	-0.00712	-0.00128		-0.00523	-0.00382		-0.00492	-0.00174	
	(0.00038)	(0.17879)		(0.00001)	(0.00000)		(0.00296)	(0.11407)	
Unknown category	-0.04857	-0.03475		-0.00017	0.01092		-0.04593	-0.03298	
	(0.00000)	(0.00000)		(0.96761)	(0.00116)		(0.00000)	(0.00001)	
Financial Health									
Financial Slack	-0.00196	-0.00528		-0.00261	-0.00476		-0.00228	-0.00605	
	(0.33695)	(0.00000)		(0.03712)	(0.00000)		(0.35436)	(0.00000)	
Sales Growth	-0.00077	-0.00102		-0.00035	-0.00053		-0.00020	-0.00055	
	(0.05710)	(0.00041)		(0.04272)	(0.00146)		(0.72288)	(0.17833)	
Firm Age	0.00239	0.00072		0.00252	0.00081		0.00231	0.00083	
	(0.00000)	(0.00000)		(0.00000)	(0.00000)		(0.00000)	(0.00000)	
Intercept	-0.06229	-0.04329	0.00927	-0.06024	-0.04470	0.01259	-0.05431	-0.03772	0.01049
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
N (observations)	11512	11512		24346	24346		8901	8901	
N (groups)	1566	1566		3858	3858		1378	1378	
R-squared	0.36377			0.42421			0.37757		
Log likelihood		33418.514			69887.155			26281.409	
p-value (LR test vs. linear regression)		0.0000			0.0000			0.0000	
Chi-square		5505.73			12798.63			4367.79	

p-values in parentheses
All models include time period fixed effects.
FE = Fixed Effects Models; RCM = Random Coefficient Models.
Standard errors are clustered at the firm level in the fixed effects models.

Online Appendices for

"Are US firms becoming more short-term oriented? Evidence of shifting firm time horizons from implied discount rates, 1980-2013"

Rachelle C. Sampson & Yuan Shi

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Appendix A: Implied Discount Rate, Hurdle Rate, and Cost of Capital

In this section, we use an illustrative case to clarify the relationship among *x*, hurdle rates in net present value models, and a firm's cost of capital. This clarification will help reconcile observed trends of declining cost of capital with our findings. Suppose *NPV* represents the net present value of a typical project. The project has a return period of *T*. In each period, the expected net cash flow is *CF*. The net terminal value of the project, *TV*, is realized in the last period. The typical hurdle rate applied by the firm is *R*. For simplicity, we assume a two-period return structure ($T = 2$), though the case can be generalized to any longer period as well. A standard NPV formula for project valuation can then be written as:

$$NPV = \frac{CF}{1+R} + \frac{CF}{(1+R)^2} + \frac{TV}{(1+R)^2} \qquad \text{(A1)}$$

We then turn to a simple version of our main model to define the stock price of a given firm in a similar fashion. A typical investor pays the market price for the stock of the firm, *MP*, and expects to reap dividends, *D* in a total of *T* periods and a terminal price, *TP*, in the last period. In addition to the cost of capital denoted by *C* (i.e., the firm specific risk premium in Eq.(2) of the main paper plus a risk-free rate), the investor applies a firm-specific discounting rate of *x* to the valuation of the stock. Recall that our main measure in the paper, *IDR*, is a function of *x*. For straightforward comparison, we also assume $T = 2$. The stock price can then be expressed as:

$$MP = \frac{Dx}{1+C} + \frac{Dx^2}{(1+C)^2} + \frac{TPx^2}{(1+C)^2} \qquad \text{(A2)}$$

To derive the relationships among firm hurdle rate (*R*), cost of capital (*C*), and the additional discount rate (*x*), we assume the market price (*MP*) of the stock reflects the present value of the firm as an investment project (*NPV*).

$$MP = NPV \qquad \text{(A3)}$$

Thus Eq.(A1) and Eq.(A2) can be seen as representing the same valuation process. Using the right-hand side formulas of both, we can rewrite Eq.(A3) as:

$$\frac{CF}{1+R} + \frac{CF}{(1+R)^2} + \frac{TV}{(1+R)^2} = \frac{Dx}{1+C} + \frac{Dx^2}{(1+C)^2} + \frac{TPx^2}{(1+C)^2} \qquad \text{(A4)}$$

Eq.(A2) is a specific case of the NPV valuation models. Dividend (*D*) may be viewed as a specific case of net cash flow (*CF*) and terminal price (*TP*) a form of terminal value (*TV*). Thus, we can replace *D* with *CF* and *TP* with *TV* and simplify Eq.(A4):

$$\frac{CF}{1+R} + \frac{CF}{(1+R)^2} + \frac{TV}{(1+R)^2} = \frac{CFx}{1+C} + \frac{CFx^2}{(1+C)^2} + \frac{TVx^2}{(1+C)^2} \qquad \text{(A5)}$$

Moving all the terms to the left-hand side, we can rewrite Eq.(A5) as:

$$CF\left(\frac{1}{1+R}-\frac{x}{1+C}\right)+(CF+TV)\left(\frac{1}{(1+R)^2}-\frac{x^2}{(1+C)^2}\right)=0 \qquad \text{(A6)}$$

Because *CF*, *TV*, *R*, *C* and *x* are all greater than zero, the only solution to *x* in Eq.(A6) is:

$$x=\frac{1+C}{1+R} \qquad \text{(A7)}$$

The greater the hurdle rate (*R*) relative to the cost of capital (*C*), the lower *x* is (i.e., more discounting and higher *IDR*). This divergence between the hurdle rate and cost of capital may be driven in practice by firms refusing to lower hurdle rates applied to project financing decisions despite shrinking costs of capital in the current market (Mankins, Harris & Harding, 2017). More generally, we can predict declining *x* as long as *C* decreases faster than *R*, though this outcome may also be explained by rising hurdle rates (*R*). Whether the cost of capital is declining or hurdle rates are increasing (or both), *x* decreases as this wedge between *C* and *R* grows, meaning that the firm's expected future cash flows are more heavily discounted by investors. This greater discounting may be a response to the shrinking time horizons of managers inside the firm, as investors may take cues from a firm's internal discounting practice and price its stock accordingly.

Given the direct link between the rate at which future cash flows are discounted and the present value of more distant payoffs, *x* and, consequently, *IDR*, have direct implications for the time horizons of projects that a firm will accept. All things equal, lower *x* (i.e., greater discounting of future cash flows and higher *IDR*) implies that firms will favor strategies that yield more short-term performance.

