Three essays on payout policy

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I declare that, except where indicated otherwise, this thesis comprises only my original work towards the PhD, and that due acknowledgement has been made in the text to all other material used. This thesis does not contain any material that has been submitted, previously, in whole or in part, for the award of other academic degree ordiploma.

Bardia Khorsand
Thursday 10th March, 2022

To my wife, my father and my mother.

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Abstract

This thesis studies dividend payout policy and its effect on firms' financial policy. It comprises three chapters. The first chapter, *"The Real and Financial Effects of Dividend Rigidity"*, explores the consequences of an inflexible dividend policy. We study dividend smoothing in tandem with debt and investment. Avid smoothers resort to net debt to absorb cash flow variations because altering dividends is not fully available. Financially constrained firms are unable to rely entirely on debt to mitigate smoothing frictions, curbing investments to fund cash flow shocks. The effect persists for transitory cash flow, making it unlikely to be driven by heterogeneous growth options. We exploit differences in the loadings of smoothing on dividend strip returns as instruments to address endogeneity concerns. Our findings result from dividend rigidity rather than total payout and the results are magnified for extreme smoothers.

The second chapter, *"Dividend Hibernation and Future Earnings: When No Dividend News Is Good News"*, studies a specific type of dividend smoothing called dividend hibernation. Firms frequently enter into dividend hibernation, periods during which dividends remain unchanged for consecutive quarters. We employ a dividend event framework to show that, compared with matched non-hibernating firms, hibernating firms experience higher unexpected future earnings growth for up to five years by reducing underinvestment. We construct an index of adverse selection measures and find that hibernating firms are more opaque, indicating that the information gap between insiders and outsiders widens when there is no change in dividends. Extended hibernation episodes increase the opaqueness, while dividend changes after prolonged periods of no signalling reduce the information gap more effectively.

A question may arise with a section of the first chapter claiming that dividend smoothing can have a negative impact on firm value while, in the second chapter, it is argued that hibernation (a specific form of smoothing) can have a positive impact

on firm value. One must note that, in the first chapter, it is argued that dividend smoothing destroys value in the presence of financial constraints. If a firm has sufficient access to external funds, smoothing is not necessarily a policy with adverse valuation outcomes. Hence, to be clear, the two chapters focus on different aspects of payout policy.

In the third chapter, *"Estimating Permanent Earnings Surprise"*, we estimate unexpected changes in permanent earnings for individual firms by using lagged stock return responses to dividend changes. We show that the estimated surprises in permanent earnings represent aggregate permanent earnings. Moreover, we document that firms return 82% of permanent earnings to shareholders through dividends, on average.

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Chapter 1

The Real and Financial Effects of Dividend Rigidity

1.1 Introduction

Dividend smoothing is a well-documented empirical regularity. Managers appear to be highly reluctant to cut dividends, but also hesitant to increase them. This rigidity in the dividend payout policy introduces friction into the cash flow allocation of the firm. If the firm is financially constrained and the costs associated with adjusting dividends are sufficiently large, then smooth dividends affect investment decisions within firms. This paper is the first to empirically investigate the extent to which dividend smoothing, and the friction arising from it, affects the allocation of internal cash flow, while controlling for unobserved investment opportunities as well as other sources and uses of funds in a cash flow identity framework.

Lintner [1956] was among the first to report that firms smooth dividends relative to earnings. Brav et al. [2005] echo this conclusion in their survey of executives, finding that managers are willing to raise external funds or trade-off assets, employees and positive net present value (NPV) projects to avoid dividend cuts. The highest agreement score (94%) in their survey pertains to the reluctance of managers to cut dividends. DeAngelo and DeAngelo [1990] report that "firms with long dividend histories appear particularly reluctant to omit dividends", while Floyd et al. [2015] show that 43% of industrials with losses continued paying dividends during the global financial crisis (GFC). Leary and Michaely [2011] show that smoothing is on the rise, and Michaely and Roberts [2011] assert that it is more prevalent among listed firms. Hence, dividend smoothing and its role in cash flow allocation warrants further examination.

In a perfect capital market, dividends and the degree to which they are smoothed become irrelevant [Miller and Modigliani, 1961]. However, observed dividend policies are too rigid, making them particularly difficult to reconcile with the theory [Hennessy and Whited, 2007]. Given this strong preference for smooth dividends, altering the dividend stream is likely to be more costly among the more constrained firms. Previous studies[1] largely assume a frictionless dividend stream that could be cut at no additional cost; however, dividends are not a costless source of internal funds. If these costs are sufficiently large, then firms could be more willing to trade-off investments to achieve smoothness.

We argue that costly dividend adjustments have important and often neglected corporate policy implications. First, absent perfect capital markets, the introduction of this previously unexplored friction increases investment–cash flow sensitivity for dividend-paying firms compared with non-dividend payers. Second, we expect this sensitivity to monotonically increase with smoothing. Third, we conjecture that the precommitment to smooth dividends exacerbates the financial constraints of the firm, inducing a positive association between financial constraints and dividend smoothing. To insulate investments from cash flow variations, firms need to absorb the shocks by altering either payout or net debt policies. Financially constrained firms with inflexible payout are likely to relay these shocks to their investments. This implies that rigid dividends bear both financial and real consequences.

Empirically, we follow Chang et al. [2014, henceforth, CDWY] to track how United States (US) firms allocate each additional dollar of cash flow to the uses and sources

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[1] Almost all models pertaining to cash flow sensitivity and financial constraints assume perfect elasticity of dividends. Refer to, for example, Fazzari et al. [1988]; Kaplan and Zingales [1997]; Almeida et al. [2004]; Moyen [2004]; Almeida and Campello [2007]; Riddick and Whited [2009]; Bond and Söderbom [2013]; Carvalho [2018].

of funds. Our structural model calibrates multiple dependent variables (investment, cash reserves, dividends, debt and equity issuance) against cash flow and common controls to form a system of equations. Since firms are bound by budget constraints, the coefficients on all cash flow variables must sum up to one for all regressions, while the sum of the coefficients on all other variables must be zero so that the cash flow identity holds. A contemporaneously exogenous smoothing regressor and its interaction with the cash flow variable are added to each regression. The loadings on the interaction term reveal the effect of smoothing and show how firms finance it. This approach adopts the combined theory of Lambrecht and Myers [2012, 2017], asserting that payout, debt and investment policies are interrelated and must be studied in tandem.

