Are US firms and markets becoming more short-term oriented? Evidence of shifting firm and investor time horizons, 1980-2013

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Abstract:

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

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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 (see, e.g., Pozen 2015). Daniel Vasella, former chairman and CEO of Novartis AG, described short-term pressures during his time as CEO and the implications for firm investment behavior (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 both public firms and their investors are shifting to favor short over long-term returns. Empirical research provides some support for this inference at both the firm and market level. Surveys confirm that firms apply investment hurdle rates higher than suggested by the cost of capital (Porterba and Summers, 1995)[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 firm behavior is reflected in financial markets; at the industry level, investor time horizons appear to be contracting (Miles 1993; Davies, Haldane, Nielsen and Pezzini 2014).

Despite widespread perceptions that firms and investors are becoming increasingly impatient, there are reasons to question whether both have become more short-term oriented. For example, price earnings ratios are at historic highs (see, e.g., Kaplan 2017), suggesting greater investor optimism about long-term growth. 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 investor time horizons are changing over time. We then link any observed trends with past firm behavior and characteristics to reveal underlying heterogeneity. Specifically, we seek to answer three questions: are firms and financial markets becoming more short-term oriented? Within any time period, (how) do market time horizons reflect firm characteristics and behavior? Do markets view similar strategies by firms differently? Thus, we

[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 (Porterba and Summers 1995). More recently, Mankins, Harris and Harding (2017) also show that firms apply investment hurdle rates higher than the cost of capital.

seek to answer not only whether and how time horizons are changing for firms and investors, but also whether similar strategies are viewed by investors as equally valuable across firms.[2]

Answers to these questions are critical to understanding how markets view firm strategy, further clarifying the broader influence of financial markets on firm behavior. Several recent works highlight increasing linkages between financial markets and firm strategy; Davis (2009) documents how firms have made a fundamental transformation from bank financing to market financing with the result that firms seek more rapid returns in investments. Foroohar (2016) similarly shows an increasing firm focus on balance sheet manipulations instead of value creation, adding to the growing literature arguing the influence of financial markets on firm strategy (e.g., Benner and Ranhanathan, 2013; Davis, 2009; Polk and Sapienza, 2009; Brandenburger and Polak, 1996). We do not address how financial markets impact future firm behavior here, but instead focus our efforts on documenting the extent to which investor time horizons are changing over time, how these time horizons vary by firm and are influenced by past firm behavior. We then go beyond these empirical observations to forge logical and empirical links between investor and firm time horizons, a starting point for a deeper examination of the relationship between firm strategy and financial markets. Providing such evidence is critical to resolving the debate around short-termism and moving onto a deeper exploration of implications for the role of time in firm strategy, which is likely heterogeneous between firms.

To investigate this phenomenon empirically and get a tangible sense of the general, but elusive, perception of changing investor time horizons, we estimate how markets discount future firm returns. Specifically, we generalize an implied market discounting rate to the firm level to capture how much investors discount future dividends and values of US public firms, from 1980-2013. This measure has been previously estimated at the overall market and industry level to examine discounting trends in the UK and the US to a more limited extent (Miles 1993; Davies, Haldane, Nielsen and Pezzini 2014). We also estimate alternative measures, including one based instead on analyst earnings forecasts in future periods,[3] and conduct extensive robustness tests to ensure the validity of our reported trends. Our firm level measures allow us to go beyond the previous analyses to not only establish market-wide trends, but also to reveal sources of firm heterogeneity in market

[2] Thus, we add to the literature revealing that strategy effectiveness depends upon the identity of the firm (see, e.g., Knott, 2008; Chung and Alcacer, 2002).

[3] This measure is adapted from Abarbanell and Bernard (2000) and Gebhardt, Lee and Swaminathan (2001).

discounting not explained by market-wide indicators, providing richer information to interpret identified trends and define implications for firm strategy.

Controlling for firm and time effects, we find evidence consistent with contracting investor 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 over time, important shifts occur. Firms are discounted more heavily by the market following economy wide shocks, such as the dot-com bubble of 1999-2000 and the financial crisis of 2007-2008.[4] 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.

In addition to the general trend shown, we observe significant heterogeneity among firms in terms of how markets discount their future returns. To explore this heterogeneity and better assess market discounting as a measure of time horizons, we estimate the relationship of market discounting with measures thought to proxy for firm time horizons. These measures include a firm's long-term investments, ownership, and management incentives as well as proxies for short-term pressures in the prior period. Results are consistent with expectations; for example, firms that make more long-term investments, in areas such as R&D and capital are discounted less than those firms investing less. Increasing share repurchases and dividends correlates with increased discounting, further corroborating the link between time horizons and our market discounting measure, since such spending is thought to be a direct substitute for longer-term investments.

Using random coefficient models, we also find that these investment effects differ meaningfully between firms. For example, on average, firms investing in R&D are discounted by the market less than those firms that do not invest, but the correlation of market discounting with R&D investment varies by firm. This finding raises important questions about why some firms are given a longer leash to pursue longer-term and sometimes more uncertain returns, while others are penalized by investors for similar decisions. While fully resolving this puzzle is beyond the scope of the paper, we provide several profiles of more or less discounted firms and their investment behavior that both help reveal the links between firm strategy and market time horizons as well as explaining why firms with seemingly similar investment strategies are viewed very differently by investors.

Long-term ownership and short-term external pressures also matter; firms held by more transient institutional owners (i.e., those that are characterized by high share turnover) and in

[4] Some attribute the financial crisis at least in part to excessive short-term thinking. Former FDIC Chairman Sheila Bair notes in her remarks to the National Press Club, "the overarching lesson of the crisis is the pervasive short-term thinking that helped bring it about," 24 June 2011.

industries where shareholder activism is more likely are more discounted. We also find that investors are likely to have a short-term outlook for firms when their share prices are relatively more responsive to earnings news (i.e., a high earnings response coefficient). In contrast, long-term CEO compensation packages, an indicator of long-term oriented management, are correlated with lower market discounting. 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 provide further support for our broad findings. Taken together, these empirical links are largely consistent with expectations from earlier research on the firm-level determinants of time horizons; this supports our central thesis that the market discounting rate is a meaningful proxy for investor time horizons, which, we argue, reflects firm time horizons.

We begin below by evaluating existing evidence of shortening investor time horizons and how this may reflect past firm choices and characteristics. From this, we establish empirical priors for what correlates with investor time horizons thus driving our choice of factors to corroborate our measure of investor time horizons, market discounting. A detailed discussion of our data, measure constructions and descriptive statistics that highlight trends in market discounting over time follow. We then examine the relationship between market discounting and firm behavior and characteristics thought to correlate with firm time horizons. We follow this analysis with descriptive firm illustrations, an in-depth discussion of results and implications, concluding with limitations and future directions. Empirical robustness tests, as well as theoretically developed links of our market discounting measure with both firm investment hurdle rates and time horizons, are set out in the appendices.

2. Investor time horizons: trends & firm heterogeneity

Obtaining evidence of whether investor time horizons are shifting and how these horizons vary by firm is challenging, given that direct measures of investor time preferences are not readily available. However, simple inferences on time horizon trends are possible from observing investor behavior. For example, declining stock holding periods – from seven years in 1940 to less than one year by 2000 (Haldane, 2010) - imply shrinking time horizons on average, since shorter-term holdings translate into impatience for returns and downward price pressure on firms whose short-term metrics do not meet expectations.

Further, there has been a 'virtual revolution in ownership', where institutional holdings have overtaken retail holdings; direct holdings are down from 92% in 1950 to only 32% in 2006, while shareholdings of large financial institutions grew over the same time from 8% to 68% (Bogle, 2006).

By 2009, these institutional owners held 73% of the equity of the top 1000 US companies (Gilson and Gordon, 2013; Barton and Wiseman, 2014). Survey evidence reveals that significant percentages of fund managers - one third of NAPF[5] and two thirds of IMA[6] members – believe that their investment mandates encourage short-term behavior (MORI, 2004). That holding periods are collapsing, shares are increasingly held by funds rather than retail investors and fund managers feel pressure to realize short-term targets are strong, albeit indirect, indicators of shortening investor time horizons.

A more targeted approach to capturing investor time horizons in the financial economics literature is to estimate how markets value a firm's expected future cash flows (e.g., Miles, 1993; Davies, Haldane, Nielsen and Pezzini, 2014). These industry level studies estimate a market discount factor and show that markets are increasingly discounting firms in the UK (and the US with a more limited sample). For example, Davies et al (2014) find that markets increasingly discount the future dividends and values of firms, discounting by five to ten percent over typical discounting via the risk-free rate and a company specific risk premium (i.e., the expected rate of return for a company over and above the risk free rate). Any excessive discounting increases the value of short-term payoffs relative to long-term, suggesting that investors prefer stocks with more rapid payoffs, even if the total payoff over the longer term is greater via investments in different firms.[7] Abarbanell and Bernard (2000) take a different approach, estimating at the market level how stock prices are correlated with analyst forecasted earnings in future time periods. They find that coefficients on near term earnings are heavily weighted compared to more distant future periods.

To better evaluate the firm strategic implications of investor time horizons, we go beyond the earlier, industry and market level work to estimate firm-level, market discount factors. We adopt both the Davies et al (2014) and Abarbanell and Bernard (2000) measures, with modifications, and estimate market discounting via two distinct approaches to approximating future firm cash flows (i.e., dividends and earnings). With these measures as well as alternatives to ensure robustness, we track how market discounting moves over time as an indicator of investor time horizons. We

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5 National Association of Pension Funds.

6 Investment Management Association.

7 Davies et al (2014) demonstrate the economic impact of this additional discounting, via a numerical example. Assume an investment that costs $60 up front and pays $10 in dividends at the end of each year. Under typical discounting (i.e., based on the rate of return for a company), payback occurs in year 9 and the net present value of the project is $61. Under an additional discount of 5%, the payback does not occur until year 15 and under an additional discount rate of 10%, the payback is never achieved (Davies et al, 2014:p.20, 22). The implications are straightforward; with more significant discounting, many investments are not made, even those with significant rates of return over the longer term. In Appendix A, we undertake a related exercise, estimating the investment time horizon implied by different market discounting rates.

anticipate, however, significant heterogeneity on how markets discount firms even within the same industry. Given the increasing influence of financial markets on firm strategy, understanding how markets view differences between firms and how this translates into investor time horizons for that firm is critical. Thus, we also explore how market discounting correlates with several categories of firm characteristics that likely influence the market's view of a firm's likely payoff horizons: a firm's long-term investments and financial health, long-term ownership, long-term management incentives as well as proxies for short-term pressures in the prior period. Several studies use these firm characteristics and behavior as a signal for time horizons.[8] By linking these observed characteristics with the market discounting rates estimated below, we can not only reveal underlying heterogeneity but also identify the extent to which market discounting captures investor and firm time horizons. Analogous to Knott (2008) and Chung and Alcacer (2002), we also seek to expose heterogeneity in market discounting between firms pursuing similar strategies.

Past research has used a firm's long-term investments as a proxy for firm time horizons, examining the links between investments that typically have a long-term payoff and mechanisms that influence firm preferences for long-term payoffs. For example, Flammer and Bansal (2017) find that firms more likely pursue investments in R&D and corporate social responsibility - investments with relatively longer-term payoffs - when the firm takes a longer-term orientation, proxied via adoption of long-term CEO compensation packages. This is consistent with earlier research; Larcker (1983) finds that managers increase capital investments after firms adopt long-term compensation schemes. Desjardine (2015) similarly finds that firms make greater investments in durable assets when they are better able to take a longer-term perspective, in this case due to loss of analyst coverage. Pressure to meet analysts' presumed preferences for short-term investments with more certain payoffs is the hypothesized reason for this link between analyst coverage and preferences around time horizons (e.g., Benner, 2010). Martin, Wiseman & Homez-Mejia (2016) add to this evidence, showing a positive correlation between longer-term durables investment and CEO incentives that encourage a longer time horizon.

The relative financial strength of a firm is also an important source of heterogeneity in time horizons, since financial health influences a firm's ability to make investments with different payoff schedules. Using investments with distinctly different payback periods for cable television operators, Souder and Shaver (2010) find that firms with greater financial slack more likely make long-term

[8] This literature is extensive and includes Flammer and Bansal (2017), Souder and Shaver (2010), Marginson and McAulay (2008), and Larcker (1983).

investments. Financial strength increases the likelihood of survival and, thus, the opportunity to benefit from longer-term investments. Similarly, when firms are more financially constrained because of returning cash to shareholders, longer-term investments decline. Almeida, Fos & Kronland (2016) find that firms that repurchase shares (in order to boost earnings per share) cut employment, capital spending, and R&D in the year following the repurchase. In this sense, share repurchases and other returns of cash to shareholders thus may signal a substitution for long-term investments.

Similarly, we expect that firms with more stable investors have a greater ability to take a long-term perspective and, thus, be discounted less 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).[9] Aghion, Van Reenen and Zingales (2013) find that higher proportions of particular types of institutional investors increase a firm's R&D productivity and that this effect is driven by institutional investors reducing career risk for managers investing in uncertain projects, like R&D (Ibid.). Examining airlines under earnings pressure, Zhang and Gimeno (2016) find that firms more likely to seek an aggressive competitive position, which typically sacrifices near term earnings for later benefits, when held by longer-term investors.