Appendix B: Trends of Implied Discount Rate (IDR) by Industry

Figure B.1: Mean values of Implied Discount Rate (IDR) over time, by industry (NAICS 2 digit)

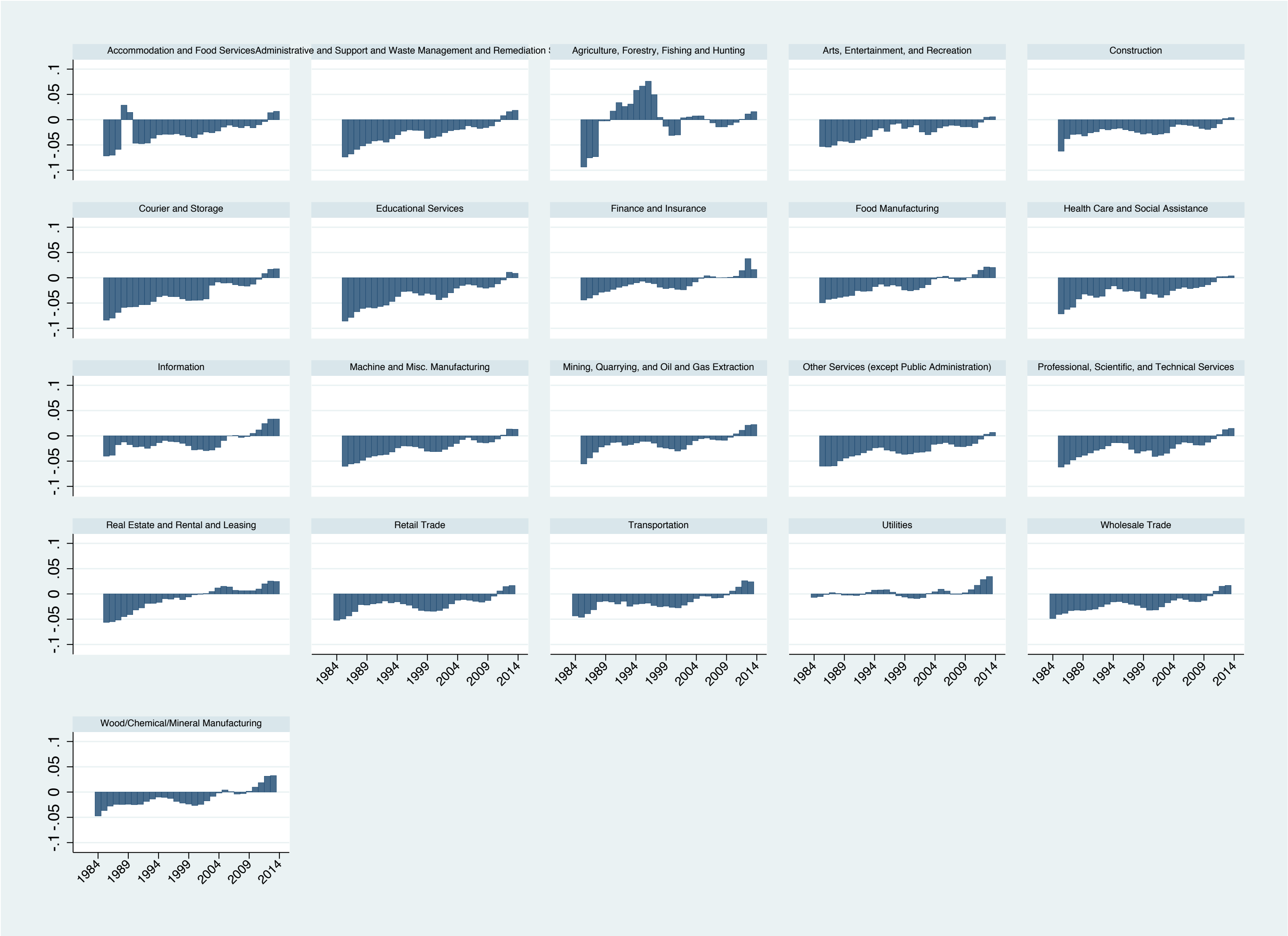
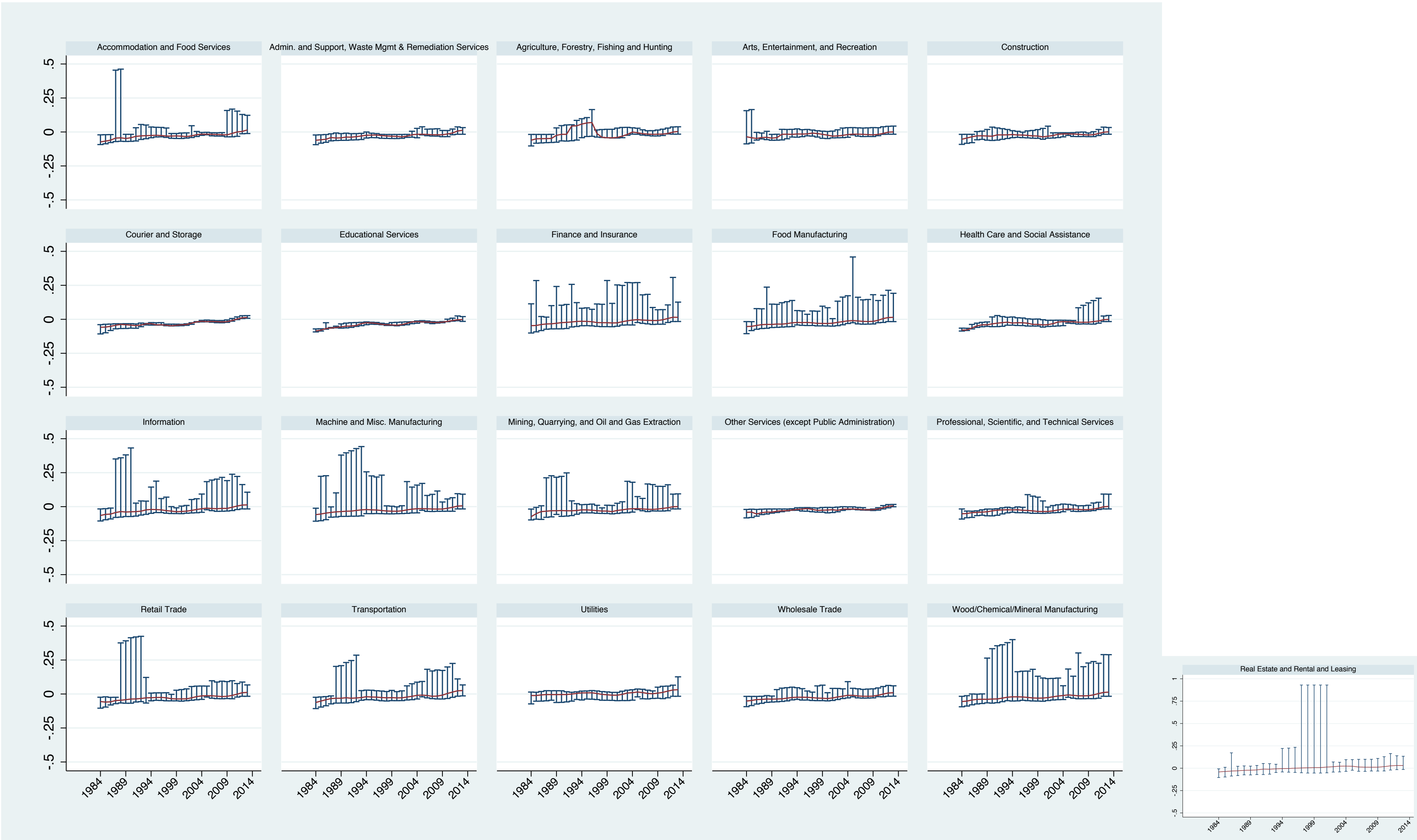


Figure B.2: Mean values and range of Implied Discount Rate (IDR) over time, by industry

(NAICS 2 digit industries, vertical lines represent the range of firm estimates within industry.)