Consistent with our prediction, we find that investment is 20% more sensitive to cash flow for dividend-paying firms compared with the full sample. The two measures of dividend smoothing, speed of adjustment (SOA) and relative volatility of dividends, are estimated following Leary and Michaely [2011] and applied to show that smoothing positively affects investment–cash flow sensitivity as hypothesised. Firms that smooth more (less) have a lower (higher) SOA (as well as relative volatility) and bear a higher (lower) dividend smoothing cost. A 10% decrease in the lagged SOA (more smoothing) is associated with a 2.6 cent (t-stat = 2.64) increase in investment–cash flow sensitivity. Because investment is a use of funds variable and the cash flow identity sums to unity, the net effect of all other cash flow variables should be 2.6 cents out of each additional dollar to balance the identity. We observe that firms finance the increased sensitivity entirely through debt, whereby a 10% increase in smoothing corresponds to a 3.1 cent (t-stat = 3.18) increase in net debt issuance.

Given that the average firm is estimated to pay out 4 cents of each additional dollar as dividends during the sample period, the effect of dividend smoothing is economically significant. More specifically, assume that a dividend-paying firm has an average SOA of 0.14 [Leary and Michaely, 2011]. This means that it takes almost 4.6 years to close half the gap between the actual and target dividends.[2] Now, assume that a firm decides to close this gap faster, say by one year (less smoothing). This 25% increase in the SOA from 0.14 to 0.18 is associated with a 7 cent decrease (2010 constant dollar) in investment–cash flow sensitivity and an 8 cent decrease in net debt issuance out of each additional dollar, indicating that dividend smoothing plays a central role in both investment and capital structure policies.

To test the link between financial constraints and smoothing frictions, we divide our sample into two subcategories based on the degree of financial constraint and observe that the effect of smoothing is statistically and economically significant in more constrained firms. A 10% decrease in the SOA becomes associated with a 5 cent increase (t-stat = 3.68) in investment–cash flow sensitivity, with only 3.7 cents (t-stat = 2.79) financed through debt, while all other cash flow variables remain unresponsive, exposing investments to an underfunded 1.3 cent variation. For less constrained firms, the effect is close to zero, indicating that smoothing frictions decrease once firms have better access to external finance. We corroborate these conclusions by conditioning on an exogenous shock to find smoothers cutting investments to finance fixed dividends when their access to credit markets is curtailed.

Our instrumental variable (IV) approach confirms that dividend smoothing has a causal effect on investments. We employ estimates of the S&P500 dividend strip prices from intra-day options data developed in Van Binsbergen et al. [2012]. The extant literature [Ang and Bekaert, 2006; Chen et al., 2012; Van Binsbergen and Koijen, 2017] shows that dividend growth is, to some extent, predictable. However, Van Binsbergen et al. [2012] document that despite this added predictability, the risk-adjusted returns for dividend strips are too high. We intend to use this puzzling result in the first-stage regression. We posit that firms with more predictable dividend streams (more smoothing) load positively on dividend strip returns. That is,

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[2] Half-life is the time needed to close half the gap between the actual and target payout. If payout follows the Lintner [1956] model, the half-life is log(0.5)/log(1 - SOA). That is, log(0.5)/log(1 - 0.14) = 4.6 years.

firms that smooth more are likely to become more persistent components of S&P500 dividend strips, and thus earn higher returns. Empirically, the returns for a dividend steepener strategy are positively correlated with the smoothing, while also being orthogonal to the investment policy of the firm, thereby satisfying the relevancy and orthogonality conditions. We find that a one-standard-deviation decrease (more smoothing) in SOA decreases the investment-to-asset ratio by 5.5%. The results remain robust to different measures of smoothing.

There are two further identification concerns. First, dividends gradually adjust to the permanent component of cash flow while being less responsive to transitory shocks [Kumar and Lee, 2001; Lambrecht and Myers, 2012]. In this case, smoothing is sustained by the permanent cash flow, and access to external finance is less relevant. That is, in a permanent setting, firms already operate close to target payout. Therefore, without a shock, rent-seeking managers have little incentive to deviate from the target dividend [Lambrecht and Myers, 2017; Wu, 2017]. Second, the above-mentioned results are permissible under the dividend irrelevancy theorem whereby dividends and investments are jointly determined by unobservable investment options.

In turn, we decompose cash flow into (orthogonal) permanent and transitory components and repeat the analysis. CDWY show that transitory cash flows are unlikely to be correlated with investment options. While verifying that dividends are largely sustained by the permanent cash flow, we find that the previous results become more pronounced in a transitory setting. The investment–transitory cash flow sensitivity for dividend payers is 48% higher than for non-dividend payers. In response to transitory shocks, investments should remain resilient, and the loading on lagged smoothing, interacted with transitory cash flow, should be insignificant because investments are driven by long-term growth opportunities. However, the effect of smoothing on investment sensitivity becomes more pronounced. A 10% decrease in the lagged SOA is associated with a 3.5 cent increase (t-stat = 2.89) in investment–

transitory cash flow sensitivity, financed entirely through debt (3.9 cents; t-stat = 3.34).

The effect of smoothing on investment–transitory cash flow surges to 6.8 cents for more constrained firms. Importantly, only 4.3 cents of the increase is financed through debt. Therefore, any variations in cash reserves and external finance are not enough to nullify the effect of smoothing on investment, causing the irrelevancy theorem to break down. Firms that smooth more exhibit a smoother but smaller dividend stream for a longer period relative to firms that smooth less. Yet, even after setting lower dividends and employing debt to counteract shocks, constrained firms that smooth more rely on investments to absorb the transitory variations because all other sources and uses of funds remain insignificant. That is, limited access to capital markets causes smoothing to be more costly, introducing a friction that leads to the formerly unrelated investment and dividend policies to be jointly determined.

Dividends are not the only way to distribute cash. We add share repurchases to dividends and measure total payout smoothing. We repeat the analysis and find that the relationship between smoothing and investment is weak and not affected by financial constraints. This result is in line with Bonaimé et al. [2013], whereby flexible payout, one that favours repurchases over dividends, and hedging are substitutes. In this sense, firms that adhere to a more flexible payout policy have more discretion in neutralising cash flow shocks compared with firms with more rigid dividends that have to transfer transitory shocks to their investment decisions.