Incentives that encourage managers to take a longer-term perspective and more stable management are also correlated with a firm's investment horizons and behavior. As noted above, Flammer and Bansal (2017) show that long-term CEO compensation is tied to increased investments in areas with more distant payoffs, like CSR. In contrast, 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 (Mizik 2010; Kothari 2001).

Beyond incentive packages, CEO tenure alone serves as a signal of time orientation for firms. CEO tenure has declined precipitously in recent decades; in 1995, the mean CEO tenure was just under ten years, but fell to under six years by 2009 (Haldane, 2010; Favaro, Karlsson and Neilson, 2011; Kaplan and Minton, 2012). Shorter CEO tenure creates a greater incentive for CEOs to engage in earnings manipulation (Kaplan and Minton, 2012). Mannix and Loewenstein (1994) find support for this idea using experimental data; as the prospect of leaving the employment of a firm increases, a manager is more likely to focus on short-term payoffs. However, other research suggests

[9] The opposite also appears true: Bushee (2001) finds that high turnover institutional investors prefer to invest in firms that have greater short-term earnings.

a different relationship between tenure and time horizons. Hambrick and Fukutomi (1991) argue that CEOs with very long tenure may see a decline in their performance due to increasing rigidity in their routines, placing more weight on personal considerations such as retirement, which may lead to short-term oriented decisions. The tendency towards shorter time horizons is further accentuated by a CEO's power, which usually increases with tenure (Ibid.).

External pressures may also lead firms to shorten their investment horizons and include the threat of activism in an industry and factors that increase the sensitivity of the market to firm information. For example, activist investors have pressured firms to use cash to buy back shares and increase dividends, boosting share prices, at the expense of using cash for long term investments (Gardner, 2015; Sorkin, 2015). 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.

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).[10] In contrast, Karpoff, Malatesta and Walkling (1996) find that the average effect of activist proposals on stock returns is not significantly different from zero and that sales growth declines in firms targeted by activists relative to controls. Activism is, however, relatively rare, occurring in only 0.8% of US listed firms in any one year (Norli, Ostergaard and Schindele, 2015). The threat of activism, however, impacts a larger number of firms. Recent research 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 (Fos, 2017). Consistent with this, Qi (2015) finds that an increasing threat of shareholder activism dampens firm innovative outcomes. This threat of activism may be enough to spur boards to improve short-term performance in order to stave off a proxy contest. Thus, these studies reveal a link between the threat of activism leads and a focus on short-term returns.

Finally, anything that increases the sensitivity of a firm's stock price to information will exacerbate earnings management to make targets. For example, Asker et al (2015) find that, as a

[10] In keeping with the controversial nature of activist engagements with firms, there is a large body of research on the impact of activists on firm behavior and performance that is beyond the scope of this paper to review, including Brav, Jiang and Kim (2015), Bratton (2010) and Greenwood and Schor (2009).

firm's stock price becomes more sensitive to earnings news, incentives to distort investments to boost stock price increase, usually in the form of cutting investments in long-term projects such as R&D. Cuts in R&D have been shown in firms under earnings pressure, particularly when investors have a shorter-term horizon as noted above (Bushee, 1998). Similarly, analyst coverage amplifies the impact of firm information on stock prices and may pressure firms to focus on the short-term. As noted above, firms losing analyst coverage due to exogenous events invest more in durables after losing coverage (Desjardine, 2015). While analyst coverage is positively correlated with R&D spending (Barth, Kasznik and McNichols, 2001), He and Tian (2013) find that firms covered by more analysts patent fewer inventions and patents generated have less impact.

Long-term investments, investors, and compensation schemes signal firms with a relative emphasis on long-term performance, while signs of external pressures from investors in the form of activist threats, analyst coverage and stock prices that are sensitive to news signal a shorter-term orientation. We anticipate that these firm characteristics translate into how the market discounts a firm's future cash flows. We treat this as an empirical question, however, and begin our empirical examination below by estimating how markets are discounting firms over three decades. After estimating market-wide trends, we then use several of the above identified factors to both explore between firm heterogeneity in discounting as well as to corroborate the use of our measure as a signal for firm-level, investor time horizons.

3. Data & sample description

Our sample is the population of 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 variables of interest were not available until the late 1970s.[11] 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.[12] We combine this security data with several other firm-level datasets to construct variables of interest discussed below and set out in Table 1.

3.1. Measuring market discounting

We adopt a measure first used for capturing market valuation horizons by Miles (1993) and later by Davies, Haldane, Nielsen and Pezzini (2014). Both of these studies use a variant of a capital asset

[11] For example, our analyst coverage information from IBES dates back to 1976 and is sparse in the early 1980s (IBES User Guide, Thomson Reuters, 2013).

[12] These changes are those security-related corporate actions that trigger a change in CUSIP identifier, which include name change, (reverse) stock split, and restructuring (FINRA, 2016).

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 stock price and future dividends, discounted by the sum of the risk-free rate and the company specific risk premium:

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

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 is used to measure the extent to which future cash flows are discounted by the market. If there is no future discounting (or overvaluing) above and beyond the sum of risk-free rate and firm-specific risk premium set by the market, then x should equal one; this is the null hypothesis.[13] Empirically, the estimate of x based on the population should not be significantly different from one in a cross section or over time. However, our primary interest is not whether x differs significantly from one in any period, but rather whether x changes over time within a firm, regardless of the distance from one, and/or differs meaningfully between firms within a time period.

Equation (1) is a dividend capitalization model (e.g., Easton, 2007) with the addition of the market discount term, x, whereby a firm's stock price is assumed to be equal to the discounted value of its future dividends and terminal stock price.[14] We use current dividends and the current stock price to proxy for the current expectation of future dividends and stock price.[15] Further, we follow Miles (1993) and substitute the following expression for the firm's risk premium:

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

Two well-established risk-related factors are used to estimate a firm-specific risk premium in equation (2), β_{jt} and Z_{jt}. β_{jt} is firm j's beta in year t, which measures the volatility of the stock price compared with the whole market, and Z_{jt} is firm j's gearing (i.e., debt/equity), which measures the

[13] Note that the exponent on x creates a functional form that is roughly consistent with hyperbolic discounting; earlier research on behavioral time biases suggests that individuals tend to be hyperbolic discounters, preferring short-term gains over longer-term rewards (Ainsley and Haslam, 1992; Laibson, 1997).

[14] 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.

[15] Using current values of prices and dividends per share as instruments give 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). Further, 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.

firm's risk associated with financial leverage.[16] 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. α_1, α_2 are coefficients associated with the firm specific risk factors and estimated by the model below.

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

$$P_0 = \frac{(D_0)x}{(1+r_0+\alpha_1\beta_0+\alpha_2 Z_0)} + \frac{(D_0)x^2}{(1+r_0+\alpha_1\beta_0+\alpha_2 Z_0)^2} + \cdots \frac{(D_0+P_0)x^N}{(1+r_0+\alpha_1\beta_0+\alpha_2 Z_0)^N} + \varepsilon \quad (3)$$

where at time 0, P_0 is the stock price of a firm, D_0 is firm dividends, r_0 is the risk-free rate and β_0 and Z_0 are the firm's beta and gearing, respectively. We set N equal to 5; we use five periods of future expected dividends and the expected stock price in year 5 to estimate P_0.[17] The annual average yield to maturity of a one-year government bond (averaged over daily quotes) is our risk-free rate. The parameters α_1, α_2 and x are simultaneously estimated by the model and x captures the extent to which the actual market discount rate of expected future cash flows in the stock price deviates from the theoretical rate predicted by the CAPM.

Both Miles (1993) and Davies et al (2014) use their 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. For example, the materials sector has values of x less than 0.90 over all time periods, while the energy and utilities sector has values of x much closer to 1 and above 1 in some periods (Davies et al, 2014). These earlier analyses, while informative, stop short of examining whether some firms are discounted more or less than others within the same time period and industry and, if so, why. Further, industry level measures of discounting do not allow estimation of how market discounting correlates with firm-specific characteristics and behavior; only with examination of firm level heterogeneity can we examine the relationship between financial markets and firm strategy. These are empirical questions that we examine below.

To estimate the market-wide implied discount rate 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

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[16] In our robustness appendices, we take up alternative specifications of this formula, including the addition of additional factors from Fama and French (1992).

[17] Brochet et al (2014) find that there is a negative and significant relationship between firm short-termism (measured via earnings conference call transcripts) and stock returns as well as 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.

that vary across firms are computed from this information and provide insight as to whether the market discount rates are firm-specific and time-varying. This is an important point of departure from earlier work because we can capture discounting at the firm level, allowing for further insights into firm level mechanisms that may influence market time horizons.

We estimate equation (3) above, allowing the estimate of x may vary across firms and years. To estimate firm specific coefficients on an annual basis, we group firm-year observations by a 5-year rolling window.[18] 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 group yields consistent and efficient estimates in RCMs (Alcacer, Chung, Hawk and Pacheco de-Almeida, 2017).[19,20]

If our estimated x_{jt} is less than 1, it indicates that the market is discounting the expected future cash flow of firm j at a steeper rate than the sum of the risk-free rate and estimated firm-specific risk premium. In other words, x represents shareholder time preferences, with lower values of x suggesting more short-term time horizons. These time horizons reflect in part shareholder expectations around a firm's future prospects, but may also indicate patience or impatience on the part of shareholders. It is this relationship that we work to reveal in our regression analyses and discussion below. To facilitate more intuitive interpretation of the measure, we transform x as follows:

$$\textit{Market discounting} = 1 - x$$

Larger values of *Market discounting* 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.[21] Note that we discuss and address several critiques of this estimation in the sections below as well as in our robustness checks set out in the appendices.

3.2. Market Discounting Trends from 1980 to 2013

Average market discounting estimates over time, along with estimates at the 5th and 95th percentiles are set out in Figure 1.

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[18] 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.

[19] The x estimated from seven years of observations is highly correlated with our main measure. Nevertheless, a longer time-window is not more desirable in our setting, because the estimate is more likely distorted by obsolete information that has little to do with today's investment decisions.

[20] Due to the sensitivity of the optimization process to outliers, we drop cases where stock price is higher than 1000. Such cases represent approximately 0.05% of the whole sample.

[21] As robustness checks, we re-estimate x (and, hence, *Market discounting*) 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 1) exhibit highly consistent patterns to those exhibited here.

[Figure 1 here.]

Figure 1 shows *Market discounting* increasing over time, despite fluctuations. All means shown in Figure 1 are statistically different from zero with a p-value of 0.001 or lower. In early time windows, there is little evidence of short-termism; values of *Market discounting* are negative. An increase in market discounting of firms occurs around the dot-com bubble (i.e., 1999-2000) as well as the time of the financial crisis (2007-2008). To put these trends in perspective, assuming consistent cash flows, the estimated discount rate over a five-year return period has shrunk by 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 positive 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 the trend of increasing market discounting has persisted in the 10 years beyond the most recent sample considered in Davies et al (2014). Further, *Market discounting* moves in expected ways following various unexpected economy-wide shocks; both the burst of the 1999-2000 dot-com bubble and the 2007-2009 financial crisis mark sharp upticks in *Market discounting* that likely reflect the increased market uncertainty following these events. In contrast, *Market discounting* appears to take a downward turn around 2004; that Google announced 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.[22]

To more directly translate what x and *Market discounting* imply for the length of time horizons, we model and calculate implied investment horizons based on different values of x in Appendix A. Using the change in x estimated around the time of the financial crisis for firms listed on the NYSE, the implied investment horizon shortens by 16% on average. For some firms, the investment horizons shrink dramatically during this time frame, by more than 75%, (i.e., effectively changing the investment time horizon from five years to just over a year).

In Appendix B, we graph *Market discounting* against two measures of economic and firm health to better understand the relationship with other market-wide trends. These measures include: 1) five-year, market-wide total factor productivity (TFP) growth; and 2) firm R&D productivity, and are

[22] While required earnings reporting frequency hasn't changed since 1970 in the US, the choice to offer earnings guidance may impact firm investment 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 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).

described in more detail in Appendix B.[23] These graphs demonstrate that, as *Market discounting* increases, neither productivity measure increases; TFP growth is largely flat and R&D productivity declines overall (with some variation over time and a notable spike just after the dot com bubble). Both patterns are consistent with increased market discounting reflecting greater firm focus on generating short rather than long-term returns but are also consistent with the possible underlying drivers of this shift, including diminished firm growth opportunities. Declining R&D productivity in the light of increased firm R&D spending suggests two possible interpretations. First, firms may be investing more in R&D, but in shorter-term projects that are focused on customization of existing inventions to new uses or customers, for example, rather than development of new materials. Alternatively, R&D projects may be riskier, with more uncertain outcomes and, consequently, lower productivity. It's likely that both explanations apply across firms.

Before exploring other patterns and heterogeneity within *Market discounting*, we address several potential critiques of the model used to estimate *Market discounting*. The first is how to interpret x (and, by extension, *Market discounting*) for firms that do not issue dividends. In our sample, 52% of firms have issued dividends. 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. Further, we do not seek precise valuation of firms, but rather use estimation of x for: 1) identification of overall trends over time; and 2) evaluation of relative discounting of firms within the same time frame. Damodoran (2002: Ch. 13, p.30) notes, "The conventional wisdom is that the dividend discount model cannot be used to value a stock that pays low or no dividends. It is wrong….a high growth firm, paying no dividends currently, can still be valued based upon dividends that it is expected to pay out when the growth rate declines." For these reasons, we include both dividend and non-dividend issuing firms in our sample. We do, however, conduct multiple robustness checks to evaluate the sensitivity of our estimation to the inclusion of both dividend and non-dividend issuing firms in our sample.