Appendix C. Robustness Tests

Summary of Robustness Tests

Topic	Potential Concern	Robustness test approaches and results
Measurement:		
Assumptions on the valuation model	The dividend discount model estimated in Equation (3) relies on a specific worldview of how investors value stocks, imposing a particular structure of the relationship among share prices, cash flows and elements of discount rates. As such, the trend observed in Figure 1 may not hold under alternative assumptions.	We relax these assumptions by using a residual income valuation model developed by Gebhardt et al. (2001) to estimate implied discount rate. The advantage of this alternative model is that it does not rely on dividends but instead, analyst forecasts to project future cash flows. Details of this estimation are set out in Appendix D. The trend of the discount rate based on this alternative model is consistent with our main measure and is shown in Figure D.3, albeit with a substantially more limited sample size. Based on an anonymous reviewer's insightful comments, we also estimate an alternative version of our dividend discount model by considering both dividends and share repurchases as expected future cash flows and replicate a similar upward trend. Results of the subsample analysis based on firms' repurchase activities are also consistent.
Treatment of firms that do not issue dividends	*IDR* may not offer much information for firms that do not issue dividends, given that future cash flows are estimated via dividends.	Conceptually, for non-dividend issuing firms, the implied discount rate is applied to the future stock price only and Equation (3) assumes that investors will capture returns through future appreciation of the stock price. In these cases, there is still a firm specific component of the stock price that is not captured by the measurable components of the cost of capital (i.e., the risk-free rate and company specific risk premium), which is reflected in x. Specifically, we draw from the simplified model of Equation (15) in Miles (1993:1386) and can demonstrate that our empirical estimates provide a reasonable approximation of the theoretical value of x and incorporate speculated growth in the long-term. Empirically, we take several approaches to test for the sensitivity of our results to this concern. First, the Gebhardt et al. (2001) residual income valuation model uses analyst forecasts for cash flows instead of expected dividends to estimate implied discount rate. As noted above, the observed trend of the estimated implied discount rate, which is not conditioned on dividend payment, is highly consistent with our primary measure and is shown in Figure D.3. Second, we split our sample into dividend and non-dividend issuing firms and estimate two versions of the discount rate based on dividend status and results reflect similar trends. We also include dividends issued in our later regressions that correlate *IDR* with firm variables, to further control for any latent differences between dividend and non-dividend issuing firms. We find that the regression results are not sensitive to the inclusion of the dividends

		variable. We acknowledge that, like all other proxies, dividends do not capture expected cash flows perfectly. Still, these analyses suggest that our main findings are unlikely to be an artifact of dividend-based models.
Modeling of risk	Relevant risk proxies may not be included in Equation (2), leading the implied discount rate measure to capture omitted rising risk rather than investor time horizons.	If omitted risk factors are driving observed results, the trend will flatten or disappear once we account for additional risk factors used in more recent studies. We incorporate two additional risk factors, size and book-to-market equity (Fama & French, 1992), into our risk premium formula (Eq. (2)) and still find a similar trend, shown in Figure D.2. More details can be found in Appendix D. To address the possibility that unobserved risks resulted from a changing firm composition may drive the trend, we investigate a sample of firms that have been listed from 1980 to 2013 and find similar trends. Further, we do not find support for increasing risk as an alternative explanation. The trends of various risk-related proxies, including size, book-to-market equity, leverage, idiosyncratic risk, implied equity risk premium and VIX index have not been increasing. We also regress the implied discount rate measure on the firm variables in the Fama-French five-factor model along with leverage. The residuals of the regression still display an upward trend over time, indicating that such a trend is unexplained by the variance of those risk-related variables. Finally, we show that our regression results are robust to the inclusion of multiple risk proxies, such as size, profitability, leverage, and idiosyncratic risk.
Confounding time effects in estimation of x	As we only allow x in the model (Eq.3) to vary by firm over time, time varying factors that affect the relationship between the firm-specific risk premium and share prices may distort x.	We split the sample by time periods to generate a market-level estimate of x using the non-linear least-squares model. We find evidence of a similar trend to that shown in Figure 1. Note also that our market level results are consistent with past evidence of declining industry level discount rates (suggesting shortening time horizons) where a random coefficient model was not used (Miles, 1993; Davies et al., 2014).
Regression:		
Endogeneity	*IDR* may be either a consequence or a driver of firm-level strategic factors.	We re-estimate regression (1) in Table 3 in a cross section of newly listed firms. By capturing firms that were recently private, we are able to partially block any feedback effect of public market pressures on firm behavior. This more limited sample better isolates the effects of firm behavior on implied discount rate. Our main results are consistent with the results of the full sample analysis reported in the paper. Further details are reported in Table C.1.
Controls for uncertainty and	Macroeconomic factors, such as uncertainty and industry technology cycle, may partially determine investment horizon but are not accounted for in the	We run a high-dimensional fixed-effects regression by Correia (2017)[1] that simultaneously accounts for firm and industry-time fixed effects. Results, which are reported in Table C.2,

[1] Sergio Correia (2017) reghdfe: Stata module for linear and instrumental-variable/gmm regression absorbing multiple levels of fixed effects. Statistical Software Components s457874, Boston College Department of Economics. https://ideas.repec.org/c/boc/bocode/s457874.html

industry technology cycle	main model because they vary across both industry sector and time.	are substantively similar to those reported in Table 3 but weaker, which may be due to the loss of statistical power as additional fixed-effects are included in the model.
Controls for dividend policy	Our regression results reported in Tables 3 and 4 may be driven by the dividend-issuing firms, where *IDR* is more interpretable.	Following earlier studies (Miles, 1993; Davies et al., 2014), we do not restrict our sample to dividend-issuing firms only. We conduct three sets of analyses to test whether dividend policy alone may explain the results. First, we conduct the same analyses reported in Tables 3 and 4 on subsamples based upon whether the firm issues a dividend in the current period in Table C.3. Second, we further restrict the analysis to a smaller subsample of firms that have never issued dividends in any observed period in Table C.4. Finally, we re-estimated *IDR* on subsamples of dividend and non-dividend issuing firms (i.e., x is estimated on each subsample separately) and plot the subsample mean effects. Using this re-estimated *IDR*, we then conduct the same analyses in Tables 3 and 4 according to subsample and report the results in Table C.5. Most results are consistent across subsamples, with models for non-dividend subsamples reporting similar or higher value for R-squared and log-likelihood in most cases.
Outlier influence	*IDR* may not be precise enough to discern variation in time horizons for firms not situated in the far ends of the distribution. The influence of extreme cases, such as firms facing imminent restructuring, may drive results shown in Tables 3 and 4.	To explore the potential effect of outliers, we run the regressions without the top and bottom 5% of the firms in terms of implied discount rate and find stronger results in Table C.6. This suggests that outliers add noise to the sample, and that our measure is precise enough to discern differences among typical firms.
Selection bias	The results may be driven by firms that are able to offer investors quicker returns increasingly selecting into public capital market in recent years and thus do not indicate a universal trend for established firms.	We analyze a sample of established firms defined as those that have been listed since 1980 or earlier and report the findings in Table C.7. We expect this analysis to yield results distinct from Tables 3 and 4 if those results are due to firms entering the market exchanges more recently. Results are consistent with Tables 3 and 4 and thus do not support the explanation of selection bias. Findings are similar when we further restrict the sample to a fixed composition of firms that have been listed since 1980 through 2013.
Alternative measure for R&D	The ability to translate R&D into output may be more important for valuation than R&D investment.	We perform a supplemental analysis where we replace R&D intensity with Research Quotient (RQ), a measure of R&D productivity estimated by Knott (2008) in Table C.8. The advantage of this measure over other R&D output measures is that it does not rely on patents, which are not used by all R&D active firms. We find the relationship between RQ and implied discount rate is negative and highly significant. Other parameter estimates remain largely the same as our reported analysis.