1.2 Method

1.2.1 Intertemporal budget constraint

Our estimation strategy is similar to CDWY. We employ an intertemporal budget constraint (IBC) that ensures simultaneity in cash flow allocation while addressing the omitted variable bias concerns that are common in corporate finance research [e.g. Lambrecht and Myers, 2012]. Firms are bound by the IBC; that is, an additional dollar of a firm's internally generated cash flow can be distributed as dividends, retained as cash reserves (zero-NPV investment), spent on investments, or used to repay debt or reduce equity financing. Therefore, flow-of-funds (cash flow) data provide us with the following cash flow identity for a given firm:[3]

$$\mathrm{Inv}_t + \mathrm{CR}_t + \mathrm{Div}_t - \mathrm{ND}_t - \mathrm{NQ}_t = \mathrm{CF}_t \tag{1.1}$$

where the internally generated cash flow (CF_t), net debt issuance (ND_t) and net equity issuance (NQ_t) are the sources of funds. The uses of funds include investment (Inv_t), cash reserves (CR_t) and cash dividends (Div_t). According to (1.1), each dollar of funds used ($\mathrm{Inv}_t + \mathrm{CR}_t + \mathrm{Div}_t$) that is not financed through external financing activities ($\mathrm{ND}_t + \mathrm{NQ}_t$) is financed by internal cash flow (CF_t).[4]

In the baseline model, each component of the cash flow identity delineated in (1.1) is regressed on cash flow (CF_{it}), and a vector of control variables (V_{it-1}) is added to control for observed heterogeneity among firms. Year dummies (y_t) in the regressions account for time effects. Further, all variables are demeaned to partially treat unobserved heterogeneity [Chang et al., 2014]. Hence, our empirical regression model is written as follows:

$$\mathrm{Inv}_{it} = \alpha^{\mathrm{Inv}} + \beta_1^{\mathrm{Inv}}\mathrm{CF}_{it} + \beta_2^{\mathrm{Inv}}\mathrm{V}_{it-1} + y_t + \varepsilon_{it}^{\mathrm{Inv}} \tag{1.2}$$

$$\mathrm{Div}_{it} = \alpha^{Div} + \beta_1^{Div}\mathrm{CF}_{it} + \beta_2^{Div}\mathrm{V}_{it-1} + y_t + \varepsilon_{it}^{Div} \tag{1.3}$$

$$\mathrm{CR}_{it} = \alpha^{CR} + \beta_1^{CR}\mathrm{CF}_{it} + \beta_2^{CR}\mathrm{V}_{it-1} + y_t + \varepsilon_{it}^{CR} \tag{1.4}$$

$$\mathrm{ND}_{it} = \alpha^{ND} + \beta_1^{ND}\mathrm{CF}_{it} + \beta_2^{ND}\mathrm{V}_{it-1} + y_t + \varepsilon_{it}^{ND} \tag{1.5}$$

$$\mathrm{NQ}_{it} = \alpha^{NQ} + \beta_1^{NQ}\mathrm{CF}_{it} + \beta_2^{NQ}\mathrm{V}_{it-1} + y_t + \varepsilon_{it}^{NQ} \tag{1.6}$$

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[3] See Appendix D for detailed definitions of the cash flow variables employed throughout this study.

[4] In Appendix A, we motivate our first two hypotheses by extending the Kaplan and Zingales [1997] model to incorporate costly dividend adjustments.

For firm i at time t, the sources of funds must equate to the uses of funds. The coefficients of CF (β_1) in Equations (1.2)–(1.6) must add up to unity and, because the control variables (V_{t-1}) are exogenously predetermined with respect to CF_t, the coefficients on all of these variables (β_2) must add up to zero. Hence, we have the following constraints:

$$\beta_1^{\text{Inv}} + \beta_1^{\text{Div}} + \beta_1^{\text{CR}} - \beta_1^{\text{ND}} - \beta_1^{\text{NQ}} = 1 \tag{1.7}$$

$$\beta_2^{\text{Inv}} + \beta_2^{\text{Div}} + \beta_2^{\text{CR}} - \beta_2^{\text{ND}} - \beta_2^{\text{NQ}} = 0 \tag{1.8}$$

Because we apply flow-of-funds data, the cash flow identity should hold without the explicit imposition of constraints (1.7)–(1.8). CDWY show that a consistent definition of the cash flow variables in (1.1) waivers the explicit imposition of the constraints. They also demonstrate that Equations (1.2)–(1.6) can be consistently estimated using ordinary least squares (OLS) because the set of explanatory variables is the same across all equations, making equation-by-equation OLS equivalent to seemingly unrelated regressions. Hence, we estimate the system of equations by applying OLS to each equation where restrictions are explicitly imposed to strictly abide by the constraints. An alternative IBC specification, in which variables are differenced rather than demeaned, is discussed in Appendix B.[5]

Following common practice in the literature, all variables are scaled by total assets at the beginning of the fiscal year.[6] The vector of control variables (V_{it-1}) includes: the market-to-book (MB) ratio to account for the investment opportunities of the firm; the natural logarithm of the book value of assets, ln(Assets), as a proxy for firm size; sales growth (SalesG), as an additional control for growth prospects; the net property, plant and equipment (PPE)-to-asset ratio (Tangibility), to measure the tangibility of

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[5] First-differencing cash flow variables partially addresses the unobservable time-invariant effect, thereby providing an alternative estimation strategy. We also consider an alternative method to estimate the SOA. The average SOA estimated from this alternative method (0.19) closely follows the average SOA in our baseline model (0.17), as well as the SOA estimates reported in prior literature. We show that more (less) financially constrained firms have higher (lower) SOA; thus, the estimated SOA is positively associated with the degree of financial constraint as hypothesised.

[6] The results hold if we do not scale by total assets at the beginning of the fiscal year.

company assets; and the leverage ratio (Leverage), defined as total interest-bearing debt (the sum of short-term and long-term debt).

In the baseline model, we report the results of our structural model to the full sample in an attempt to provide comparability with CDWY, although the authors do not directly consider the effect of dividend smoothing. Then, we test our first hypothesis by dividing our sample into dividend-paying and non-dividend-paying firms, expecting a higher investment–cash flow sensitivity among dividend payers.

To test the second hypothesis, we insert an estimate of dividend smoothing (DS) into the system and make it interact with the cash flow variable as follows:

$$\text{Inv}_{it} = \alpha^{\text{Inv}} + \beta_1^{\text{Inv}}\text{CF}_{it} + \beta_2^{\text{Inv}}\text{DS}_{it-1} + \beta_3^{\text{Inv}}\text{DS}_{it-1} \times \text{CF}_{it} + \beta_4^{\text{Inv}}\text{V}_{it-1} + y_t + \varepsilon_{it}^{\text{Inv}} \tag{1.9}$$

$$\text{Div}_{it} = \alpha^{Div} + \beta_1^{Div}\text{CF}_{it} + \beta_2^{Div}\text{DS}_{it-1} + \beta_3^{\text{Div}}\text{DS}_{it-1} \times \text{CF}_{it} + \beta_4^{Div}\text{V}_{it-1} + y_t + \varepsilon_{it}^{Div} \tag{1.10}$$

$$\text{CR}_{it} = \alpha^{CR} + \beta_1^{CR}\text{CF}_{it} + \beta_2^{CR}\text{DS}_{it-1} + \beta_3^{\text{CR}}\text{DS}_{it-1} \times \text{CF}_{it} + \beta_4^{CR}\text{V}_{it-1} + y_t + \varepsilon_{it}^{CR} \tag{1.11}$$

$$\text{ND}_{it} = \alpha^{ND} + \beta_1^{ND}\text{CF}_{it} + \beta_2^{ND}\text{DS}_{it-1} + \beta_3^{\text{ND}}\text{DS}_{it-1} \times \text{CF}_{it} + \beta_4^{ND}\text{V}_{it-1} + y_t + \varepsilon_{it}^{ND} \tag{1.12}$$

$$\text{NQ}_{it} = \alpha^{NQ} + \beta_1^{NQ}\text{CF}_{it} + \beta_2^{NQ}\text{DS}_{it-1} + \beta_3^{\text{NQ}}\text{DS}_{it-1} \times \text{CF}_{it} + \beta_4^{NQ}\text{V}_{it-1} + y_t + \varepsilon_{it}^{NQ} \tag{1.13}$$