All robustness checks are set out in Appendix C and summarized in Table 5. Summarizing those tests that are relevant to the inclusion of firms irrespective of dividend policy, we observe very similar patterns in terms of *Market discounting* trends over time when we estimate x separately for

[23] While not a measure of economic or firm health, we also graph price earnings (P/E) ratios against *Market discounting* in Appendix B; we address this graph in our discussion section below.

dividend and non-dividend issuing firms. We also estimate our main regression models (i.e., specifications set out in Tables 3 and 4 below) for subsamples based on dividend policy and find very similar results.

We also estimate two alternative measures of *Market discounting*: 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). This second measure has the added advantage of being based on an estimate of cash flows not reliant on dividends (i.e., earnings).

Fama and French (1992) identify two additional factors that improve the fit of asset pricing models, namely market capitalization size and book to market ratio. The inclusion of these factors reflected the observation that small cap (i.e., low market capitalization) and value firms (i.e., high book to market ratio) tend to outperform the market as a whole. We adapt equations (2) and (3) above to include a firm's market value and book to market ratio (both logged) in the function for the firm specific risk premium in equation (2); this revised term is then included in equation (3) when estimating x. In this sense, we account for two additional factors that may systematically change firm risk.

For our second alternative, we estimate an implied market discount rate based on analyst forecasts, 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 in equations (1) and (3) above, the advantage of this model is that it does not rely on dividends to estimate future cash flows. However, a limitation of the model is that empirical estimation of the measure relies on information of analysts' forecast of future earnings, which is only available for some public firms over a limited time horizon. Further, 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 details on these additional measures are set out in Appendix D below. Alternative estimates of *Market discounting*, based on the inclusion of Fama-French factors or analyst forecasts, are graphed against our original measure in Figures 2a and 2b.

[Figures 2a and 2b here.]

Figure 2a shows very similar patterns of *Market discounting* over time between our original model based on equation (3) and a modification that includes the Fama-French factors described above.

Market discounting rises in the 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 2b displays *Market discounting* (original model) graphed against an estimate of discounting based on analyst estimates. 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). What is intriguing in latter half of the sample is how discounting based on analyst forecasts appears to precede fluctuations in our original measure. For example, the increase in analyst forecast discounting in the early 2000's and again in the late 2000's precedes the rise in our original measure, with similar patterns observed for declines in *Market discounting*.[24] While the differences between the various estimates of *Market discounting* raise interesting questions regarding how inclusion of different firm measures influences the relationship between firm fundamentals, interest rates and stock prices, the relevance for our purposes of Figures 2a and 2b lies in their corroboration of the *Market discounting* trend over time. *Market discounting*, 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.

Before exploring firm specific variance in our regressions below, note that there is both significant industry variance and firm variance within industry on mean values of *Market discounting*, using our original measure. Appendix E graphs *Market discounting* over time, split by industry (here, 2-digit NAICS codes), followed by similar graphs of these mean values of *Market discounting*, overlaid by the range of firm estimates within industry. All industries reveal a positive number on *Market discounting* (i.e., increased market discounting) at the end of the period. The firm heterogeneity within

[24] This is suggestive of information asymmetries between the analysts and shareholders, where the analysts obtain information earlier than the market (even if based on public information, since analysts spend more time and attention on obtaining firm specific details) and the time delay reflects a diffusion model of information dispersal.

industry revealed in the second set of graphs demonstrates the value of generating firm specific estimates.

Trends discussed in the preceding graphs suggest that investors are discounting firms listed on US exchanges increasingly over time. However, they do not address whether some of this effect is due to the changing composition of firms on these exchanges or that firms switch places over time, with some firms being more discounted over time and some less but the average being pulled by a few firms that are more strongly discounted. To examine these questions, we graph the intra-firm movement in *Market discounting* 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 *Market discounting* within a given time period.

[Figure 3 here.]

Market discounting 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 *Market discounting* 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, 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 pulling the average. Second, the three sequential comparison periods moving up the diagonal illustrate that, overall, *Market discounting* 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).

Overall, the above descriptive statistics display the broad US market trends; markets are increasingly discounting the future dividends and stock prices of firms. While these descriptives reveal the market level phenomenon (i.e., trend changes over time), they do not directly answer whether *Market discounting* is linked to past firm behavior, as would be suggested by an efficient markets hypothesis, even in a weak form. We expect that how individual firms are discounted by the market reflects both past firm behavior and broad market factors, such as changes in investor time preferences and market-wide uncertainty. Also, these overall trends, while suggestive of shrinking time horizons, do not reveal potential correlates that help disentangle whether the trend we observe is due to changing behavior of firms above and beyond general market trends.

3.3. Corroborating measures

We first investigate the relationship between *Market discounting* and five categories of variables, most of which have been identified by earlier research to signal firm time horizons. These five categories of variables include: 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 *Market discounting*, we can assess the extent to which *Market discounting* captures firm time horizons as well as investor time horizons. All variable constructions, data sources and expected signs from prior literature are set out in Table 1. Negative expected signs indicate our priors that the variable is correlated with lower *Market discounting* (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 investor time horizons. All variables are measured in the year before the estimation window for *Market discounting*, unless noted otherwise.

[Table 1 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. We also capture firms offering a short-term return of cash to shareholders through 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).

Institutional ownership variables capture the extent to which these investors have long-term horizons, which has implications for the time horizons of the firms that they own (Bushee, 1998; Bushee, 2001). We follow Bushee (2001), who develops a comprehensive method to classify institutional investors based on their portfolio turnover and diversification.

We also include measures to capture a firm's financial health and maturity, 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 (Souder and Shaver, 2010). 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 market discounting. In recognition of the fact that more mature firms may experience lower growth rates, which may then be reflected in diminished market expectations (and higher market discounting), we also include a measure of firm age.

Measures capturing management incentives are included to proxy for the time orientation of managers and, consequently, the firm. We include two measures of management incentives. One measure, LTIP (long-term incentive plans) for CEOs captures how well incentives of top management are aligned with the long-term performance of the firm, typically 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.

Finally, we include three measures of external pressures on the firm that likely lead the firm to manage current earnings (and, therefore, focus on short over long-term returns). Analyst coverage increases visibility of whether a firm conforms to market expectations and thus may put pressure on firms to realize short-term metrics at the expense of long-term orientation (Desjardine, 2015; Graham et al, 2005; He and Tian, 2013). The earnings response coefficient ('ERC'), proposed by Ball and Brown (1968), captures market pressure in the form of price volatility around earnings announcements, which may force firms to respond to short-term expectations and invest less overall (Asker et al, 2015). Finally, as discussed in more detail above, the threat of shareholder activism has been shown to lead firms to change their behavior consistent with increased focus on short-term returns (Fos, 2017; Qi, 2015). Table 2 contains descriptive statistics for these measures.

[Table 2 here.]

4. Validating market discounting as a proxy for time horizons

To examine the validity of market discounting as a proxy for firm and investor time horizons, we estimate *Market discounting* as a function of firm investment measures, then adding institutional ownership, financial health, market pressures and executive compensation and tenure. We run both fixed effect models as well as random coefficient models ('RCM'), with the firm investment variables and intercept as 'free' parameters that vary across firms (i.e., firm specific betas are estimated for these variables in addition to the full sample mean betas). The RCM also allow the intercept to vary across firms to account for the potential between-firm baseline differences in discounting. RCM 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; Alcacer, Chung, Hawk and Pacheco-de-Almeida, 2017). For instance, two firms with the same level of R&D intensity might face different levels of discounting due to unobserved differences in the nature of their R&D projects. RCM allow us to capture both the mean and variance of the effect of R&D intensity on market discounting. Further, the RCM estimate of the intercept (as a 'free' variable) functions in part as a firm specific fixed effect.[25] To alleviate concerns that our findings are dependent on RCM assumptions, we also report the results of fixed-effects models, which account for firm and time fixed effects. Fixed-effects models essentially translate firm heterogeneity into baseline differences of the dependent variable and produce average effects in the population.[26]

Note that *Market discounting* 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 and reduce concerns of simultaneity. An exception to this is *Sales Growth*, which is measured in the two years prior to *Market discounting* (i.e., *t* and *t-1*). 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 the RCM report mean betas for the sample, while the 'b' columns report the standard deviation on these betas under the random coefficient model. Significant standard deviation 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 *Market discounting*. 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 *Market discounting*, 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 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 payoffs to R&D efforts and, thus, value R&D investments

[25] The primary difference between the firm fixed effect and the 'quasi-fixed' effect estimated via a free intercept term in the RCM is that traditional firm fixed effects can follow any pattern, while those estimated via the RCM are constrained to follow a specific distribution (e.g., normal, uniform, etc., as specified). 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 Alcacer et al (2017) for more details.

[26] Standard errors are clustered on the firm level in fixed-effects models to address potential dependence across observations.

differently between firms. This effect is precisely the reason to use the RCM; the significant negative relationship between *R&D Intensity* and *Market discounting* is obscured with a fixed effect model. 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 *Market discounting*. Without estimating this second moment, we would be unable to explore this important heterogeneity and instead assume that there was no relationship between the variables. We delve further into firm examples that illustrate both the mean and standard deviation of the *R&D Intensity* effect in our discussion section below.

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 *Market discounting* (e.g., p = 0.002 in (2a)). The negative mean effect suggests that firms that advertise less are also 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 *Market discounting* 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 the relationship between capital spending and market discounting depends on the firm.

Firm spending on both *Share repurchases* and *Dividends* is significantly positively correlated with *Market discounting* (p-value = 0.000 for both), consistent with our priors. 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. Such firms are more heavily discounted by the market, an observation consistent with interpreting *Market discounting* as a proxy for firm and investor time horizons. We note also the significant standard deviation on both of these effects reported by the RCM.

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, *Market discounting* 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., institutional owners with high portfolio turnover) (e.g., Bushee, 1998). *Dedicated* institutional ownership has the opposite effect; as ownership by institutions with low portfolio turnover increases, *Market discounting* 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 make short-term earnings targets decrease. This is correlated with a compensating decrease in discounting of the firm's future value.

Institutional ownership by *Quasi-indexer*s has a positive relationship with firm *Market discounting* (p = 0.000, all specifications), suggesting that pressure for short-term payoffs increases with increasing investment by quasi-indexers. While we did not have specific priors on the effect of *Quasi-indexers* on *Market discounting*, our result is consistent with Porter (1992). Porter (1992) argues that quasi-indexers increase pressures for short-term investment behavior because these investors have fragmented ownership and this reduces monitoring of firms and managers. We also did not hold specific priors on unclassified institutional investors, *Unknown Category*, which is significantly and negatively correlated with short-termism (p = 0.000, all specifications).[27]

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 market discounting on the firm's future value (p-value = 0.013 and 0.000 for the fixed effect and RCM, respectively). *Sales Growth* bears a negative and significant relationship with *Market discounting* across specifications (p = 0.000 for both). Since *Sales Growth* is a proxy for future growth expectations, this negative relationship suggests that *Market discounting* captures, at least in part, shareholder expectations about future opportunities for the firm. In contrast, *Firm Age* is positively correlated with *Market discounting* (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 *Market discounting* may well be a rational market response to expectations around diminished future growth. Overall, our estimates in Table 3 show that *Market discounting* is correlated in largely expected ways with measures that have been previously argued to be indicators of firm time horizons.

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

[27] These investors tend to be dedicated investors, but have few holdings and insufficient information to categorize (per discussions with Brian Bushee, March, 2016).

sample size is significantly reduced in these estimations, given the more limited data coverage for several measures.

[Table 4 here.]

Long-term compensation *(LTIP - CEO)* has the expected negative sign and a significant relationship with *Market discounting* (p values range from 0.018 to 0.075). Our running average of *CEO Turnover* (i.e., the total number of CEOs a firm has had, scaled by years since IPO) shows mixed effects. Column (1) shows a significant positive relationship with *Market discounting* (p = 0.002), consistent with expectations that shorter tenure is indicative of shorter time horizons, translated to greater market discounting. However, this effect reverses in the RCM and when we add measures of external pressure in (5) and (6); shorter tenure (or higher turnover) dampens market discounting.[28] 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 may include the change of sampling (i.e., our sample size drops further when we add external pressure measures).[29] It's possible that changing CEOs is a strong signal to the market that a firm is making any necessary changes to adapt to market conditions and to 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 any conclusions on the relationship between CEO turnover and market discounting, given these varied coefficients.

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 *Market discounting* (p = 0.001 and 0.000 in column (3), respectively),[30] suggesting when a firm's stock prices are more sensitive to earnings news or there is significant shareholder activism in the industry that may affect the firm in future, then the firm plausibly emphasizes short-term returns and is more heavily discounted.

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[28] 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 discounting.

[29] In robustness checks not reported here, we attempt to rule out concerns of multicollinearity by re-estimating *Market discounting* as a function of *CEO Turnover* having removed significantly correlated explanatory variables in both samples, but still observe the sign flip between the two samples.