Table C.1. Implied Discount Rate of Newly Listed Firms

DV = IDR	(1)	(2)	(3)	(4)
Firm Investment				
R&D Intensity	-0.00785	-0.00721	-0.00134	-0.00122
	(0.00000)	(0.00001)	(0.25895)	(0.30001)
Advertising Intensity	-0.05985	-0.05630	-0.01924	-0.01923
	(0.00000)	(0.00000)	(0.04063)	(0.04014)
Capital Expenditure	-0.03939	-0.03653	-0.01866	-0.01849
	(0.00000)	(0.00000)	(0.00000)	(0.00001)
Dividends	0.00620	0.00570	0.00412	0.00406
	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Institutional Ownership				
Transient		0.02632		0.02743
		(0.14307)		(0.04822)
Dedicated		-0.02022		-0.05155
		(0.36532)		(0.00155)
Quasi-Indexer		0.05635		0.00378
		(0.00175)		(0.76219)
Unknown category		0.18783		0.03421
		(0.07175)		(0.31980)
Intercept	-0.03834	-0.03953		
	(0.00000)	(0.00000)		
Industry × Time FE	N	N	Y	Y
N	2835	2835	2701	2701
R-squared	0.09618	0.11520	0.46866	0.47063

p-values in parentheses

OLS with robust standard errors in (1) and (2). HDFE reported in (3) and (4).

The sample is a cross-section of firms that are newly listed on NYSE/NASDAQ since 1981.

The dependent variable is measured in the period immediately after the first annual report is released to public investors.

Table C.2 High-Dimensional Fixed Effects Models

DV = IDR	(1)
Firm Investment	
R&D Intensity	-0.00065
	(0.40589)
Advertising Intensity	-0.00028
	(0.96812)
Capital Expenditure	-0.00387
	(0.00931)
Share Repurchase	0.00080
	(0.00000)
Dividends	0.00308
	(0.00000)
Institutional Ownership	
Transient	0.00857
	(0.00000)
Dedicated	-0.01017
	(0.00000)
Quasi-Indexer	0.00364
	(0.00105)
Unknown category	-0.01487
	(0.00003)
Financial Health	
Financial Slack	-0.00070
	(0.19139)
Sales Growth	-0.00021
	(0.00412)
Firm Age	0.00187
	(0.00000)
N of obs.	70697
N of groups	7237
R-squared	0.66587

p-values in parentheses
The model includes firm fixed effects and industry-time fixed effects.
Standard errors are clustered on the firm level.

Table C.3 Subsample Analysis Based on Dividend Status in Current Period

DV = IDR	FE		RCM			
Common stock dividend in current period?	Y	N	Y		N	
			beta	sd	beta	sd
	(1)	(2)	(3a)	(3b)	(4a)	(4b)
Firm Investment						
R&D Intensity	-0.01756	-0.00074	-0.01000	0.17613	-0.00211	0.00788
	(0.39486)	(0.06373)	(0.33080)	(0.00000)	(0.00037)	(0.00000)
Advertising Intensity	-0.02014	0.00391	-0.01274	0.45883	0.00470	0.06751
	(0.35541)	(0.04847)	(0.49894)	(0.00000)	(0.16293)	(0.00000)
Capital Expenditure	-0.00968	-0.00362	-0.01046	0.06862	-0.00658	0.03111
	(0.00377)	(0.00019)	(0.00103)	(0.00000)	(0.00000)	(0.00000)
Share Repurchase	0.00045	0.00107	0.00100	0.00542	0.00109	0.00135
	(0.00185)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Dividends	0.00288	-0.00017	0.00317	0.00465	0.00006	0.00173
	(0.00000)	(0.23145)	(0.00000)	(0.00000)	(0.59697)	(0.00000)
Institutional Ownership						
Transient	0.00626	0.01018	0.00805		0.00872	
	(0.00260)	(0.00000)	(0.00000)		(0.00000)	
Dedicated	-0.01320	-0.00453	-0.01495		-0.00799	
	(0.00010)	(0.00006)	(0.00000)		(0.00000)	
Quasi-Indexer	-0.00208	0.00799	-0.00091		0.00669	
	(0.26001)	(0.00000)	(0.41496)		(0.00000)	
Unknown category	-0.01735	-0.01003	-0.01535		-0.00733	
	(0.00241)	(0.00007)	(0.00022)		(0.00004)	
Financial Health						
Financial Slack	0.00026	-0.00282	-0.00230		-0.00374	
	(0.88010)	(0.00000)	(0.01994)		(0.00000)	
Sales Growth	-0.00118	-0.00015	-0.00084		-0.00012	
	(0.00001)	(0.00158)	(0.00113)		(0.00412)	
Firm Age	0.00225	0.00123	0.00101		0.00051	
	(0.00000)	(0.00000)	(0.00000)		(0.00000)	
Intercept	-0.04577	-0.04732	-0.04182	0.02826	-0.04780	0.00859
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
N of obs.	35222	36454	35222		36454	
N of groups	3982	5811	3982		5811	
R-squared	0.30260	0.44422				
Log likelihood			85282.314		122545.93	
p-value (LR test vs. linear regression)			0.0000		0.0000	
Chi-square			9561.58		24067.57	

p-values in parentheses
All models include time fixed effects.
FE = Fixed Effects Models; RCM = Random Coefficient Models.
Standard errors are clustered at the firm level in the fixed effects models.
The sample is split by whether a firm issues dividends in the current period, when implied discount rate is measured.

Table C.4. Subsample Analysis Based on Dividend Status of Any Period

DV = IDR	**FE**		**RCM**			
Common stock dividend in any period?	Y	N	Y		N	
			beta	sd	beta	sd
	(1)	(2)	(3a)	(3b)	(4a)	(4b)
Firm Investment						
R&D Intensity	-0.00237	-0.00041	-0.02103	0.11455	-0.00175	0.00681
	(0.36407)	(0.41326)	(0.00422)	(0.00000)	(0.00250)	(0.00000)
Advertising Intensity	-0.01196	0.00468	-0.02289	0.26734	0.00644	0.06455
	(0.40417)	(0.03379)	(0.06482)	(0.00000)	(0.08099)	(0.00000)
Capital Expenditure	-0.01135	-0.00270	-0.01358	0.06123	-0.00530	0.02815
	(0.00017)	(0.00649)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Share Repurchase	0.00067	0.00128	0.00114	0.00481	0.00125	0.00156
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Dividends	0.00339	-0.00032	0.00378	0.00463	-0.00026	0.00179
	(0.00000)	(0.06443)	(0.00000)	(0.00000)	(0.10235)	(0.00000)
Institutional Ownership						
Transient	0.00793	0.00948	0.00853		0.00801	
	(0.00000)	(0.00000)	(0.00000)		(0.00000)	
Dedicated	-0.01001	-0.00540	-0.01268		-0.00929	
	(0.00021)	(0.00006)	(0.00000)		(0.00000)	
Quasi-Indexer	-0.00037	0.00872	-0.00056		0.00725	
	(0.81706)	(0.00000)	(0.57216)		(0.00000)	
Unknown category	-0.01958	-0.00616	-0.01547		-0.00434	
	(0.00008)	(0.03857)	(0.00005)		(0.03746)	
Financial Health						
Financial Slack	-0.00066	-0.00223	-0.00334		-0.00328	
	(0.62870)	(0.00000)	(0.00004)		(0.00000)	
Sales Growth	-0.00134	-0.00012	-0.00115		-0.00011	
	(0.00001)	(0.00809)	(0.00000)		(0.00756)	
Firm Age	0.00211	0.00112	0.00075		0.00046	
	(0.00000)	(0.00000)	(0.00000)		(0.00000)	
Intercept	-0.04760	-0.04622	-0.04401	0.02132	-0.04692	0.00835
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
N of obs.	43715	27961	43715		27961	
N of groups	3762	4448	3762		4448	
R-squared	0.29292	0.42498				
Log likelihood			105908.83		94832.912	
p-value (LR test vs. linear regression)			0.0000		0.0000	
Chi-square			11995.51		17085.78	

p-values in parentheses
All models include time fixed effects.
FE = Fixed Effects Models; RCM = Random Coefficient Models.
Standard errors are clustered at the firm level in the fixed effects models.
The sample is split by whether a firm issues common stock dividends in any observable period.