Dividend smoothing is lagged and thus determined in the previous period, which makes it exogenous to the cash flow identity in the current period. The restrictions are:

$$\beta_1^{\text{Inv}} + \beta_1^{\text{Div}} + \beta_1^{\text{CR}} - \beta_1^{\text{ND}} - \beta_1^{\text{NQ}} = 1 \tag{1.14}$$

$$\beta_2^{\text{Inv}} + \beta_2^{\text{Div}} + \beta_2^{\text{CR}} - \beta_2^{\text{ND}} - \beta_2^{\text{NQ}} = 0 \tag{1.15}$$

$$\beta_3^{\text{Inv}} + \beta_3^{\text{Div}} + \beta_3^{\text{CR}} - \beta_3^{\text{ND}} - \beta_3^{\text{NQ}} = 0 \tag{1.16}$$

$$\beta_4^{\text{Inv}} + \beta_4^{\text{Div}} + \beta_4^{\text{CR}} - \beta_4^{\text{ND}} - \beta_4^{\text{NQ}} = 0 \tag{1.17}$$

Adding a measure of DS provides several insights that are central to our study. First, we expect a positive association between smoothing and investments. We theoretically elaborate on this mechanical relationship in Appendix A and show it empirically in Appendix B. Given that a lower (higher) DS measure corresponds to more (less) smoothing, we expect β_2^{Inv} to be negative and significant. Further, DS is expected to have a positive effect on cash flow sensitivities. That is, more smoothing should increase investment–cash flow sensitivity because firms have precommitted their internal cash flow to maintain stable dividends over time. Therefore, a priori, β_2^{Div} is expected to be negative.

If a firm is more financially constrained, then more (less) dividend smoothing increases (decreases) the effect of dividend payout on available cash flow, and the firm has less (more) discretion in modifying its response to transitory cash flow shocks. The notion of dividends as a precommitment device is explored by John et al. [2015], who conclude that firms that are more prone to a weaker governance scheme precommit to regular dividends to mitigate the agency costs of cash flow. We investigate the precommitment constraint that smoothing imposes on the allocation of internal cash flow and the ways in which it alters cash-related decision-making. Second, the relationship between dividend smoothing and investment–cash flow sensitivity is defined on a yearly basis. However, it is a stylised fact that the growth options of a firm usually span beyond one year and are long term in nature [Lambrecht and Myers, 2012]. Given fixed cash flow, less variation in investment must mean more variation in cash reserves, variation in net debt issuance, variation in net equity issuance or more flexible payout. Therefore, it follows that firms that smooth dividends more (less) must have more (less) changes in their cash reserves, outside finance, or both. Later, we explore this proposition.

1.2.2 Cash flow decomposition

To investigate how dividend smoothing alters the allocation of cash flow, we need to control for unobservable q. We decompose the cash flow (CF) series for each firm i into its permanent and transitory components by applying the rational square-wave filter method of Pollock [2000]. This method is a variant of the Butterworth [1930, henceforth, BW] high-pass filter that is tailored to economic applications. The BW filter produces an orthogonal decomposition of cash flow into its permanent and transitory components. This makes the BW filter an appropriate choice for our work because we require the transitory component to be independent of growth opportunities.[7] Alternative filters [Christiano and Fitzgerald, 2003; Baxter and King, 1999] are considered robustness checks.[8]

By focusing on the transitory component, we add empirical results to the growing theoretical literature on the role of this part of cash flow in shaping corporate decision-making. Decamps et al. [2016] build a dynamic structural model in which a financially constrained firm is exposed to both transitory and permanent cash flow shocks, and show that firm policies are significantly affected by both. The authors relate the increase in cash buffers among firms to growing demands by managers to hedge temporary shocks in cash flow. We relate to their theoretical work by providing evidence on the cash flow sensitivity of cash when firms are exposed to permanent

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[7] Chang et al. [2014] apply the BN [Beveridge and Nelson, 1981] filter to decompose cash flow into its permanent and transitory parts. However, the authors note that the BN filter is not an orthogonal decomposition, which raises concerns about the possible correlation between transitory cash flow and investment opportunities. The authors attempt to mitigate these concerns by showing that the two variables are not highly correlated. In our decomposition of cash flow via the BW filter, the correlation between the permanent and transitory components is 0.02 for the full sample.

[8] The results are available upon request. We do not tabulate the results of applying the Hadlock and Pierce [2010] filter as a result of criticism in the literature [Pollock, 2000; Hamilton, 2018].

as well as transitory shocks. Gorbenko and Strebulaev [2010] develop a theoretical model in which transitory cash flow is included separately, and conclude that larger transitory shocks lead firms to become more financially conservative (adopt a smaller debt ratio). We expand on the role of payout flexibility in providing financial slack to the firm. Our study is most related to Lambrecht and Myers [2012, 2017], who invoke the IBC and study the interactions between investment, financing and payout policies. Although we do not specify the source of the friction responsible for smooth dividends, our empirical findings are consistent with those of Lambrecht and Myers [2017]. In their model, managers are driven by self-interest to smooth their rent in tandem with payout, even in the absence of financial frictions. As a result, dividends are no longer deemed as a residual cash flow but identified as a decision variable (alongside investment, rent-seeking and debt) to be maximised. From our perspective, the theoretical development in this field has significantly outpaced the empirical evidence. This paper strives to fill this gap.

The BW filter is "maximally flat"; that is, its gain function approaches zero for unwanted frequency ripples, while becoming nearly a flat line (full gain at 1) for wanted frequencies. To decompose the CF series, we should aim to limit the possibility of spillovers from permanent into transitory components, and vice versa. High-pass filters block lower-frequency stochastic cycles while passing through cycles that are at or above a specific frequency. We assume that we have a finite time series of interest, y_t, as defined below:

$$y_t = \tau_t + c_t \tag{1.18}$$

where $t = 1, ..., T-1$, τ_t is the permanent component and $c_t \sim N(0, \sigma^2)$ is the transitory component. τ_t may be non-stationary. Like many other filters, the BW filter initially estimates stationary transitory components (c_t), that is, stochastic cycles within a specified range of periods. Then, τ_t is simply defined as:

$$\tau_t = y_t - c_t \tag{1.19}$$

According to Pollock [2000], the gain function of the BW high-pass filter is given by:

$$\psi(\omega) = \left[\left\{1 + \frac{tan(\omega_c/2)}{tan(\omega_c/2)}\right\}^{2m}\right]^{-1} \tag{1.20}$$

where m represents the order of the filter, $\omega_c = 2\pi/p_h$ is the cut-off frequency and p_h is the maximum period. Following general practice, we set p_h to eight years because we have annual data [Pollock, 2000].