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

The effects of *Analyst Coverage* are more challenging to interpret; the coefficients are significant (though marginal in two specifications), but change sign according to the sampling. In the larger sample, *Analyst Coverage* shows a positive correlation with *Market discounting* (p = 0.104 and 0.000 for the fixed effect and RCM, respectively), suggesting that when a firm has greater attention by analysts, firms may seek 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 the management incentive measures in columns (5) and (6). For our purposes here, we focus on the overall pattern presented by the variables as a whole and leave resolution of this specific puzzle to future exploration.

In addition to our main analyses reported above, we also conducted extensive robustness checks, summarized in Table 5 and reported in Appendix C.

[Table 5 here.]

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 *Market discounting* 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 *Market discounting*, 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 *Market discounting*, but it's also possible that investor preferences around time horizons (included in *Market discounting*) also affect subsequent firm behavior. Since we focus in this paper on the first relationship, that is, *Market discounting* as a dependent variable, we examine whether firm behavior and characteristics affect later *Market discounting* in a sample where causality is more transparent. 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 *Market discounting* in the following time period. We focus only on firm investments and ownership because other variables either require more than one year of data or show little variance for newly listed firms.[31] We find that results are largely consistent with our main analysis; a higher level of R&D, advertising and capital investments in the first period since 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.

To rule out that observed patterns may simply be a reflection of the IPO market environment at a particular period in time, we re-run this post IPO analysis with a high-dimensional fixed-effects model that accounts for industry-time effects, with robust standard errors. Signs are unchanged in this model, but significance levels change on some variables, with transient and dedicated ownership having more significant correlations with *Market discounting*, but R&D being 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 and more general 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 these industry factors, we again construct a high-dimensional fixed-effects model with fixed industry by period effects on top of firm fixed effects for our full sample. In this model, any environmental influence specific to a given industry at a given time is captured by the industry-period fixed effects. 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 *Market discounting* 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 *Market discounting* captures market expectations of firm time horizons. That is, we argue that

[31] This includes share repurchases, which are very rare for newly listed firms.

Market discounting reflects both investor perceptions of past firm behavior related to the timing of returns as well as investor preferences around time horizons. We consider more broadly the interpretation of these results and implications in our discussion below.

5. Discussion: Are firms and markets becoming more short-term oriented?

Here, we evaluate whether the above evidence suggests that firms and markets are becoming more short-term. We first reflect on what our measure captures at the firm level, and then broaden our perspective to the market as a whole. We take two approaches to evaluating what *Market discounting* represents at the firm level: (1) an analytical approach that models x as a function of the internal firm hurdle rate and cost of capital; and (2) an exploration of several firm examples to provide greater context to our firm level results.

Theoretically, we can evaluate what x represents for a firm by restating x as a function of the internal firm hurdle rate and cost of capital, where increasing hurdle rates indicate shorter time horizons for payoffs. As shown in Appendix F (Eq.F7), x can be restated as: $x = \frac{1+C}{1+R}$

Where C is the cost of capital and R is the investment hurdle rate applied by the firm. The key underlying assumption for this derivation is that the stock market price for a firm reflects the present value of the firm as an investment project. Note that x equals one when the firm's cost of capital is equivalent to the firm's internal hurdle rate. Recall that our null hypothesis is that x is equal to one; that is, there is no additional market discounting beyond the risk free rate and firm specific risk premium. We discuss the fuller implications in the appendix, but point out here that as a firm's investment hurdle rate increases (i.e., R increases), x decreases and *Market discounting* increases. In this sense, firm and market discounting of future payoffs are tightly linked. This analytical approach suggests that what we observe in the movements of x (and therefore *Market discounting*) reflects movements in firm internal hurdle rates, which drive firm investment decisions.

We also identified and explored several firms in our sample with low or high *Market discounting* at various periods of time to provide greater context to both the analytical example and our empirical results. While a full qualitative study of firm contextual heterogeneity is beyond the scope of this paper, several mini-cases, when paired with our quantitative findings, are especially useful to reduce the abstraction around what *Market discounting* captures. Our examples show two different types of firm level heterogeneity in our sample: (1) intra-industry differences in the levels of *Market discounting* and how these correlate with firm characteristics (Unilever/P&G, Boeing/General Dynamics); and (2) across firm variation in the correlation between firm R&D investment and *Market discounting* (Ericsson/Microsoft). While we focus on a small set of firms in our illustrations here, note that many other illustrations exist and conform to expectations. For example, Apple (not profiled here) is one of the least discounted firms in our sample, perhaps not surprising given the expectations of both large and long-term payoffs from investments made by the company.

Unilever and P&G are two consumer goods giants with household name brands. Unilever is significantly more discounted than P&G during the period 1997-2009; for example, *Market discounting* for Unilever was 0.0203, while for P&G was -0.0142 over 1999-2003. While the firms do not operate in identical market segments, there are enough similarities between the two to make some comparisons. One of the most commonly touted differences between the two firms is the difference in R&D and advertising investment; during the period of divergence, P&G invested around 4% of sales in R&D, more than twice that of Unilever's R&D spending. In 2003, Alan Lafley, then CEO of P&G, stated during an earnings call, that P&G has, "consciously embarked on a longer-term approach to initiative commercialization…" and that, "instead of looking at six to twelve month introductory plans, we are asking for three year plans."[32] This contrasts with the lower spending in both R&D and advertising at Unilever during this period, while attempting to cut costs. In 2004, Morgan Stanley warned clients that, "Unilever had underinvested in its brands – a mistake that would take time and money to rectify."[33] This sentiment seemed to be validated by weakening sales growth among Unilever's strongest brands and a concern that, "in a desire to avoid upsetting markets with a profit warning, Unilever might not spend enough on advertising: a potentially damaging move for a company that relies so heavily on creating consumer demand for its portfolio of brands."[34]

A comparison between General Dynamics and Boeing, two aerospace manufacturers and defense contractors, is also instructive. General Dynamics is one of the most heavily discounted firms during 1992-96, while Boeing is among the least discounted in the same sector (*Market discounting* = 0.2184 and -0.0326, respectively). Over the same time period, Boeing's R&D and capital expenditures vastly exceed those of General Dynamics by a multiple of ten or greater. Executive compensation differed significantly between the two firms as well. General Dynamics implemented a bonus plan based on short-term gains in the firm's stock price, doling out $18M to the firm's top twenty-five managers during this period. In contrast, Boeing had a long-term compensation plan in place for its top executives at this time. For example, Boeing chairman Frank Shrontz received a

[32] P&G earnings call transcript for 28 January 2003.
[33] The Evening Standard, "New Blow for Unilever as Sales Slump Again," 27 October 2004.
[34] Financial Times, "Stumbling blocks on Unilever's path to growth," 22 August 2004.

bonus package of share options in 1992, exercisable at $46/share, expiring in 2002;[35] Boeing's share price as of December 31, 1992 was $20.06.

These brief examples help illustrate the heterogeneity between firms in the same industry that are, more or less, subject to similar market changes and competitive threats, demonstrating the link between *Market discounting* and firm fundamentals. In this sense, *Market discounting* does reflect firm behavior and, given the links between identified firm traits and firm time horizons, is a marker for firm time horizons. (*Market discounting* also likely captures investor preferences around time horizons, separate from expectations set by observing firm behavior, and we evaluate this element of *Market discounting* below.)

Several other illustrations reveal the variation of market responses to similar firm behaviors, such as R&D spending. These examples highlight the mechanisms underlying the standard deviations shown for the betas estimated in Tables 3 and 4 (i.e., the 'b' columns). Two firms that have very different firm specific parameter estimates for *R&D Intensity* in these tables are Ericsson and Microsoft. Ericsson's R&D parameter estimate is positive and in the highest 5% of the sample, indicating that increased R&D spending by Ericsson is correlated with greater *Market discounting*. The opposite is true for Microsoft; the firm has a slope on *R&D Intensity* in the lowest 5% of the sample (i.e., most negative), implying that the market views its R&D spending more positively and discounts the firm less.

In the years 1991-95, Microsoft had a R&D strategy in place that emphasized both support for basic R&D in collaboration with academics, projects with a longer-term payoff horizon, as well as spending on multimedia applications that would exploit features of the (then) upcoming Windows95 operating system, presumably a more short-term payoff. Further, Microsoft was explicit that it intended to develop products rather than acquire companies to grow in 1995 and intended to spend significant sums hiring people, such as computer scientists for basic research; "We're more interested in taking deliberate steps in the long-term than winning an economic battle in the short term," (CFO Mike Brown).[36]

At Ericsson, R&D was conducted in a very decentralized manner at this time, across more than forty research centers in twenty countries.[37] Referring to how R&D is organized at the firm, CEO Lars Ramqvist noted that, "When I came to Ericsson we had a huge central organization. Now we

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[35] Reuters News, 25 March 1993.
[36] Austin American-Statesman, "Microsoft to spend $5B developing technology," 4 November 1995.
[37] Business Wire, "Ericsson joins Stanford University Center for Integrated Systems R&D Collaboration – Will focus on key areas of microelectronics," 6 October 1994.

have no one at the center." Ericsson also outspends other firms in the electronics industry, spending 16% of sales on R&D in 1992 versus the industry average of 7%.[38] It appears that this structure and level of spending was unpopular with analysts, being both less transparent and a restraint on short-term profit growth. One industry analyst noted that Ericsson was, "simply doing too many things… From a strategic standpoint they may have to be positioning themselves in all these things. But there's a price to be paid, and it's lousy profit margins."[39] Thus, both Microsoft and Ericsson spend heavily on R&D, but the variance on our parameter estimates implies that such investment is not always interpreted positively by the markets. This further refinement of the relationship between firm behavior and *Market discounting* also supports the idea that the measure reflects firm behavior and market speculations on the likely outcomes of such behavior.

The above illustrations provide context to our empirical results and the sources of firm heterogeneity that we are capturing with Market discounting. Interpreting *Market discounting*, particularly when comparing firms within the same period, as a discount over and above the risk-free rate and company specific premium that reflects the market's evaluation of firm behavior, is consistent with our figures and analyses above. In this sense, *Market discounting* is closely linked with observable firm differences and captures, for example, why a firm may be assessed in a long-term fashion by the market despite the opposite overall trend. However, this responsiveness of markets to inter-firm heterogeneity in expected ways does not explain the market-wide trends shown in Figures 1 through 3. We now delve further into interpreting these market-wide trends, evaluating whether our evidence suggests that markets and firms are becoming more short-term on average, and highlight implications for firm strategy.

A key focus of our analysis is whether increased market discounting indicates that investors are becoming more impatient. The interpretation of *Market discounting* as reflective of past firm behavior and future expectations is not novel, but is consistent with the traditional interpretation of stock prices and firm valuation models. What is less explicit, however, is the extent to which *Market discounting* reflects evolving investor preferences and views of broader economic prospects that impact their time horizons.

Strong temporal effects shown in Figures 1-3, consistent upward shifting of within firm discounting over time (Figure 3) and expected movements around significant, market-wide shocks

[38] The Engineer, "The road to success is paved with R&D," 17 February 1994.

[39] The Wall Street Journal Europe, "Ericsson seeks to calm investors' jitters – CEO aims to balance research, profit needs," 26 November 1993.

such as the financial crisis signal that there is a market level component of discounting that captures broader sentiments applying to a majority of firms. Thus, we argue that *Market discounting* captures investor assessments of market opportunities for a firm not just based on the firm's behavior and unique set of skills and assets, but also opportunities or threats that affect the economy more broadly. Our observed trend likely captures increasing uncertainty and shortened cycles of production and investment stemming from technology change, exposure to globalization and significant financial events such as the dot-com bubble and financial crisis.

Reactions to market uncertainty are consistent with shifting investor time preferences; investors may be more impatient for gains in light of increased uncertainty, preferring a more certain short-term payoff over a more exposed, but potentially larger long-term payoff. Our regression analyses reported above suggest that investor time preferences and expectations are part of what is captured by *Market discounting*. The mean parameter estimates on firm characteristics (i.e., the betas in Tables 3 and 4) show market wide effects that correlate with time preferences, even if they do not comment on the shift over time in the way that Figures 1-3 do. For example, the mean negative correlation between *Market discounting* and capital investment, which typically has more certain payoffs over a fixed time frame, is larger and more significant in most specifications than the link with R&D investment, usually characterized by greater uncertainty on payoffs and longer payoff horizons relative to capital investment. Thus, on average, markets are discounting firms that invest heavily in capital less than they do those investing in R&D.

The positive coefficients on share repurchases and dividends are also consistent with *Market discounting* encompassing investor time horizons. Share repurchases and dividends have an immediate impact on investor returns, increasing stock prices. A firm repurchases shares if it has inadequate opportunities to invest, is unsure how to invest (i.e., opportunities do exist), or in response to external pressure to return capital and increase stock price. This return of capital sometimes comes at the expense of investing in future sources of growth. Similar arguments surround dividends, though dividends are typically associated with more mature firms that may have fewer growth opportunities. Whether due to lack of opportunity or failure to invest, however, the positive correlations between *Market discounting* and firm share repurchases and dividends imply an expectation for more short-term returns.