Table C.5. Robustness Test with Implied Discount Rate Estimated from Subsamples

DV = IDR	Estimated from Dividend-Issuing Firms only			Estimated from Non-Dividend-Issuing Firms only		
	FE	RCM		FE	RCM	
		beta	sd		beta	sd
	(1)	(2a)	(2b)	(3)	(4a)	(4b)
Firm Investment						
R&D Intensity	0.00757	-0.00712	0.08953	-0.00033	0.00382	0.00512
	(0.35974)	(0.42576)	(0.00000)	(0.46512)	(0.00000)	(0.00000)
Advertising Intensity	-0.02099	-0.00036	0.53158	0.00963	0.01090	0.02968
	(0.34701)	(0.98648)	(0.00000)	(0.00016)	(0.00000)	(0.00000)
Capital Expenditure	-0.01052	-0.00974	0.07937	-0.00379	-0.00654	0.02336
	(0.00269)	(0.00412)	(0.00000)	(0.00033)	(0.00000)	(0.00000)
Share Repurchase	0.00057	0.00098	0.00484	0.00071	0.00086	0.00119
	(0.00006)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Dividends	0.00301	0.00272	0.00456	-0.00029	-0.00023	0.00137
	(0.00000)	(0.00000)	(0.00000)	(0.04781)	(0.05893)	(0.00000)
Institutional Ownership						
Transient	0.00262	0.00399		0.01249	0.01181	
	(0.17330)	(0.00718)		(0.00000)	(0.00000)	
Dedicated	-0.01452	-0.01718		-0.00977	-0.01569	
	(0.00001)	(0.00000)		(0.00000)	(0.00000)	
Quasi-Indexer	-0.00245	-0.00207		-0.00012	0.00100	
	(0.14981)	(0.04732)		(0.87980)	(0.05394)	
Unknown category	-0.01749	-0.01578		-0.00982	-0.00454	
	(0.00193)	(0.00005)		(0.00053)	(0.03741)	
Financial Health						
Financial Slack	-0.00080	-0.00217		-0.00277	-0.00234	
	(0.69564)	(0.03835)		(0.00000)	(0.00000)	
Sales Growth	-0.00113	-0.00081		-0.00005	0.00012	
	(0.00020)	(0.00355)		(0.38308)	(0.01308)	
Firm Age	0.00198	0.00088		0.00251	0.00031	
	(0.00000)	(0.00000)		(0.00000)	(0.00000)	
Intercept	-0.03934	-0.03300	0.02588	-0.05835	-0.06689	0.00534
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
N of obs.	33955	33955		37491	37491	
N of groups	3481	3481		5873	5873	
R-squared	0.29393			0.60973		
Log likelihood		84965.396			119798.44	
p-value (LR test vs. linear regression)		0.0000			0.0000	
Chi-square		8476.78			62364.37	

p-values in parentheses
All models include time fixed effects.
FE = Fixed Effects Models; RCM = Random Coefficient Models.
Standard errors are clustered at the firm level in the fixed effects models.
The dependent variable is estimated in two separate subsamples based on current dividend status.

Table C.6. Robustness Test of Outlier Influence

DV = IDR	FE	RCM	
		beta	sd
	(1)	(2a)	(2b)
Firm Investment			
R&D Intensity	-0.00008	-0.00119	0.00314
	(0.86751)	(0.02003)	(0.00000)
Advertising Intensity	0.00361	0.00190	0.09538
	(0.11284)	(0.58883)	(0.00000)
Capital Expenditure	-0.00226	-0.00407	0.03463
	(0.01528)	(0.00002)	(0.00000)
Share Repurchase	0.00081	0.00090	0.00127
	(0.00000)	(0.00000)	(0.00000)
Dividends	0.00290	0.00345	0.00374
	(0.00000)	(0.00000)	(0.00000)
Institutional Ownership			
Transient Ownership	0.00876	0.00885	
	(0.00000)	(0.00000)	
Dedicated Ownership	-0.00981	-0.01203	
	(0.00000)	(0.00000)	
Quasi-Indexer Ownership	0.00522	0.00481	
	(0.00000)	(0.00000)	
Other Ownership	-0.01470	-0.01266	
	(0.00000)	(0.00000)	
Financial Health			
Financial Slack	-0.00202	-0.00308	
	(0.00000)	(0.00000)	
Sales Growth	-0.00009	-0.00004	
	(0.04882)	(0.31958)	
Firm Age	0.00176	0.00077	
	(0.00000)	(0.00000)	
Intercept	-0.04830	-0.04787	0.01000
	(0.00000)	(0.00000)	(0.00000)
N of obs.	65184	65184	
N of groups	7984	7984	
R-squared	0.6023		
Log likelihood		212601.11	
p-value (LR test vs. linear regression)		0.0000	
Chi-square		59206.21	

p-values in parentheses
All models include time fixed effects.
FE = Fixed Effects Models; RCM = Random Coefficient Models.
Standard errors are clustered at the firm level in the fixed effects models.
The sample excludes top 5% and bottom 5% of the observations based on implied discount rate.

Table C.7. Robustness Test of Established Firms

DV = IDR	FE	RCM	
		beta	sd
	(1)	(2a)	(2b)
Firm Investment			
R&D Intensity	-0.00400	-0.02967	0.15951
	(0.60209)	(0.00593)	(0.00000)
Advertising Intensity	-0.02685	-0.03665	0.29479
	(0.24563)	(0.03647)	(0.00000)
Capital Expenditure	-0.00908	-0.00985	0.05814
	(0.01385)	(0.00443)	(0.00000)
Share Repurchase	0.00050	0.00105	0.00591
	(0.00104)	(0.00010)	(0.00000)
Dividends	0.00549	0.00521	0.00594
	(0.00000)	(0.00000)	(0.00000)
Institutional Ownership			
Transient Ownership	0.00760	0.00625	
	(0.00181)	(0.00089)	
Dedicated Ownership	-0.01000	-0.01153	
	(0.00826)	(0.00000)	
Quasi-Indexer Ownership	-0.00186	-0.00395	
	(0.41341)	(0.00358)	
Other Ownership	-0.01557	-0.01382	
	(0.11188)	(0.03005)	
Financial Health			
Financial Slack	-0.00329	-0.00455	
	(0.03398)	(0.00000)	
Sales Growth	-0.00100	-0.00100	
	(0.00001)	(0.00034)	
Firm Age	0.00189	0.00185	
	(0.00000)	(0.00000)	
Intercept	-0.05451	-0.05083	0.01760
	(0.00000)	(0.00000)	(0.00000)
N of obs.	26775	26775	
N of groups	2102	2102	
R-squared	0.26996		
Log likelihood		65599.996	
p-value (LR test vs. linear regression)		0.0000	
Chi-square		6237.31	

p-values in parentheses
All models include time fixed effects.
FE = Fixed Effects Models; RCM = Random Coefficient Models.
Standard errors are clustered at the firm level in the fixed effects models.
The sample includes only firms that have been listed on stock exchange since 1980 or earlier.