One could write y_t as a function of ν_t and ϵ_t, two zero mean, covariance stationary, i.i.d shocks as follows:

$$y_t = \frac{(1+L)^m}{(1-L)^m}\nu_t + \epsilon_t \tag{1.21}$$

where L is the lag operator that moves forward and backward over y_t.

Pollock [2000] shows that the optimal estimate for c_t (represented in a vector containing all cs) is given by:

$$c = \lambda \mathrm{Q}(\Omega_L + \lambda\Omega_H)^{-1}\mathrm{Q}^{'}y \tag{1.22}$$

where $\lambda = tan(\pi/p_h)^{-2m}$ is a function of the order and the maximum period, $\Omega_L = \frac{Var\{\mathrm{Q}^{'}(y-c)\}}{\sigma_\nu^2}$ and $\Omega_H = \frac{Var\{\mathrm{Q}^{'}c\}}{\sigma_\epsilon^2}$ are symmetric Toeplitz matrices and $\mathrm{Q}^{'}$ is a matrix that stores the coefficients of the polynomial $(1-L)^d = 1 + \delta_1 L + ... + \delta_d L^d$.

After applying the filter to the unscaled CF series for each firm, we obtain the permanent (CF_Permnt) and transitory (CF_Transit) components of the original series, which we then deflate by the beginning-of-period book value of assets to arrive at the applicable variables.

1.2.3 Estimating dividend smoothing measures

To test the second hypothesis, we need a measure of dividend smoothing. Empirically, estimating the degree to which firms smooth dividends is not a straightforward task. Lintner [1956] was the first to propose a partial adjustment model that predicts changes in dividends for a given firm. According to this model:

$$\Delta \text{Div}_t = \alpha + \text{SOA}(\text{Target Div} - \text{Div}_{t-1}) + \epsilon_t \tag{1.23}$$

where ΔDiv_t is the change in the dividend from the previous dividend in period $t-1$, SOA (< 1) is the speed of adjustment of the dividend, Target Div is the target dividend payout ratio multiplied by current earnings, α is the constant and ϵ_t is the error term. The target payout ratio and the SOA are assumed to be constant over time, although they vary across firms. The outcome variable is a smooth dividend as a function of earnings.

However, Leary and Michaely [2011] show that within the structure of Lintner [1956], the SOA of the dividend is a materially biased estimate of the true SOA, mainly because of the small-sample bias in estimating autoregressive models. They propose two measures that correct for this bias. The first approach has a two-step procedure to estimate the SOA. First, Leary and Michaely [2011] estimate an unobservable target dividend payout ratio (Target_i) as the median dividend payout ratio of the firm over 10-year rolling windows. The dividend payout ratio is defined as common dividends divided by net income. Next, the gap between the lagged dividends and the target dividends is estimated as follows:

$$\text{dev}_{it} = \text{Target}_i * \text{E}_{it} - \text{Div}_{it-1} \tag{1.24}$$

Regressing the deviations from the target measure on the changes in dividends in a 10-year rolling windows generates a time series estimate for the β coefficient, which is the alternative SOA. Given that this measure captures the degree of smoothness as defined by Lintner's model, we report our baseline results by applying this proxy for the SOA. Formally:

$$\Delta \text{Div}_{it} = \alpha + \beta * \text{dev}_{it} + \epsilon_{it} \tag{1.25}$$

where ΔDiv_{it} is the change in dividends for firm i at time t, dev_{it} is an estimate of the deviation from the target dividend, E_{it} is the earnings and Div_{it-1} is the lagged dividend.

The second alternative measure of dividend smoothing, introduced by Leary and Michaely [2011], is a non-parametric measure. This metric is designed to overcome the inherent limitations of the SOA. The survey results of Brav et al. [2005] show that only 28% of chief financial officers (CFOs) claim that they target the payout ratio, while almost 40% claim that they target a specific level of dividend per share (DPS). This casts doubt on the empirical relevance of Lintner's model in more recent samples. Leary and Michaely [2011] construct a measure of dividend volatility relative to the volatility of earnings. First, the median dividend payout ratio of the firm is multiplied by each year's earnings to mitigate the effect of the dividend level on the relative volatilities. Then, the series is detrended by the following regressions:

$$\mathrm{AdjDPS}_{it} = \alpha_1 + \beta_1 * t + \beta_2 * t^2 + \epsilon_{it}, \tag{1.26}$$

$$\mathrm{Target}_i * \mathrm{AdjEPS}_{it} = \alpha_2 + \gamma_1 * t + \gamma_2 * t^2 + \eta_{it} \tag{1.27}$$

where t is the year and AdjDPS_{it} is the DPS, adjusted for corporate actions by firm i in period t. The regressions are estimated in the same 10-year rolling windows as before. Last, the measure is defined as the ratio of the root mean squared errors from these two regressions $(\sigma(\epsilon)/\sigma(\eta))$ and referred to as a relative volatility measure of dividend smoothing.

To measure the SOA, we require sample firms to have at least 10 years of dividend payments and at least 10 years of non-missing cash flow data. We divide the panel into 10-year overlapping rolling windows. Over each panel, the median target payout ratio and the deviation from the target are estimated according to (1.24). The SOA is obtained by fitting (1.25) and estimating β. We remove negative SOA and SOA larger than one [Lintner, 1956]. The alternative dividend smoothing measure, relative volatility, is also calculated over the same rolling window horizon. The two measures are winsorised at the top 1%.

Figure 1.1 illustrates the time series evolution of the median SOA and relative volatility, as well as the related empirical distributions for the period 1980–2018. The two measures of dividend smoothing are highly correlated (58%). Because the relative volatility measure does not have an upward bound of one, it differs from the SOA in its scale. The pattern in the figure is close to what is reported by Leary and Michaely [2011][9] for a comparable time period. However, because their sample ends in 2005, we can provide more information on the evolution of smoothing over a more recent period.

Both measures remain fairly stable throughout the sample period, consistent with the findings of Floyd et al. [2015] and Almeida et al. [2009], who assert that dividends are resilient. The empirical distribution of the two measures shows a sizeable variation in our panel. There is a concentration of 28% and 9% at zero for the SOA and relative volatility, respectively. This shows a relative prevalence of zero dividend changes (i.e. dividend stickiness) among sample firms. It is important to note that these two measures of dividend smoothing are not substitutable and capture different aspects of smoothing. In the SOA measure, deviation from the target is a key factor in determining the degree of smoothing. The relative volatility measure captures the relative variations in dividends with respect to earnings and does not include deviation from a target. Therefore, we treat the SOA as the main dividend smoothing estimate, while appending it with relative volatility to provide a more comprehensive picture.