Similar logic applies to the relationship between the threat of shareholder activism and discounting. Firms and industries attract activists (usually) by poor stock market performance. However, sometimes activists target firms where performance is steady and positive, such as

Dupont, which was targeted by Trian in 2015, despite a boost in the bottom line of twenty percent in 2014 over the prior year.[40] Given that a common objective of activists is to increase stock prices 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). Whether activists become engaged because a firm is underperforming or because activists are seeking a short-term payoff, the threat of activism (and its positive correlation with *Market discounting*) strongly points to a preference for short-term payoffs. Overall, the strong correlations in largely expected directions further corroborate this posited link between *Market discounting* and investor time horizons, even if the mechanism is via uncertainty around firm returns.

Beyond indicating the points of our analysis that are consistent with interpreting *Market discounting* as encompassing investor time preferences, we also wish to address two recent trends that suggest, at least superficially, that investor time horizons are not shortening: rising P/E ratios (see Appendix B) and firm R&D spending.

Rising P/E ratios can be interpreted as optimism around growth, since the larger a firm's price relative to earnings, the more markets anticipate earnings growth. (Note that we capture such optimism around growth to some extent with our financial health variables in Tables 3 and 4.) On the surface, this seems counter to our observation that market-wide discounting of firms is increasing. However, while market-wide P/E ratios may be rising in recent periods, the correlation between firm-level P/E ratios and *Market discounting* is negative (ρ = -0.0853, p-value=0.000).[41] This is consistent with expectations; as markets increasingly discount firms, the P/E ratio declines, suggesting diminished future opportunities for those firms, whether due to past firm strategic choices, responses to external pressures or more industry and market wide shifts in prospects. Also, while the negative correlation is unsurprising, we would not expect the magnitude of the correlation to be large. Our measure uses the benchmark rate and company specific risk premium to back out any additional discounting by the market, whereas P/E ratios do not isolate the component of price that is not specifically attributable to firm and market risk. As such, any market discounting factor contained within P/E ratios is confounded by these other components of price, making P/E ratios a poor signal for time horizons.

[40] New York Times, "The Battle for Dupont," 8 May 2015.

[41] This is an average correlation over 1980-2013. However, firm-level correlations for each year in our sample are also negative and significant.

A firm level observation that is potentially inconsistent with our results is that R&D spending by firms has increased dramatically over our time frame (NSF 2016). However, declining R&D productivity (shown in Appendix B) can reconcile our results with observed increased R&D spending. While beyond the scope of our analysis here, declining R&D productivity may be a result of investing in different types of projects; for example, firms may be investing in incremental projects that involve customization of existing materials for new customers instead of new materials development. Indeed, our results may explain recent research showing that firms underinvest in the type of research that leads to inventions that become influential over the long run, leaving this type of research for government funding (Corredoira, Goldfarb and Shi, 2017). Alternatively, Knott (2016) shows that increased outsourcing of R&D by firms may also be a source of declining firm R&D productivity, arguing that such outsourcing is less beneficial for the funding firm than internally conducted R&D. For these reasons, rising P/E ratios and firm R&D spending can be reconciled with our observations of increased market discounting and conjectures around shortening investor time preferences.

Our graphed time trends (including increased within firm movement of *Market discounting*) and results on firm level variables in our regressions collectively point to increased *Market discounting* over time. It is difficult to explain our many results and trends reported above without reference to shifting investor time horizons. Uncertainty over technology change, globalization exposure and other market wide shifts point to less optimism for long-term returns and shortened investment cycles at the market level and, we conjecture, rising impatience around firm level returns. Thus, we do not rely on assumptions of dis-equilibrium or market inefficiencies to support our inference that investor and firm time horizons are shifting towards the short-term. Greater impatience for returns may well be a rational response for investors under these circumstances.

As a measure that is both correlated largely as expected with firm traits capturing firm time horizons and that displays considerable firm level heterogeneity both within and across investment strategies, *Market discounting* provides a mechanism for assessing not only for evaluating whether investor time horizons have shifted over time, but also firm time horizons. Increasing *Market discounting* highlighted above thus points to contracting firm time horizons on average. However, our analysis shows clear heterogeneity between firms on this measure; 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 perceived market-wide trend of increased short-termism by firms and investors noted in the press and some empirical work.

If firms on average are becoming more short-term as these results suggest, 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 also ensure long-term growth and survival. Firms, however, may not pursue profitable strategies if payoffs are not transparent to markets (e.g., R&D investment) and/or if payoffs are longer term. It's difficult to underestimate what this implies for longer-term firm productivity. If firms change their investment strategy to favor short-term payoffs, long-term growth and performance may suffer. While we cannot identify for which firms shortening time horizons are most problematic, since we do not observe firm investment opportunities, it is likely that increasing market impatience is not ideal for many publicly listed firms, even if it may be rational or ideal for investors due to increased economic uncertainty.

Firms that do not wish to be subject to the scrutiny of markets, however, have the option of going private. While a full examination of the 'going private' option is beyond the scope of this paper, we note that going private has significant costs for firms that anticipate large investments requiring access to public capital markets. Ironically, the firms for which shortening time horizons may be most significant (i.e., those that need to make large investments with potentially longer-term payoffs) need the public capital markets most. In these cases, it appears that excellent communication of firm strategy and the underlying rationale for longer-term investments with more uncertain outcomes is critical. However, information asymmetry plagues such investments and it can be difficult for firms to convey sufficient information to the markets to avoid excessive discounting and downward price pressure, since information provided to investors risks helping competitors. While market intermediaries, such as security analysts, may help to translate the long-term strategy for the public in theory, they often exert undue pressure on delivering quarterly earnings. The real question is the match among the investor time horizons, firm opportunity and firm investment strategies. Are organizations optimally selecting into different time horizons and attracting investors that share the optimal time horizons for the firm? This is a fertile area for future research.

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's difficult to imagine private equity held firms or VC funded start-ups making significant long-term investments in large-scale projects with steep capital requirements, such as aircraft or machinery. 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 examination.

6. Conclusion

In this paper, we explore how market discounting of firms has changed over the last 30 years and how this discounting varies by firms according to their investment behavior and other traits. Our goal is to identify whether markets are discounting firms more over time and evaluate whether this discount captures investor preferences around the timing of returns and can be explained by firm time horizons. Using a measure of market discounting drawn from an asset pricing approach and a comprehensive dataset of US publicly listed firms, we estimate how market discounting has changed over time and its correlations with various measures thought to be proxies of short or long-term behavior by firms.

Despite fluctuations, we observe an unequivocal increase in market discounting of firms between 1980 and 2013. Alternative measures of market discounting confirm this trend, including one based on analyst earnings forecasts. We also expose significant across firm heterogeneity in *Market discounting*, though we also show that within firm discounting has increased over time for the majority of firms in our sample. Inter-firm heterogeneity in discounting is tied to firm investment and several variables that capture exposure to external market pressures, such as institutional investor behavior and the threat of shareholder activism in an industry. Being previously identified as being correlated with firm time horizons, we use these measures to evaluate whether market discounting captures firm and investor time horizons.

Our empirical results as well as several within sample firm illustrations are consistent with our conjecture that *Market discounting* reflects firm time horizons, not only in terms of market observations of firm behavior and the expectations that follow, but also in terms of investor preferences on time horizons. In this sense, we use our estimated measure to capture whether markets and firms are becoming more short-term oriented; our results here suggest they are.

These findings must be taken with important caveats; much work remains to be done. Our measure, *Market discounting,* has limitations; not all agree that asset-pricing models reliably explain asset values and, thus, in our case, discount rates.[42] For these reasons, despite the correlations we observe with alternative discount models estimated, we do not make inferences about the meaning

[42] See Chen, Chen and Wei (2011) for a brief discussion of related literature.

of absolute values of *Market discounting*. Accordingly, care must be taken with placing too much weight upon single firm estimates in isolation from the full sample or outside a comparison within the same time frame. While the imperfections of our measure challenge interpretation of absolute values, they do not prevent inference from the time trend or the relative differences in *Market discounting* between firms in the cross section and correlations with variables of interest.

As noted above, exploring the heterogeneity of the impacts of market discounting on firms is an important follow on from this work. While we focus here on the relationship of past firm strategic choices and traits with later *Market discounting*, earlier research also illustrates that shortening investor time horizons pressure firms to focus more on short-term returns. It would be useful to know for which firms are increased pressures to generate short-term returns harmful versus helpful to the long-term performance and survival of the firm. We expect in some cases that short-term pressures 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). Understanding what systematic factors influence this distinction would help guide firms in devising their strategies not only for investment, but also communications with investors. The results of such analysis would also yield policy implications, particularly with respect to shareholder governance.

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 shifting market preferences around time horizons and their heterogeneous implications for firm strategy.

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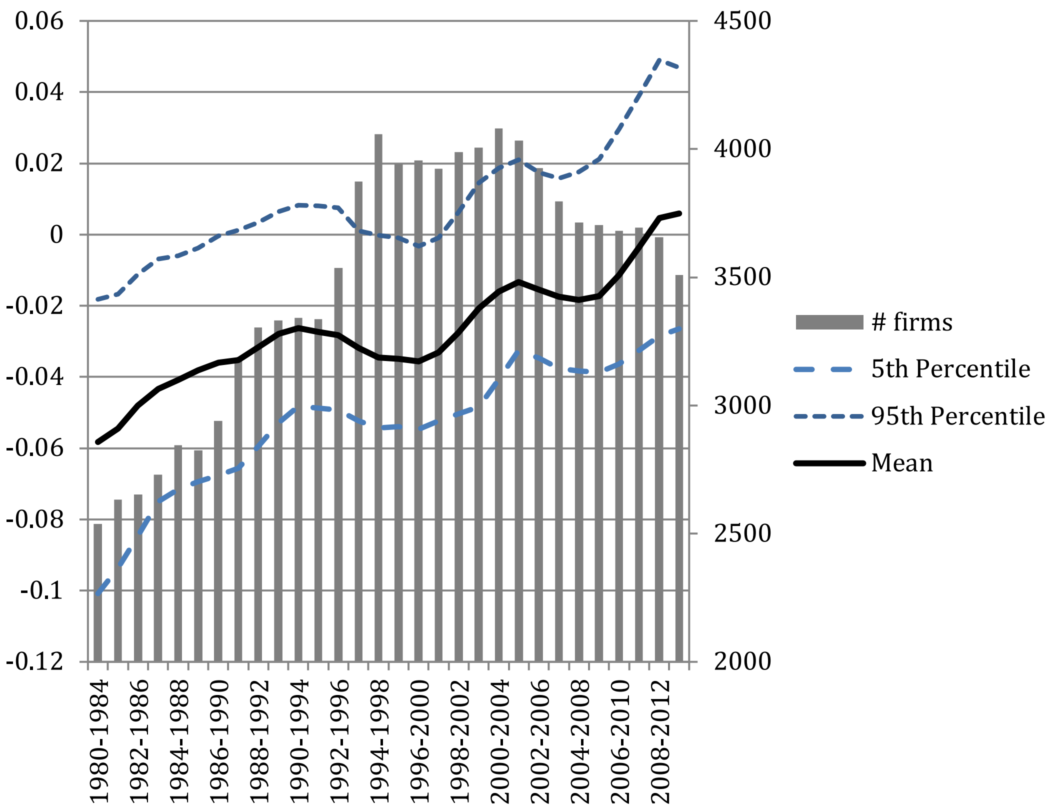
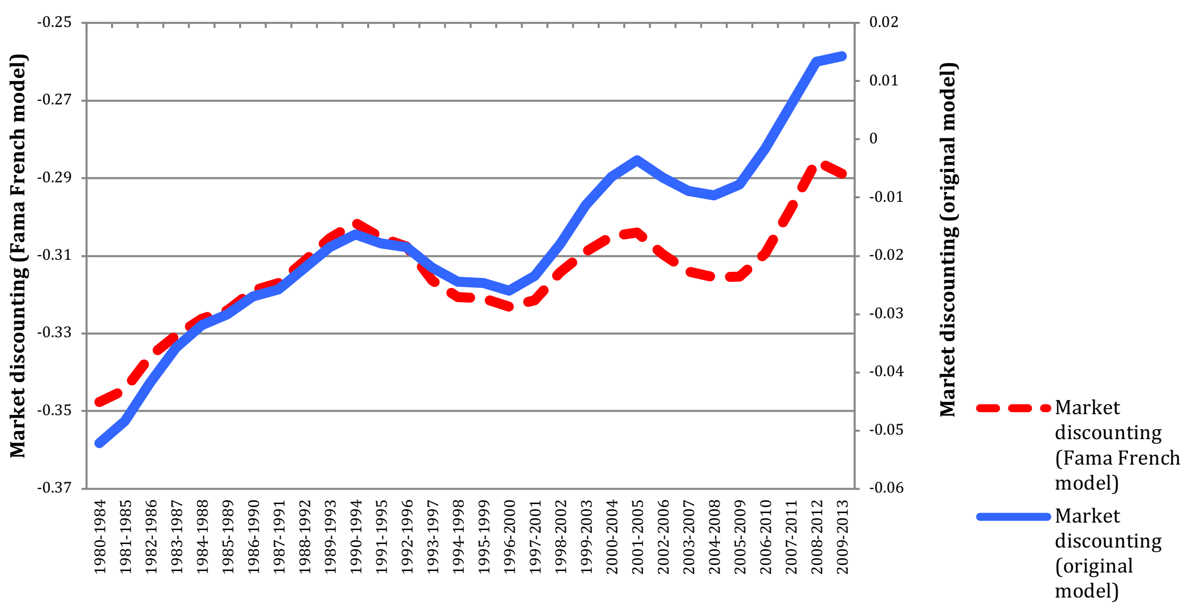
Figure 1: Market discounting mean values over time