Table C.8. Analysis of Research Quotient and Implied Discount Rate.

DV = IDR	OLS	FE	RCM		FE	RCM	
			beta	sd		beta	sd
	(1)	(2)	(3a)	(3b)	(4)	(5a)	(5b)
Research Quotient	-0.02273	-0.00668	-0.01575	0.13841	-0.00701	-0.02135	0.14660
	(0.00000)	(0.06025)	(0.00015)	(0.00000)	(0.05128)	(0.00000)	(0.00000)
Firm Investment							
Advertising Intensity					0.00444	0.00056	
					(0.49114)	(0.90839)	
Capital Expenditure					-0.00869	-0.01490	
					(0.09365)	(0.00000)	
Share Repurchase					0.00066	0.00059	
					(0.00006)	(0.00000)	
Dividends					0.00358	0.00352	
					(0.00000)	(0.00000)	
Institutional Ownership							
Transient Ownership					0.00946	0.00718	
					(0.00000)	(0.00000)	
Dedicated Ownership					-0.00986	-0.01567	
					(0.03716)	(0.00000)	
Quasi-Indexer Ownership					0.00128	0.00271	
					(0.44568)	(0.01100)	
Other Ownership					-0.00528	-0.00421	
					(0.43771)	(0.35007)	
Financial Health							
Financial Slack					-0.00215	-0.00353	
					(0.20685)	(0.00005)	
Sales Growth					-0.00142	-0.00100	
					(0.00000)	(0.00140)	
Firm Age					0.00208	0.00063	
					(0.00000)	(0.00000)	
Intercept	-0.02496	-0.05372	-0.05251	0.02397	-0.05275	-0.04858	0.02269
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
N of obs.	24560	23140	23140		21911	21911	
N of groups		2852	2852		2764	2764	
R-squared	0.00423	0.29594			0.31269		
Log likelihood			58874.934			56672.581	
p-value (LR test vs. linear regression)			0.0000			0.0000	
Chi-square			8461.44			9182.28	

p-values in parentheses
FE = Fixed Effects Models; RCM = Random Coefficient Models.
Standard errors are clustered at the firm level in the fixed effects models.
Research Quotient is a measure of R&D productivity (Knott, 2008).

Appendix D: Alternative Measures of Implied Discount Rate (IDR)

Appendix D.1: Modeling Risk Premia with Fama-French Risk Factors

A potential criticism of the findings is that the decline in *x* (and rise in *IDR*) over time may be explained by systematic risk factors omitted in the original model. To account for additional factors that may systematically change firm risk,[2] we introduced two Fama-French risk factors, size and book-to-market ratio, to the firm-specific risk premium function (Fama & French, 1992). Specifically, in Eq.(2) in the paper, we modeled risk premium for firm *j* in year *t* as a function of beta β and company gearing *Z*. The equation is thus rewritten as:

$$\pi_{jt} = \alpha_1\beta_{jt} + \alpha_2 Z_{jt} + \alpha_3 MV_{jt} + \alpha_4 BM_{jt} \quad \text{(D1)}$$

Following Chen et al. (2011), market value, *MV*, is defined as the logged product of the number of shares outstanding and equity price for firm *j* in year *t*. Book-to-market ratio, *BM*, equals the logged term of book value per share over equity price. Substituting Eq.(D1) above into Eq.(3) in the paper, the equation that incorporates the Fama-French factors is:

$$P_{jt} = \frac{(D_{jt})\boldsymbol{x_{jt}}}{\left(1+r_t+\alpha_1\beta_{jt}+\alpha_2 Z_{jt}+\alpha_3 MV_{jt}+\alpha_4 BM_{jt}\right)} + \frac{(D_{jt})\boldsymbol{x_{jt}}^{2}}{\left(1+r_t+\alpha_1\beta_{jt}+\alpha_2 Z_{jt}+\alpha_3 MV_{jt}+\alpha_4 BM_{jt}\right)^2} + \cdots + \frac{(D_{jt}+P_{jt})\boldsymbol{x_{jt}}^{N}}{\left(1+r_t+\alpha_1\beta_{jt}+\alpha_2 Z_{jt}+\alpha_3 MV_{jt}+\alpha_4 BM_{jt}\right)^N} + \varepsilon_{jt} \quad \text{(D2)}$$

The other model specifications follow the original measure. We dropped extreme values due to the complexity of the non-linear estimation.[3] For simplicity, we used the NYSE/AMEX sample only. To probe the consistency between the two measures, we plotted them in Figure D.1 and find that the two measures are highly correlated (corr. = 0.68). Nevertheless, the alternative measure demonstrates poorer model fit with past investment and ownership (AIC = -88906.38 vs. -113409.7 with the original measure). Further, Figure D.2 shows very similar patterns of *IDR* over time between our original model based on Eq.(3) in the original paper and the modification that includes the Fama-French factors described above. *IDR* that includes the Fama-French factors rises in the

[2] As an additional test of whether increased risk explains the trend that we observe in *IDR*, we regressed *IDR* on leverage and the firm characteristics in Fama and French's (2015) five-factor model. The residual of the regression, therefore, is the component in our measure that remains unexplained by the variance of these factors. This residual displays a very similar trend to *IDR* in Figure 2, suggesting that increased risk as captured by these additional factors does not explain Figure 2. Further, other risk measures, such as idiosyncratic risk (Bartram, Brown and Stultz, 2018) and the volatility index (VIX), do not display an increasing time trend over the period of our sample. Finally, rising risk aversion also does not appear to explain the trend observed in Figure 2; the implied equity risk premium has not increased over the sample period (Damodaran, 2016). These additional checks are described in Table 5 in the main paper.

[3] Specifically, we dropped 599 (0.11%) cases in which stock price is greater 1000 (vs. 99% quintile: 99.5), dividends are larger than 100 (vs. 99% quintile: 3.09), or gearing is higher than 100 (vs. 99% quintile: 22.9).

1980's, followed by a dip that corresponds with the dot-com bubble and fluctuations before a sharp increase towards the end of our sample period. The divergence between the two models starting in the early 2000's may be driven by the changing influence of size and firm strategy (specifically, value versus growth in this context) on company specific risk premia. However, despite this divergence, we note that the fluctuations over time are largely identical between the two estimates.