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[9] See Panel A of Figure 6 (p. 28) in Leary and Michaely [2011].

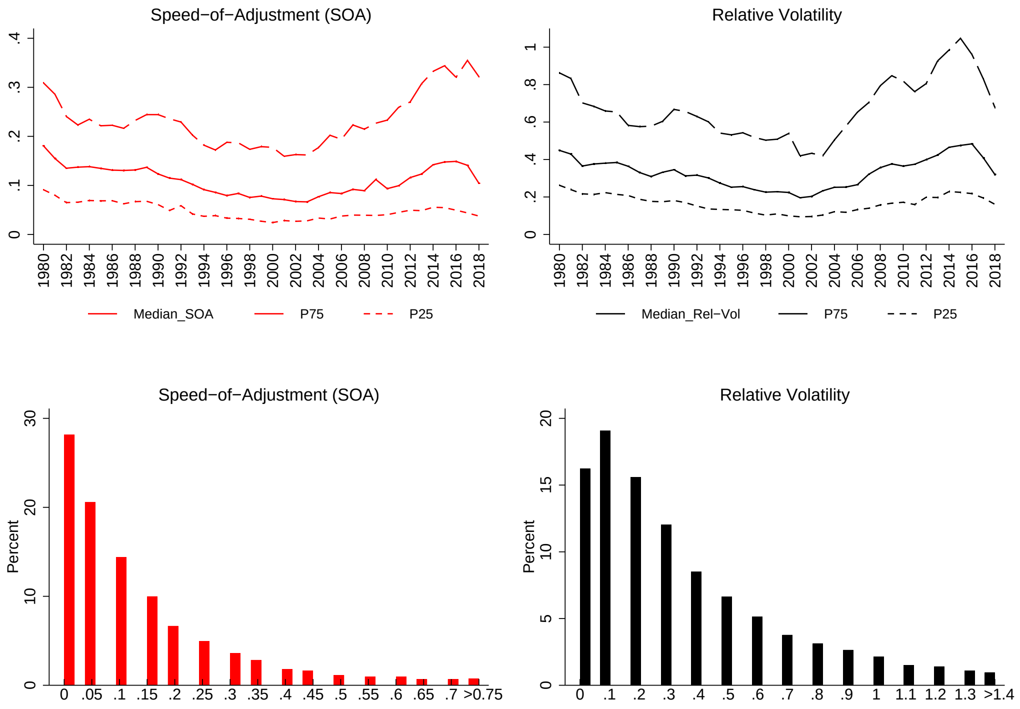

Figure 1.1: Time series and empirical distribution of the speed of adjustment (left) and relative volatility (right). For the period 1980–2018, a sample of dividend-paying industrial firms with at least 10 years of non-missing data on dividends is divided into panels of 10-year overlapping windows. The SOA and Rel-Vol measures of dividend smoothing are estimated within each panel following Leary and Michaely [2011]. If SOA < 0 or SOA $>= 1$, the corresponding observation is set to missing. Measures are winsorised at the top 1%. Time trends show median SOA and Rel-Vol measures.

1.3 Data and summary statistics

Our sample includes all US firms at the intersection of the Compustat industrial annual files and the CRSP tapes at any point between 1987 and 2018. Although Compustat started reporting the data in 1971, prior to 1984, changes in cash variables (Compustat item CHECH) have missing values for up to 93% of the sample. This casts doubt on the validity of the cash flow identity in (1.1) prior to 1984. To account for this, as well as the substantial increase in share repurchases in 1982 [Bagwell and Shoven, 1989] and the different methods of reporting flow-of-funds data, we limit the sample to non-missing format code 7 in Compustat. This shifts the starting point to 1987 and ensures consistency across the data.

We closely follow Frank and Goyal [2003] and CDWY in setting up our cash flow identity variables. The gross domestic product (GDP) deflator data from the Federal Reserve Bank of St. Louis are used to convert all dollar values into 2010 constant dollar terms. We exclude financial institutions (SIC codes 6000–6999) and utilities (SIC codes 4900–4999) from our sample to maintain comparability with prior studies. The sample is also restricted to firms with non-missing dividend data, and those with non-missing data for key cash flow identity variables. Following Almeida et al. [2004], firms with extreme asset growth (larger than 100%), a market value of assets below $1 million (US dollars), or annual sales lower than $1 million are dropped to ensure that the sample is not biased towards more financially distressed firms. Moreover, following CDWY, if the absolute value of the difference between the left-hand and right-hand sides of (1.1) is greater than 1% of the beginning-of-period total assets, we exclude that observation. To avoid concerns arising from sample attrition in an unbalanced panel, we require a given firm to pay dividends for at least 10 years (for dividend-paying firms) and no dividends for at least 10 years (for non-dividend-paying firms). We restrict the sample to firms that are listed in Compustat for at least 10 years to allow for the BW filter to detect the cash flow trend and decompose the series. It is worth noting that after applying the filters, we are left with two non-overlapping samples of dividend-paying and non-dividend-paying firms. We are left with 49,691 firm-year observations and a final sample period that runs from 1987 to 2018 (3,071 unique firms).[10] Following CDWY, we define CF as the operating cash flow net of the change in working capital, which mitigates the unwanted positive correlation between investment and working capital accruals. Earnings are defined as income before extraordinary items plus extraordinary items and discontinued operations. These variables and all other variables are scaled by

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[10] We report the results with 10 years of non-missing cash flow data. The results remain qualitatively identical if we employ 15 years of non-missing cash flow data as in Chang et al. [2014].

the beginning-of-year total assets and winsorised at the 1% top and bottom levels.

1.3.1 Summary statistics

Summary statistics for the key variables in the full sample, as well as the dividend-paying and non-dividend-paying subsamples, are in Table 1.1.[11] Dividend payers are skewed towards larger and more mature firms compared with non-dividend-paying firms, with more tangible assets, more leverage and a higher return on assets (ROA). Consistent with intuition, non-dividend payers have higher sales growth, a higher market-to-book ratio, higher earnings volatility and a lower total payout ratio (10%) relative to dividend-paying firms (66%). Clearly, the two subsamples of dividend payers and non-dividend payers are not fully comparable. This is by necessity because we intend to investigate both dividend smoothing and cash flow allocation behaviour, but limit our sample to firms that pay and do not pay dividends for at least 10 years. This approach is also consistent with Lintner [1956], asserting that the SOA measure is most applicable to large (publicly traded) mature firms [Myers and Majluf, 1984]. Further, we continue reporting the results for non-dividend payers as a point of comparison.[12]

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[11] An average firm in our full sample distributes 14% of its income as dividends ($45.39 million in 2010 constant dollar terms). It has a total payout ratio (dividends plus repurchases divided by net income) of 33%, reports $0.41 earnings per share, has $2,502 million in total assets, exhibits a 0.11% annual sales growth rate, has an annual earnings volatility of 0.07%, identifies 27% of its total assets as tangible, has a leverage level of 0.21, presents a market-to-book ratio of 1.80, has a compounding annual stock return of 17% with a rolling 24-month volatility of 14%, reports a beta of 1.15 (σ_β = 0.71) and has an idiosyncratic volatility of 13% with a rolling 24-month stock alpha of 0.4% (estimated from the market model).