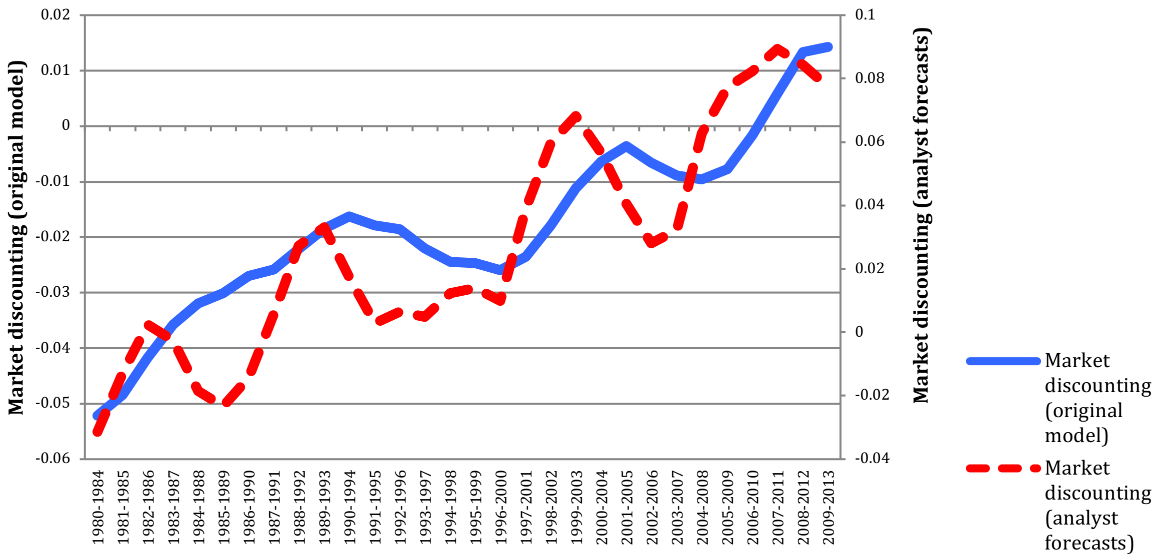
Average, 5th percentile and 95th percentile *Market discounting* (i.e., 1-x) for firms, with number of sample firms shown in histogram.

Figure 2a: Market discounting mean values, original model and including Fama-French factors



Market discounting for firms listed on the NYSE/AMEX against an alternative *Market discounting* measure that includes Fama-French factors as described in detail in Appendix 3.

Figure 2b: Market discounting mean values, original model and model based on analyst forecasts



Market discounting for firms listed on the NYSE/AMEX against an alternative *Market discounting* measure based on analyst estimates as described in detail in Appendix 3.

Figure 3: Within firm movement of Market Discounting

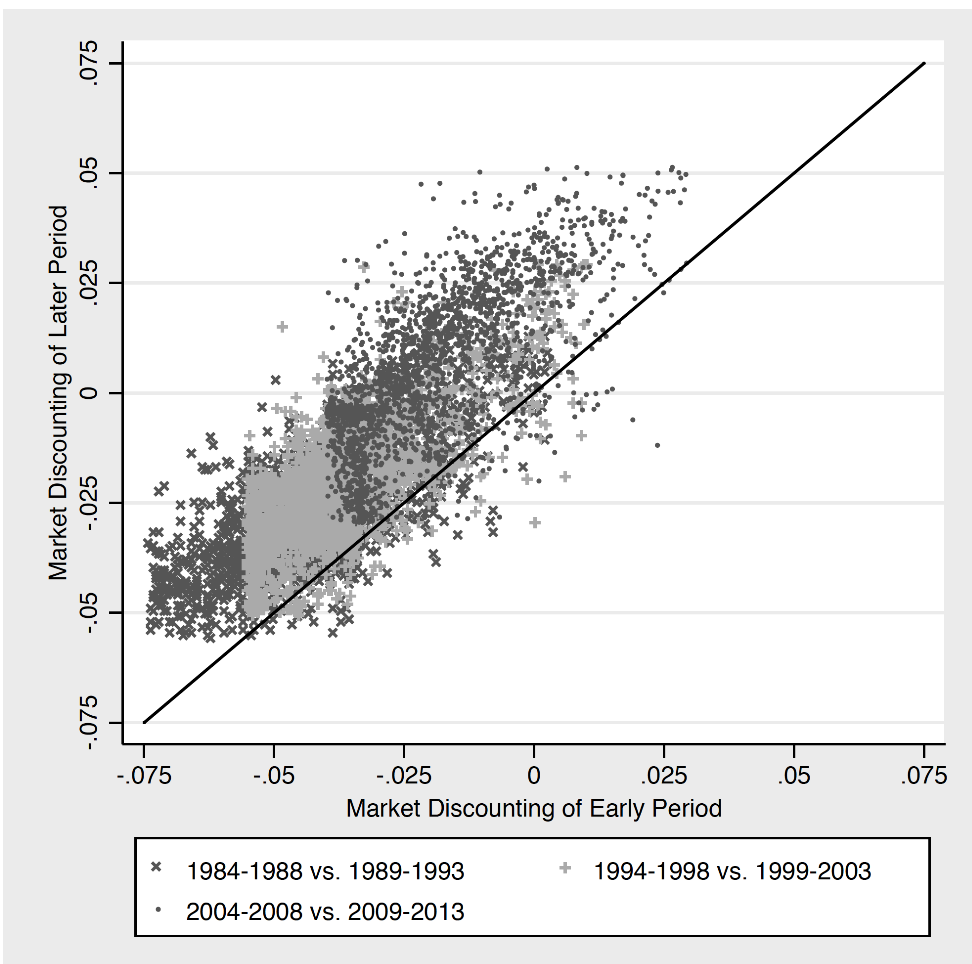


Table 1: Variable Construction, Expected Signs & Data Sources

Variable	Expected Sign[1]	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 (Bushee, 2001).[2]	Thomson Reuters Institutional (13F) Holdings matched to the classification in Bushee (2001)[3]
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 (Bushee, 2001).	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 (Bushee, 2001).	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

[1] Negative signs imply lengthening time horizons (i.e., lower *Market Discounting*), while positive signs imply contracting time horizons (i.e., greater *Market discounting*).
[2] We drop observations where a firm's ownership among all types adds to more than 100% in a year.
[3] 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
<u>Management incentives:</u>			
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
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
<u>External pressure:</u>			
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
Market discounting	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 Market Discounting: Firm Investment, Ownership and Financial Health

DV = Market discounting	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)	
Intercept	-0.05117	-0.05090	0.01652	-0.05064	-0.0503	0.01669	-0.04753	-0.04747	0.01431
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(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			237465.9			187208.6	
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.

Table 4. Explaining Market Discounting: Management Incentives & External Pressure

	FE	RCM		FE	RCM		FE	RCM	
DV = Market discounting		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.

Table 5: Summary of Robustness Tests

Topic	Potential Concern	Robustness test approach 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 estimating market discounting using a residual income valuation model developed by Gebhardt et al. (2001). 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 3. The trend of the discounting rate based on this alternative model is consistent with our main measure and is shown in Figure 2b, albeit with a substantially more limited sample size.
Treatment of firms that do not issue dividends	*Market discounting* may not offer much information for firms that do not issue dividends, given that future cash flows are estimated via dividends.	We take two 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 market discounting. As noted above, the observed trend of estimated market discounting, which is not conditioned on dividend payment, is highly consistent with our primary measure and is shown in Figure 2b. 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 *Market discounting* with firm variables, to further control for any latent differences between dividend and non-dividend issuing firms.
Modeling of risk premium	Relevant risk factors may not be included in Equation (2), leading the market discounting measure to capture omitted factors 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 2a. More details can be found in Appendix 3.
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	Market discounting 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 market discounting. 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 industry technology cycle	Macroeconomic factors, such as uncertainty and industry technology cycle, may partially determine investment horizon but are not accounted for in the main model because they vary across both industry sector and time.	We run a high-dimensional fixed-effects regression by Correia (2017)[4] that simultaneously accounts for firm and industry-time fixed effects. Results, which are reported in Table C.2, 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 *Market discounting* is more interpretable.	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 *Market discounting* 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 *Market discounting*, 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	*Market discounting* 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 market discounting 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.
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 market discounting is negative and highly significant. Other parameter estimates remain largely the same as our reported analysis. Note that we plot RQ against market discounting in Figure B.2; this plot shows the expected negative correlation.

[4] 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

Appendix A: Transformation of Market Discounting to Investment Time Horizon

In our main model, we estimate the discount rate *x* from a fixed number of period of returns and state that a higher x implies longer investment horizon. We now transform our main measure, *x*, into investment time horizon, T_a in a simple case and offer some intuitive numeric examples on the magnitude of change in investment horizon when market discounting takes different values. We write out a five-period model as used in the main specification here and simplify the notation in the same way as Appendix F. The model assumes that investors hold the stock for a five-year period and may apply additional discount to the pricing of the stocks.

$$MP(x) = \frac{Dx}{1+C} + \frac{Dx^2}{(1+C)^2} + \frac{Dx^3}{(1+C)^3} + \frac{Dx^4}{(1+C)^4} + \frac{Dx^5}{(1+C)^5} + \frac{TPx^5}{(1+C)^5} \qquad \text{Eq.(A1)}$$

Applying the formula for geometric sequence, we can simplify Eq.(A1) as a function of *x* as below.

$$MP(x) = \frac{Dx}{1+C-x}\left[1 - \left(\frac{x}{1+C}\right)^5\right] + \frac{TPx^5}{(1+C)^5} \qquad \text{Eq.(A2)}$$

Another way to model investor time horizon is to construct a varying number of return periods. Instead of specifying *T* as a fixed value, we can leave out the variation of *x* (set *x* = 1) and estimate market price as a function of future cash return over an indefinite number of period, T_a, with the model below. Essentially, the alternative assumption is that investors do not apply additional discounting captured by x, but hold the stock for an unspecified period of T_a, which is the time horizon that we are interested in.

$$MP(T_a) = \frac{D}{1+C} + \frac{D}{(1+C)^2} + \cdots + \frac{D+TP}{(1+C)^{Ta}} \qquad \text{Eq.(A3)}$$

Applying the formula for geometric sequence, we can then derive *MP* as a function of T_a:

$$MP(T_a) = \frac{D}{C}\left[1 - \frac{1}{(1+C)^{Ta}}\right] + \frac{TP}{(1+C)^{Ta}} \qquad \text{Eq.(A4)}$$

To derive the relationship between discounting rate and explicit time horizon, we can equate Eq.(A2) with Eq.(A4) and assume the two models capture the same process in different forms.

$$MP(x) = MP(T_a) \qquad \text{Eq.(A5)}$$

We can then solve T_a in Eq.(A5) as:

$$T_a = \log_{(1+C)}\left\{\frac{C*TP-D}{\frac{CDx}{1+C-x}\left[1-\left(\frac{x}{1+C}\right)^5\right]+\frac{Cx^5TP}{(1+C)^5}-D}\right\} \qquad \text{Eq.(A6)}$$

From Eq.(A6), you may see that specific values of TP and D do not matter, as long as we know the dividend yield ratio, *Y*, which can defined as D/TP:

$$T_a = \log_{(1+C)}\left\{\frac{C-Y}{\frac{CYx}{1+C-x}\left[1-\left(\frac{x}{1+C}\right)^5\right]+\frac{Cx^5}{(1+C)^5}-Y}\right\} \qquad \text{Eq.(A7)}$$

With given values of *C* and *Y*, T_a is a function of *x*. For each *x*, there is a corresponding value of T_a. This is consistent with our intuition that difference in discounting (higher *x*) implies varying investment horizon T_a, though T_a is much harder to estimate empirically. Having mapped out the general relationship between x and investment horizon in a simple case, we now set up parameters to interpret our main measure in the sense of time horizon. Below is a conversion chart for x and the corresponding investment horizon under the assumption of 2% cost of capital and 10% dividend yield. We also report the relative change in horizon as compared to the standard five-year horizon in the table.

Table A1. Illustration of market discounting and implied investment horizon.