Figure D.1: Scatterplot of original estimate against estimate containing Fama-French factors

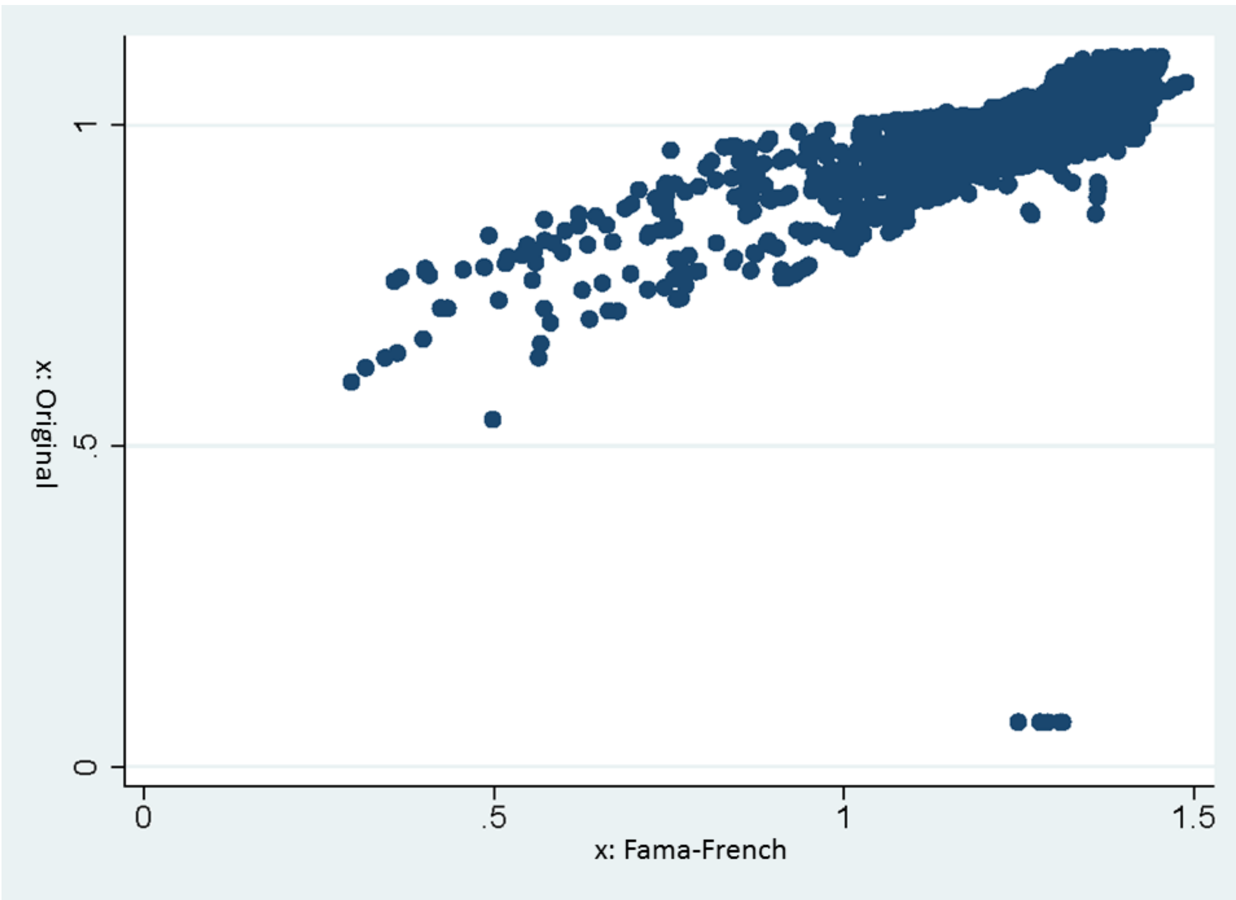
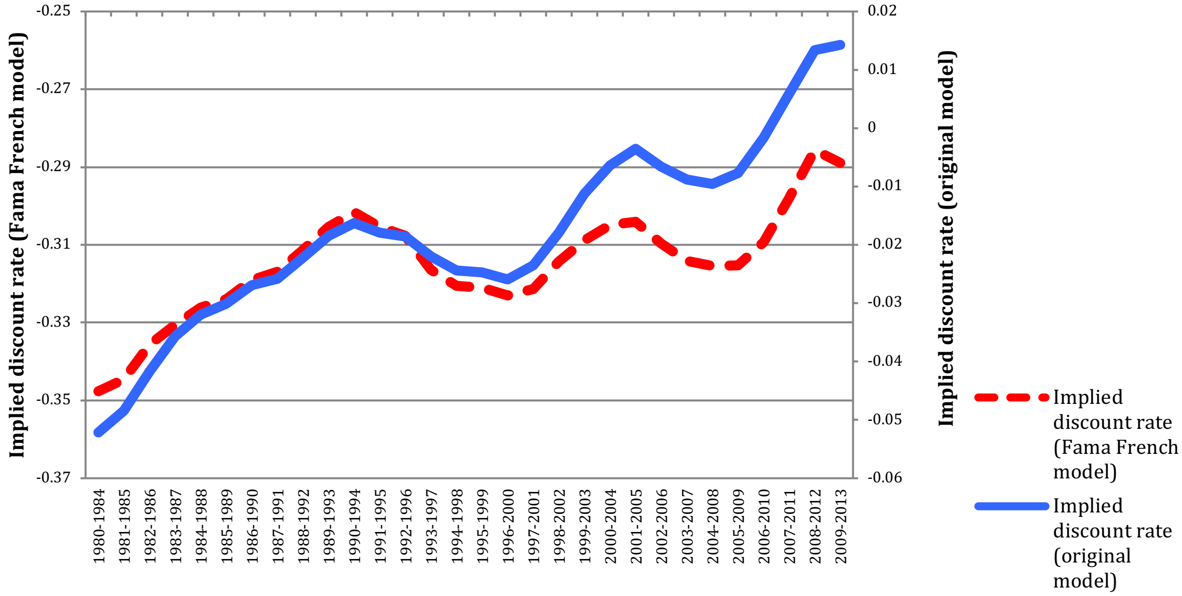


Figure D.2: Implied discount rate mean values, original model and including Fama-French factors



Implied discount rate (*IDR*) for firms listed on the NYSE/AMEX against an alternative implied discount rate (*IDR*) measure that includes Fama-French factors as described above.

Appendix D.2: Estimation of Discount Rate with Residual Income Model

The second potential criticism of the model is that the bulk of future cash flows sought by investors is not in the form of dividends. If so, then the discount rate trend that we display (from dividend-based models) may not reflect broader market preferences.[4] To address this concern, we estimate an implied discount rate based on analyst forecasts of future earnings, rather than expected dividends and future share price. We begin by estimating the implied cost of equity based on Gebhardt et al.'s (2001) residual income valuation model. Compared to the dividend discount model, this model has the advantage of a more generalizable theory of stock returns that does not depend upon dividend policy. However, the model's reliance on analysts' forecast of future earnings, which is only available for some public firms over a limited time horizon, places a severe empirical constraint on its applicability to a market-wide test. While earnings forecasts are collected for five future years, forecasts beyond year three are missing for most reported firms. Thus, our estimate based on analyst forecasts uses a three-year time horizon, rather than the five-year horizon applied above. Further, note that this approach does not consider firm specific risk (i.e., the company specific risk premium included in our focal estimation).

[4] We have also addressed a more specific critique, namely that the original model only applies to non-dividend paying firms in the robustness checks. This section is to address a more general criticism that using dividends as future cash flows is not general enough for the whole market.