[12] We replicate the mean, median and standard deviation of almost all of the cash flow variables reported in CDWY. An average firm in our sample pays 1% of its total assets as dividends (Div) and reserves 1% of its total assets as a cash buffer (CR) while investing 9% of its total assets (Inv). This use of funds is almost entirely financed by internally generated cash flow, which amounts to 8% of total assets. Outside finance plays a much less important role in the cash flow allocation for the average firm, which finances 2% of its total assets with new debt (ND) while retiring 1% of its equity financing (NQ) annually.

Table 1.1: Summary statistics. The sample includes US industrial firms at the intersection of the annual Compustat file and CRSP during 1987–2018. Firms are required to have non-missing cash flow variables for at least 10 years. The full sample is divided into two groups: dividend-paying firms that pay dividends for at least 10 years and non-dividend-paying firms that do not pay dividends for at least 10 years. DPS and EPS are dividends and earnings per share, respectively. The Dividend Ratio is dividends for common shares divided by income before extraordinary items. The Total Payout Ratio is dividends for common shares plus share repurchases divided by income before extraordinary items. ROA is return on assets, defined as income before extraordinary items plus total interest and related expenses plus deferred taxes, all scaled by total assets. Earnings Volatility in year *t* is the standard deviation of the ratio of EBITDA to total assets over the prior 10 years. Asset Tangibility is the net PPE over total assets. Market-to-Book is defined as the market value of assets divided by the book value of assets. Leverage is defined as total debt divided by total assets. SaleG is the one-year change in sales. Repurchase is defined following Fama and French [2001]. All cash flow identity variables are calculated based on the method described in Chang et al. [2014]. Div is cash dividend, Inv is investment, CR is cash reserve, NQ is net equity and ND is net debt, with all scaled by lagged total assets. Cash flow (CF) is decomposed into its transitory (CF_Transit) and permanent (CF_Permnt) components by applying the Butterworth filter. DIF is the absolute difference between the left-hand and right-hand sides of the CF identity.

	Full Sample			Dividend Payers[1]			Non-Dividend Payers[2]			Mean [1] $\neq$ Mean[2]	
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	T-stat	Significance
DPS	0.23	0.49	0.00	0.61	0.63	0.40	0.00	0.00	0.00	-128.50	***
EPS	0.41	3.53	0.52	1.40	2.37	1.22	-0.46	4.41	0.13	-49.01	***
Repurchase	0.01	0.03	0.00	0.01	0.03	0.00	0.01	0.03	0.00	5.04	***
Ln(Asset)	5.86	2.06	5.82	7.05	1.87	7.07	4.86	1.76	4.79	-118.66	***
ROA	0.03	0.15	0.06	0.07	0.06	0.08	-0.02	0.20	0.03	-62.72	***
Asset Tangibility	0.27	0.22	0.21	0.32	0.21	0.27	0.22	0.22	0.15	-42.02	***
Market-to-Book	1.80	1.36	1.42	1.73	0.94	1.46	1.96	1.73	1.46	18.83	***
Leverage	0.21	0.19	0.18	0.22	0.16	0.21	0.19	0.20	0.14	-15.62	***
SaleG	0.11	2.60	0.05	0.06	0.20	0.04	0.17	4.28	0.06	4.76	***
Earnings Volatility	0.07	0.10	0.05	0.04	0.03	0.04	0.11	0.10	0.08	68.92	***
Dividend Yield	0.01	0.02	0.00	0.02	0.03	0.01	0.00	0.00	0.00	-108.54	***
Dividend Ratio	0.14	0.33	0.00	0.36	0.44	0.28	0.00	0.01	0.00	-111.04	***
Total Payout Ratio	0.33	0.77	0.00	0.66	0.88	0.50	0.10	0.54	0.00	-73.20	***
Compounded (Annual) Stock Return	0.17	0.76	0.06	0.14	0.42	0.10	0.18	0.94	-0.00	4.73	***
Two-Year Stock Return Volatility	0.14	0.09	0.12	0.10	0.04	0.09	0.18	0.11	0.16	92.81	***
Stock Beta	1.15	1.04	1.06	0.98	0.70	0.94	1.30	1.24	1.21	24.69	***
Standard Deviation of Stock Beta	0.71	0.56	0.58	0.47	0.25	0.42	0.91	0.69	0.76	67.52	***
Monthly Stock Alpha (%)	0.45	3.33	0.29	0.29	2.04	0.29	0.50	4.16	0.24	4.72	***
Monthly Idiosyncratic Volatility	0.13	0.09	0.11	0.09	0.04	0.08	0.17	0.11	0.15	79.58	***
Inv	0.09	0.13	0.06	0.09	0.11	0.06	0.09	0.16	0.05	1.05	
Div	0.01	0.02	0.00	0.02	0.02	0.01	0.00	0.00	0.00	-129.31	***
CR	0.01	0.09	0.00	0.01	0.06	0.00	0.01	0.12	0.00	3.75	***
ND	0.02	0.10	0.00	0.02	0.09	0.00	0.02	0.11	0.00	3.08	***
NQ	0.01	0.12	0.00	-0.01	0.05	0.00	0.04	0.17	0.00	39.76	***
CF	0.08	0.12	0.08	0.11	0.08	0.11	0.04	0.15	0.06	-58.10	***
DIF	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	-57.44	***
CF_Transit	0.00	0.08	0.00	0.00	0.05	-0.00	0.00	0.10	0.00	-0.62	
CF_Permnt	0.08	0.09	0.08	0.11	0.06	0.10	0.04	0.12	0.05	-76.16	***
N	46136			16477			16713				

* $p < .10$, ** $p < .05$, *** $p < .01$

We find that the average dividend-paying firm in our sample invests, holds cash and issues new debt almost at the same level as the average firm in the full sample, while paying 1% of total assets more as dividends. Further, dividend-paying firms retire more equity (2% of total assets more). The means of the investment-to-asset ratios for the two subsamples are not statistically different. Non-dividend-paying firms rely on more external finance (equity and debt) and retain more cash than dividend-paying firms. A priori, these results show that, on average, the two subsamples do not differ along the investment dimension, but are different in terms of their financing decisions [Fazzari et al., 1988].