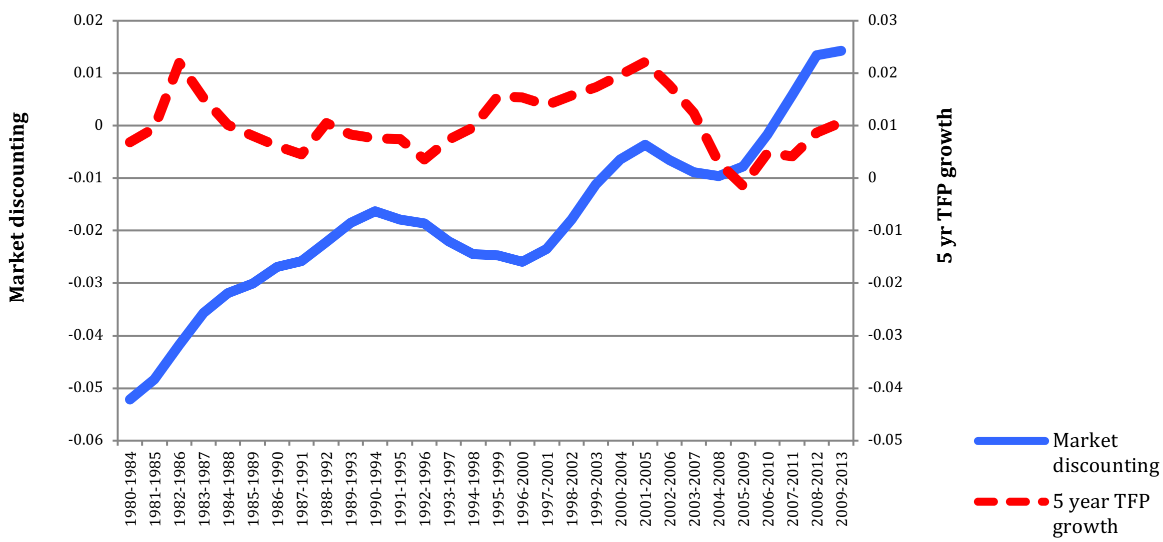
x	Market Discounting	Investment Horizon (Ta)	Relative Change in Horizon
0.95	0.05	1.367201485	-72.66%
0.99	0.01	4.195757049	-16.08%
1.00	0.00	5	0%
1.01	-0.01	5.848140832	16.96%
1.05	-0.05	9.742840447	94.86%

Appendix B:

Graphing Market Discounting Against Measures of Firm & Economic Health

We graph *Market discounting* against three measures of firm, market and economic health: total factor productivity (TFP), R&D productivity (RQ) and price to earnings (P/E) ratios. TFP captures the efficiency of all production inputs and shown to drive long-run income growth and economic well-being (Solow, 1956). We use data on multi-factor productivity from the Bureau of Labor Statistics, calculating a five-year moving average of productivity growth.[1] We measure firm R&D productivity via 'RQ' or R&D elasticity, in this case, the percentage increase in firm revenues from a 1% increase in R&D spending (Knott, 2008). RQ bears a positive relationship with firm R&D investment, market value and future revenue (Knott and Vieregger, 2017) and is a measure of R&D effectiveness, instead of effort (R&D spending).[2] Finally, we capture firm P/E ratios via a moving five-year average of year-end market capitalization (i.e., share price multiplied by shares outstanding) divided by net income. P/E ratios are typically used as a signal of how over- or under-valued stocks are, relative to historical earnings; high historical P/E ratios have been shown to signal lower future returns (Campbell and Shiller, 1988).[3]

Figure B.1: Market discounting mean values and 5-year TFP growth



Graph shows *Market discounting* for firms listed on the NYSE/AMEX against a moving average of five-year total factor productivity (TFP) growth (TFP source: Bureau of Labor Statistics).

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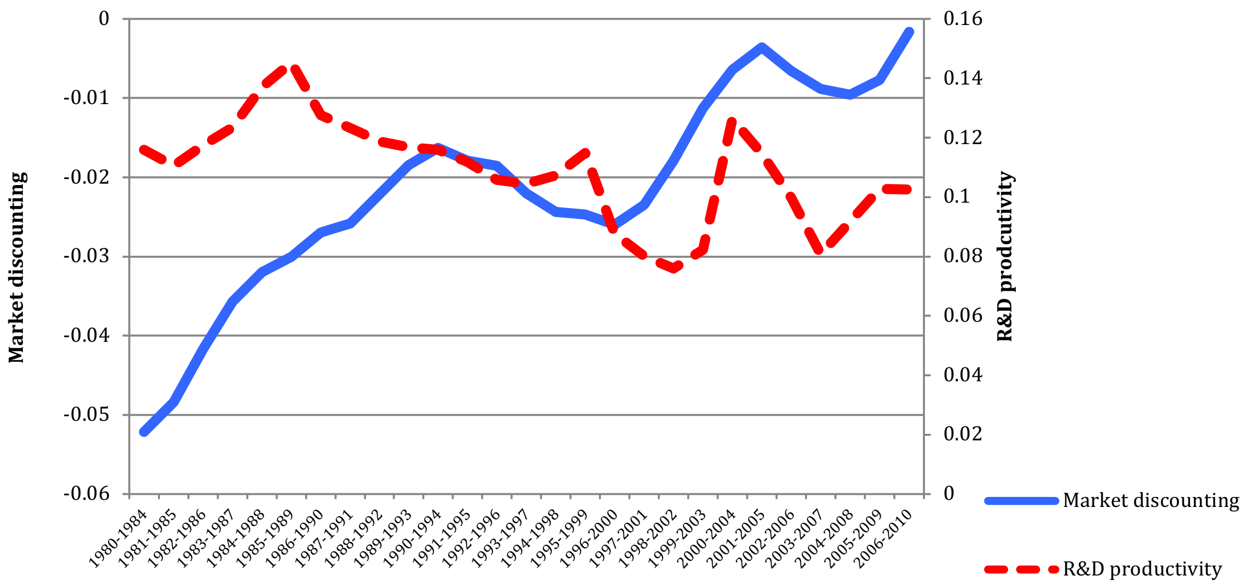
1 https://www.bls.gov/mfp/

2 More details on RQ construction are available via WRDS: https://wrds-web.wharton.upenn.edu/wrds/query_forms/navigation.cfm?navId=379

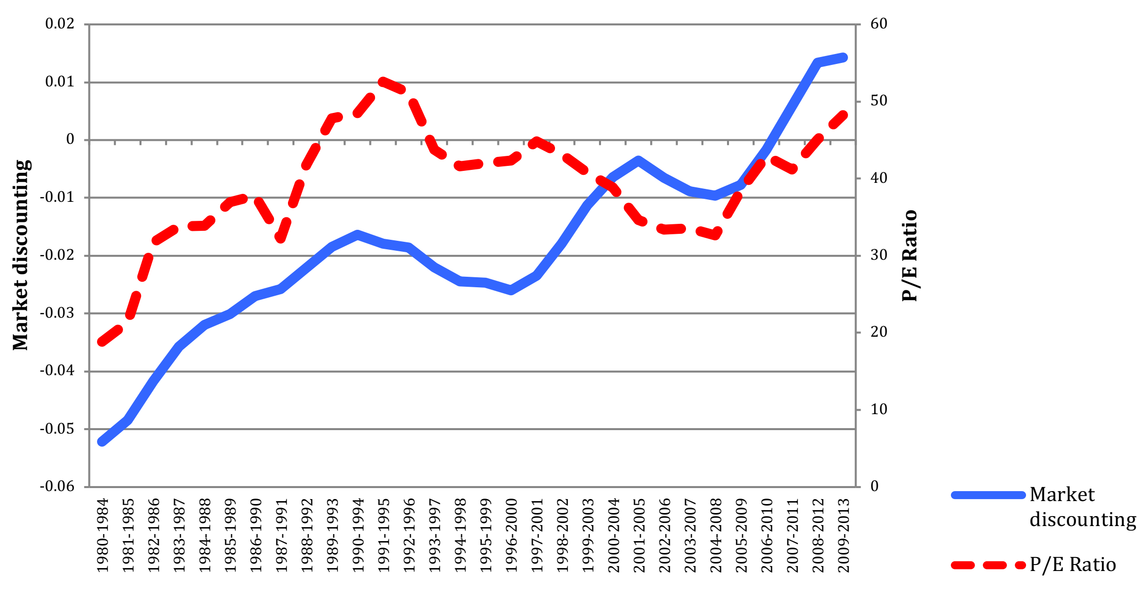
3 We also compare our P/E ratio to the traditional, cyclically adjusted P/E ratio, as generated by Shiller (http://www.econ.yale.edu/~shiller/data.htm). While not identical, we note that the traditional cyclically adjusted P/E ratio displays a similar trend to that shown in Figure 1d below.

Figure B.2: Market discounting mean values and R&D productivity (RQ)



Graph shows *Market discounting* for firms listed on the NYSE/AMEX against a moving average of firm R&D productivity or RQ (RQ data source: WRDS).

Figure B.3: Market discounting mean values and P/E ratios



Graph shows *Market discounting* for firms listed on the NYSE/AMEX against a moving average of firm P/E ratios over the same time window. (P/E ratios constructed from COMPUSTAT data.)

Appendix C: Robustness Tests

Table C.1. Market Discounting of Newly Listed Firms

DV = Market discounting	(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 Model

DV = Market discounting	(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 = Market discounting	**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 market discounting is measured.

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

DV = Market discounting	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 Market Discounting Estimated from Subsamples

DV = Market discounting	Estimated from Dividend-Issuing Firms only: FE	RCM		Estimated from Non-Dividend-Issuing Firms only: 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

	FE	RCM	
DV = Market discounting		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 market discounting.

Table C.7. Robustness Test of Established Firms

DV = Market discounting	**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 Market Discounting.

DV = Market discounting	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.1: Modeling Risk Premium with Fama-French Risk Factors

A potential criticism of the findings is that the decline in the implied discounting rate *x* over time may be explained away by some systematic risk factors omitted in the original model. To rule out this alternative, we introduced two Fama-French risk factors, size and book-to-market ratio, to the function of firm-specific risk premium (Fama & French 1992). In Eq. (2), 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:

$$\pi_{jt} = \alpha_1 \beta_{jt} + \alpha_2 Z_{jt} + \alpha_3 MV_{jt} + \alpha_4 BM_{jt} \tag{A1}$$

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. (A1) into the Eq. (3), we have the equation that incorporates the Fama-French factors as:

$$P_{jt} = \frac{(D_{jt})\boldsymbol{x_{jt}}}{\left(1+r_t+\alpha_1\beta_{jt}+\alpha_2 Z_{jt}+\alpha_3 MV_{jt}+\alpha_4 BM_{jt}\right)} + \frac{(D_{jt})\boldsymbol{x_{jt}}^2}{\left(1+r_t+\alpha_1\beta_{jt}+\alpha_2 Z_{jt}+\alpha_3 MV_{jt}+\alpha_4 BM_{jt}\right)^2} + \cdots + \frac{(D_{jt}+P_{jt})\boldsymbol{x_{jt}}^N}{\left(1+r_t+\alpha_1\beta_{jt}+\alpha_2 Z_{jt}+\alpha_3 MV_{jt}+\alpha_4 BM_{jt}\right)^N} + \varepsilon_{jt} \tag{A2}$$

The other model specifications follow the original measure. We dropped extreme values due to the complexity of the non-linear estimation.[4] For simplicity, we used the NYSE/AMEX sample only. To probe the consistency between the two measures, we plotted them in Figure A1 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).

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.[5]

To address this criticism, we estimate a different model of the cost of equity that values stock based on the expected residual income (Gebhardt et al., 2001). Compared to the dividend discount model, this model has the advantage of a more generalizable theory of stock return that does not depend upon dividend policy. However, the model's reliance on the information of analysts' forecast of future earnings place a severe empirical constraint on its applicability to a market-wide test, as such information is only available for some public firms over a limited time horizon. Moreover, this approach does not control for firm specific risk (i.e., the company specific risk premium included in our focal estimation).

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

$$P_{it} = B_{it} + (FROE_{it+1} - r_{it}) * \frac{B_t}{1+r_{it}} + (FROE_{it+2} - r_{it}) * \frac{B_{t+1}}{(1+r_{it})^2} + (FROE_{it+3} - r_{it}) * \frac{B_{t+2}}{(1+r_{it})^2 * r_{it}} \tag{A3}$$

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 forecast future return on equity. We assume a three-year return period in the model due to complexity of the non-linear estimation technique and the more limited availability of analyst forecasts beyond three years hence. While cost of equity, *r*, is estimated by solving equation (A3) 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

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

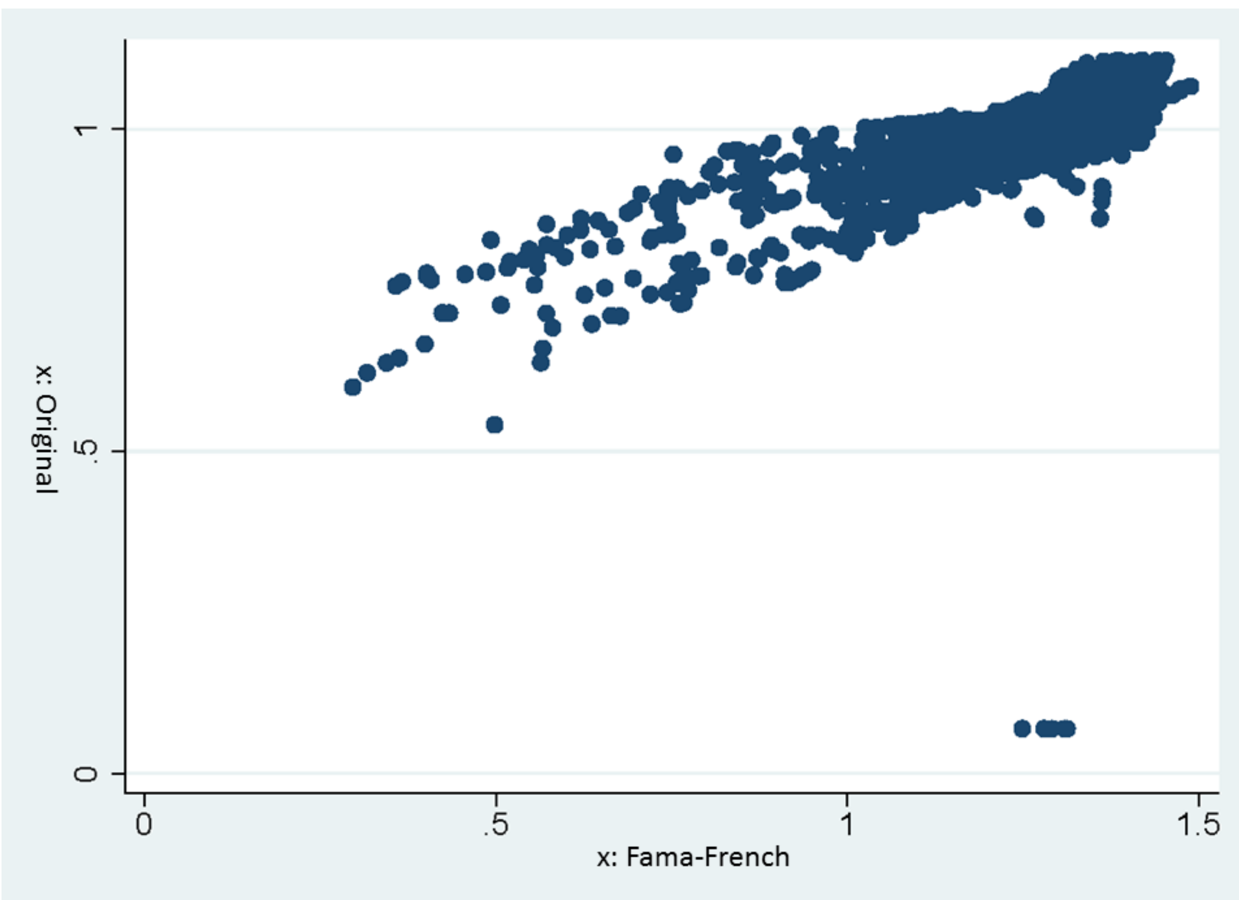
[5] We have also addressed a more specific critique, namely that the original model only applies to non-dividend paying firms in the robustness checks. This section is to address a more general criticism that using dividends as future cash flows is not general enough for the whole market.