Following Gebhardt et al. (2001) and Chen et al. (2011), we estimate the following equation for firm *i* in year *t*:

$$P_{it} = B_{it} + (FROE_{it+1} - r_{it}) * \frac{B_t}{1+r_{it}} + (FROE_{it+2} - r_{it}) * \frac{B_{t+1}}{(1+r_{it})^2} + (FROE_{it+3} - r_{it}) * \frac{B_{t+2}}{(1+r_{it})^2 * r_{it}} \qquad \text{(D3)}$$

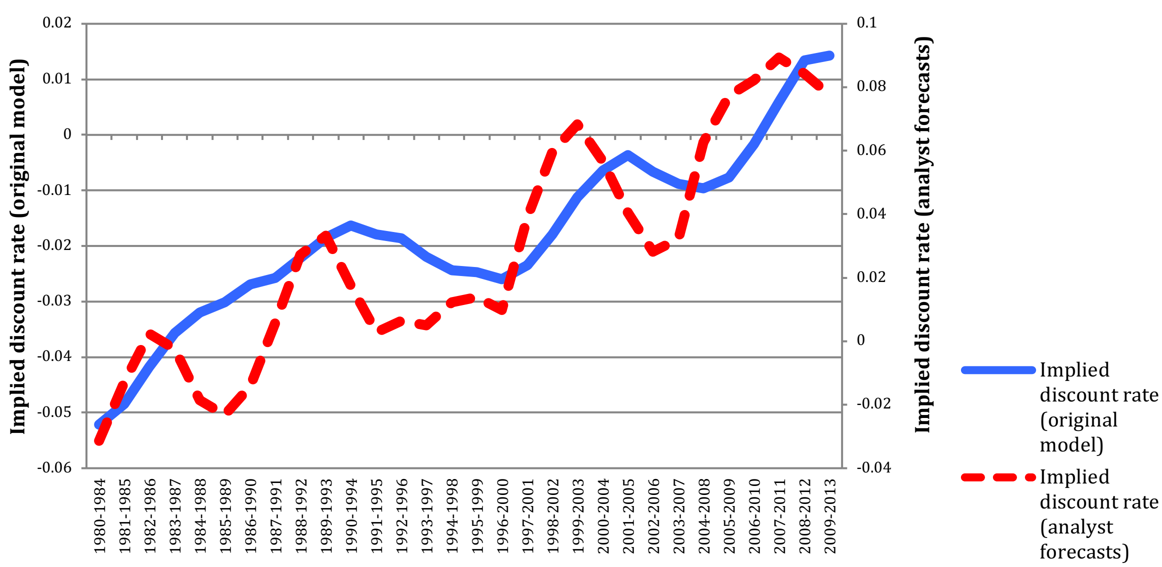
In this equation, price *P* is modeled as the present value of the streams of residual income, with *r* being the key discount rate we estimate. Additionally, *B* represents book value of equity, and *FROE* is the forecast future return on equity. We assume a three-year return period in the model due to more limited availability of analyst forecasts beyond three years. While cost of equity, *r*, is estimated by solving Eq.(D3) for a given firm each year in Gebhardt et al.'s (2001) work, we use a non-linear random-coefficient model that accounts for information from the other firms in the market to estimate the firm-specific cost of equity (*r*) in a rolling, five-year window. This is consistent with the estimation technique used for our main measure.

We largely follow Gebhardt et al.'s (2001) approach in variable construction, except for cases where earnings forecasts are missing. Instead of imposing the assumption of mean reversion on the long-term forecast from the industry level (as used in Gebhardt et al., 2001), we used the firm-specific forecast of the long-term growth rate and the most recent earnings forecast available to extrapolate the earnings forecast in the missing forecast period. For example, assume that the 3-year earnings forecast is missing for a firm, but the 1-year earnings forecast is $1 per share and is the only earnings forecast available. If the forecast long-term growth rate is 2% for the firm, we would impute the value of $1*(1+0.02)^2$ = $1.04 per share as the 3-year earnings forecast. Additionally, in cases where long-term growth is missing, we assumed a growth rate of zero and used the original value of the most recent earnings forecast.

We use analyst forecast data on NYSE (AMEX) and NASDAQ firms from I/B/E/S and fundamentals data from Compustat over the period of 1980-2013 for our calculation. To ensure that valuation is only based on the latest information that is available to the public, we only retained the forecasts that are issued immediately after the fundamentals are reported and the market price immediately after the forecasts are issued. In cases where all forecasts for the next year are made before fundamentals for the current year are reported (7% of the observations), the most recent forecast was retained. We drop outliers, defined as observations with: i) stock price > $1000; ii) absolute value of forecast book value per share (*B*) > 100; or iii) absolute value of *FROE* > 100; or iv) absolute value of company gearing > 100. We then deduct the risk-free rate for year *t* (i.e., the rate used in our original model) from the firm-specific estimate *r* in year *t* to obtain the firm-specific risk premium, r_{prm}. To enable comparison with the implied discount rate measure, we use $(1 - 1/1+r_{prm})$ in the yearly plot.

Figure D.3 displays our original *IDR* measure graphed against an estimate of discounting based on analyst forecasts. Here, the trend of the discount based on analyst forecasts is rising but shows greater volatility than our original measure. This volatility is likely a result of two factors: 1) the much smaller sample represented in the analyst forecast measure; and 2) that the measure is based on consensus analyst forecasts (i.e., the mean of all estimates in that time frame), which vary in accuracy over time, since analysts influence each other's beliefs and have been observed to be collectively wrong about some securities that they cover (Rao, Greve and Davis, 2001; Bowers, Greve, Mitsuhashi and Baum, 2014). While the differences between the various estimates of *IDR* raise interesting questions regarding how inclusion of different firm measures influences the relationship among firm fundamentals, interest rates and stock prices, the relevance for our purposes of Figures D.2 and D.3 lies in their corroboration of the *IDR* trend over time. *IDR*, employing both different specifications and, in some cases, entirely different sources of information on future firm expectations, shows an unambiguous, overall increase from 1980 to 2013.

Figure D.3: Implied discount rate mean values, original model and model based on analyst forecasts



Implied discount rate (*IDR*) for firms listed on the NYSE/AMEX against an alternative implied discount rate (*IDR*) measure based on analyst estimates as described above.

References

Bartram, S. M., Brown, G. W., & Stulz, R. M. (2018). Why Has Idiosyncratic Risk Been Historically Low in Recent Years? *NBER Working Paper No. w24270*.

Bowers, A. H., Greve, H. R., Mitsuhashi, H., & Baum, J. A. (2014). Competitive parity, status disparity, and mutual forbearance: Securities analysts' competition for investor attention. *Academy of Management Journal*, *57*(1), 38-62.

Chen, K. C., Chen, Z., & Wei, K. J. (2011). Agency costs of free cash flow and the effect of shareholder rights on the implied cost of equity capital. *Journal of Financial and Quantitative Analysis*, *46*(1), 171-207.

Correia, S. (2017). reghdfe: Stata module for linear and instrumental-variable/gmm regression absorbing multiple levels of fixed effects. Statistical Software Components s457874, Boston College Department of Economics. Retrieve from https://ideas.repec.org/c/boc/bocode/s457874.html

Damodaran, A. (2016). *Damodaran on Valuation: Security Analysis for Investment and Corporate Finance*. John Wiley & Sons. Hoboken, NJ.

Davies, R., Haldane, A. G., Nielsen, M., & Pezzini, S. (2014). Measuring the costs of short-termism. *Journal of Financial Stability*, *12*, 16-25.

Fama, E. F., & French, K. R. (1992). The cross‐section of expected stock returns. *Journal of Finance*, *47*(2), 427-465.

Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *Journal of Financial Economics*, *116*(1), 1-22.

Gebhardt, W. R., Lee, C. M., & Swaminathan, B. (2001). Toward an implied cost of capital. *Journal of Accounting Research*, *39*(1), 135-176.

Knott, A. M. (2008). R&D/returns causality: Absorptive capacity or organizational IQ. *Management Science*, *54*(12), 2054-2067.

Mankins, M., Harris, K., & Harding, D. (2017). Strategy in the Age of Superabundant Capital. *Harvard Business Review,* March-April.

Miles, D. (1993). Testing for short termism in the UK stock market. *Economic Journal*, *103*(421), 1379-1396.

Rao, H., Greve, H. R., & Davis, G. F. (2001). Fool's gold: Social proof in the initiation and abandonment of coverage by Wall Street analysts. *Administrative Science Quarterly*, *46*(3), 502-526.