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 method of our main market discounting 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 instance, 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 zero growth rate 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 of year t (same as 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 make it comparable to market discounting measure, we use $(1 – 1/1+r_{prm})$ in the yearly plot.

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



Appendix E: Market discounting trends by industry

Figure E.1: Market discounting mean values over time, by industry (NAICS 2 digit)

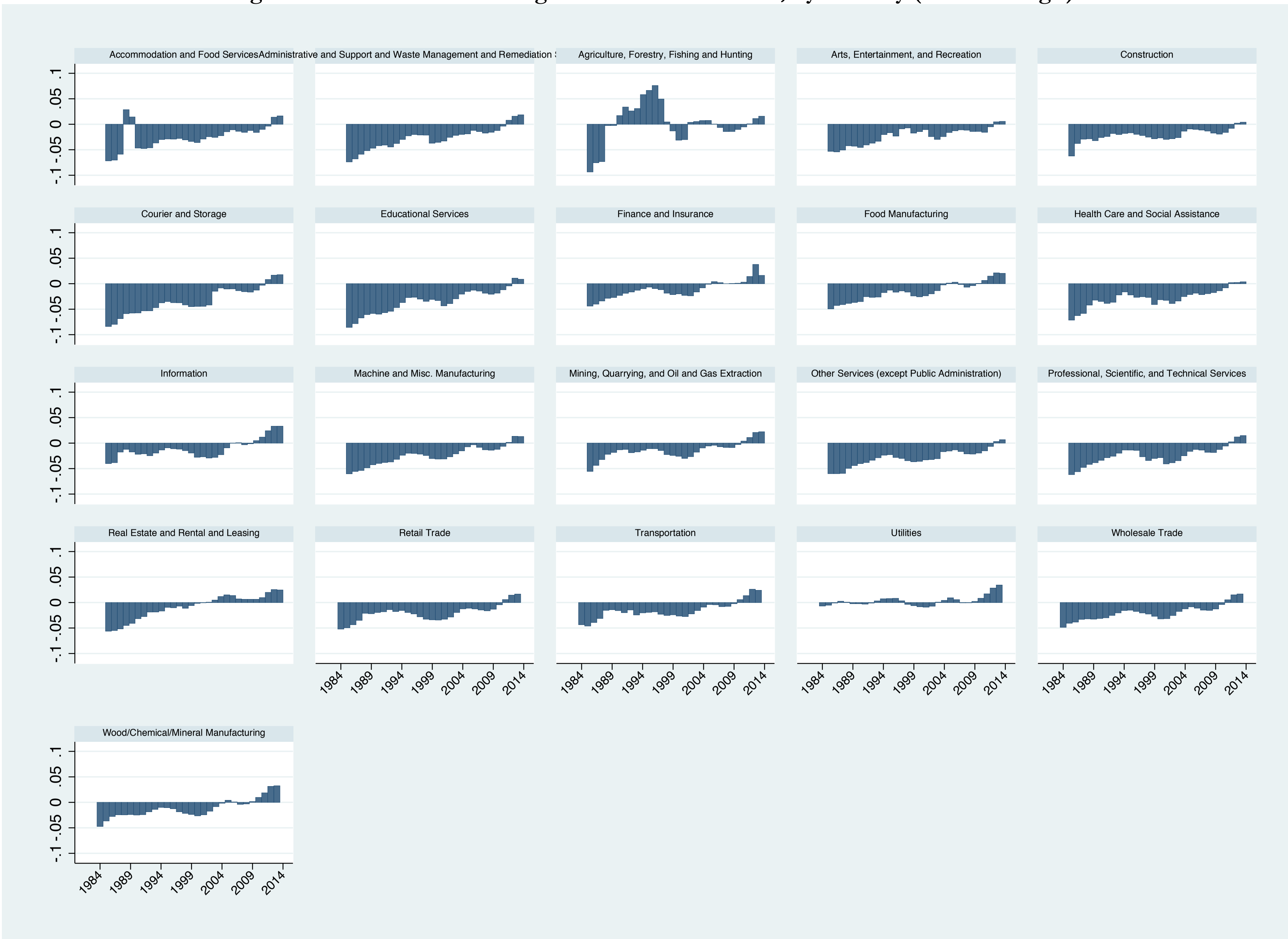
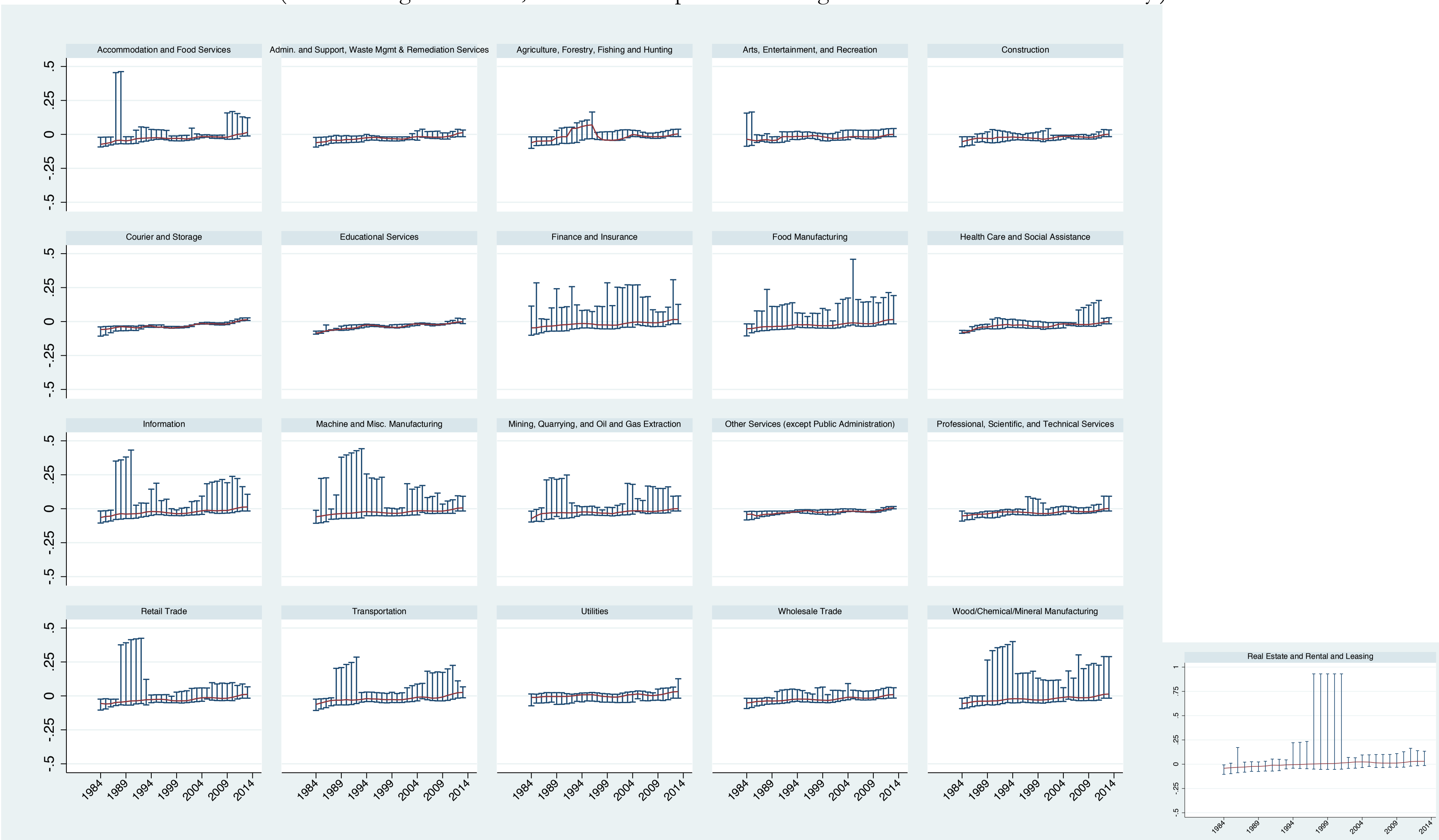


Figure E.2: Market discounting mean values and range over time, by industry
(NAICS 2 digit industries, vertical lines represent the range of firm estimates within industry.)



Appendix F: Market Discounting, Hurdle Rate, and Cost of Capital

In this section, we use an illustrative case to clarify the relationship between x, hurdle rate in NPV models and cost of capital. Through the clarification, we will also reconcile potential trend of declining cost of capital and 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:

$$NPV = \frac{CF}{1+R} + \frac{CF}{(1+R)^2} + \frac{TV}{(1+R)^2} \qquad \text{Eq.(F1)}$$

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 then pay the market price of the stock of the firm, *MP*, and expect to reap dividends, *D* in a total of *T* periods and a terminal price, *TP*, in the last period. On top of the cost of capital denoted by *C* (the firm specific part modeled as Eq.(2) in the text plus a risk-free rate), the investor applies a firm-specific discounting rate of *x*, our main measure, to the valuation of the stock. For easy comparison, we also assume *T* = 2. The stock price can then be expressed as:

$$MP = \frac{Dx}{1+C} + \frac{Dx^2}{(1+C)^2} + \frac{TPx^2}{(1+C)^2} \qquad \text{Eq.(F2)}$$

To derive the relationships between hurdle rate R and market discounting rate *x*, we assume market price (*MP*) of the stock reflects the present value of the firm as an investment project (*NPV*).

$$MP = NPV \qquad \text{Eq.(F3)}$$

Thus Eq.(F1) and Eq.(F2) can be seen as representing the same valuation process. Using the right-hand side formulas of both, we may rewrite Eq.(F3) as:

$$\frac{CF}{1+R} + \frac{CF}{(1+R)^2} + \frac{TV}{(1+R)^2} = \frac{Dx}{1+C} + \frac{Dx^2}{(1+C)^2} + \frac{TPx^2}{(1+C)^2} \qquad \text{Eq.(F4)}$$

Eq.(F2) 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.(F4):

$$\frac{CF}{1+R} + \frac{CF}{(1+R)^2} + \frac{TV}{(1+R)^2} = \frac{CFx}{1+C} + \frac{CFx^2}{(1+C)^2} + \frac{TVx^2}{(1+C)^2} \qquad \text{Eq.(F5)}$$

Moving all the terms to the left-hand side, we can rewrite Eq.(F5) as:

$$CF\left(\frac{1}{1+R} - \frac{x}{1+C}\right) + (CF + TV)\left(\frac{1}{(1+R)^2} - \frac{x^2}{(1+C)^2}\right) = 0 \qquad \text{Eq.(F6)}$$

Because *CF*, *TV*, R, *C* and *x* are all greater than zero, the only solution to *x* in Eq.(F6) is:

$$x = \frac{1+C}{1+R} \qquad \text{Eq.(F7)}$$

Holding hurdle rate R constant in Eq.(F7), lower cost of capital C would lead to lower x (more discounting). The interpretation is that firms do not lower hurdle rate to finance long-term project even when they can afford to do so with the lowering cost of capital in the current market (Mankins, Harris & Harding, 2017). In more general scenarios, we may predict a declining x as long as C decreases faster than R. Holding C constant in Eq.(F7), a higher R would then indicate lower x, or more discounting. The association between x and R suggests that the shortening investment horizon of market investors may be a response to the shrinking time horizon of the managers inside the firm, as investors may take cues from firms' internal discounting practice and price their stocks accordingly.