Last, we report a residual term (DIF) equal to the absolute value of the difference between the left-hand and right-hand sides of (1.1). The mean of DIF is close to zero, and it has a negligible standard deviation in the full sample, indicating that the cash flow identity holds. Moreover, Table 1.1 shows that the cash flow decomposition is successful in filtering the cash flow series into zero mean cash flow cycles in the full sample, as well as in the two subsamples. The means of the cash flow cycles are not statistically different, indicating that cash flow shocks have the same mean property in both samples.

To show that the smoothing measures exhibit variation in the cross-section of firms, we divide our sample into quintiles based on the beginning-of-year SOA (relative volatility) measure. Within each quintile, the mean (median) statistics are reported in Table 1.2. The last column presents the t-statistics of the difference between the highest (Q5) and the lowest (Q1) quintiles of the SOA (relative volatility) measure. Consistent with Leary and Michaely [2011], we find that firms that smooth dividends more pay out less dividends (2% of total assets) compared with firms that smooth less (4% of total assets). In effect, firms that smooth dividends the most have lower (average) dividend and total payout ratios (40% and 62%, respectively) compared with firms that smooth the least (43% and 64%, respectively).[13]

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[13] According to the SOA, firms that smooth more (Q1) are, on average, more levered firms with less volatile earnings, lower market-to-book ratios, lower ROA ratios and lower cash-flow-to-asset ratios

A lower (average) dividend payout ratio for more avid smoothers has an immediate implication. Empirically, dividends are one of the most widely used variables in determining a firm's financial constraint [Farre-Mensa and Ljungqvist, 2016], dating back to the seminal work of Fazzari et al. [1988]. In a sample of 49 firms, Fazzari et al. [1988] find that firms that pay no or low dividends experience larger cash flow sensitivity of investment. In response, Kaplan and Zingales [1997] show that only 15% of firms in Fazzari et al. [1988] are actually constrained; therefore, low dividends cannot be a valid indicator of financial constraints. Table 1.2 shows that the key missing component is dividend smoothing. This motivates us to provide insights into the potential relationship between dividends (including their smoothing) and the financial constraints of the firm.

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compared with firms that smooth less (Q5). The average annual compounded return for the two groups shows no statistical difference; however, firms that smooth the most show higher stock return (total) volatility, higher idiosyncratic volatility (market model) and a higher market beta. These market-implied measures are consistent with Larkin et al. [2016] and show that dividend smoothing does not bear a premium in the market. The alternative measure of dividend smoothing, relative volatility, provides a similar picture, albeit with different levels of statistical significance.

Table 1.2: Summary statistics of the main variables for firms with different degrees of dividend smoothing. The sample includes US industrial firms at the intersection of the annual Compustat file and CRSP during 1987–2018. To be included in the sample, firms are required to have non-missing cash flow variables for at least 10 years and pay dividends for at least 10 years. Speed of adjustment (SOA) and relative volatility of dividends are the two measures used of dividend smoothing, estimated following Leary and Michaely [2011]. For each year, firms are sorted according to each measure of dividend smoothing and divided into quintiles, where the lowest quintile (Q1) includes firms that smooth dividends the most, and the highest quintile (Q5) includes firms that smooth dividends the least. DPS and EPS are dividends and earnings per share, respectively. The Dividend Ratio is dividends for common shares divided by income before extraordinary items. The Total Payout Ratio is dividends for common shares plus share repurchases divided by income before extraordinary items. ROA is the return on assets, defined as income before extraordinary items plus total interest and related expenses plus deferred taxes, all scaled by total assets. Earnings Volatility in year *t* is the standard deviation of the ratio of EBITDA to total assets over the prior 10 years. Asset Tangibility is the net PPE over total assets. Market-to-Book is defined as the market value of assets divided by the book value of assets. Leverage is defined as total debt divided by total assets. SaleG is the one-year change in sales. Repurchase is defined following Fama and French [2001]. All cash flow identity variables are calculated based on the method described in Chang et al. [2014]. Div is cash dividend, Inv is investment, CR is cash reserve, NQ is net equity and ND is net debt. All cash flow variables are scaled by lagged total assets. Cash flow (CF) is decomposed into its transitory (CF_Transit) and permanent (CF_Permnt) components by applying the Butterworth filter. DIF is equal to the absolute value of the difference between the left-hand and right-hand sides of the CF identity.

	Speed-of-Adjustment (SOA)					**Relative Volatility**				
	Mean[Q1]	Median	Mean[Q5]	Median	[Q1] $\neq$ [Q5]	Mean[Q1]	Median	Mean[Q5]	Median	[1] $\neq$ [5]
DPS	0.95	0.70	0.84	0.58	***	0.97	0.73	0.86	0.60	***
EPS	2.00	1.53	1.90	1.50		2.06	1.63	2.00	1.58	
Repurchase	0.01	0.00	0.01	0.00	***	0.01	0.00	0.02	0.00	***
Ln(Asset)	7.66	7.72	7.69	7.93		7.75	7.78	7.85	7.96	
ROA	0.06	0.07	0.09	0.09	***	0.06	0.07	0.09	0.09	***
Asset Tangibility	0.30	0.26	0.30	0.26		0.31	0.27	0.30	0.25	*
Market-to-Book	1.60	1.40	1.97	1.64	***	1.59	1.39	2.10	1.80	***
Leverage	0.24	0.23	0.20	0.20	***	0.24	0.24	0.20	0.20	***
SaleG	0.03	0.03	0.05	0.04	***	0.03	0.02	0.04	0.04	***
Earnings Volatility	0.03	0.03	0.04	0.03	***	0.03	0.03	0.03	0.03	
Dividend Yield	0.02	0.02	0.02	0.02		0.03	0.02	0.02	0.02	***
Dividend Ratio	0.40	0.32	0.43	0.37		0.42	0.33	0.41	0.35	
Total Payout Ratio	0.62	0.46	0.64	0.52		0.62	0.47	0.65	0.54	
Compounded (Annual) Stock Return	0.13	0.11	0.13	0.09		0.13	0.11	0.12	0.10	
Two-Year Stock Return Volatility	0.09	0.08	0.08	0.07	***	0.09	0.08	0.08	0.07	***
Stock Beta	1.01	0.96	0.88	0.85	***	1.01	0.95	0.91	0.88	***
Standard Deviation of Stock Beta	0.42	0.39	0.41	0.36		0.43	0.39	0.40	0.35	***
Monthly Stock Alpha (%)	0.11	0.24	0.25	0.28		0.07	0.11	0.21	0.22	**
Monthly Idiosyncratic Volatility	0.08	0.07	0.07	0.06	**	0.08	0.07	0.07	0.06	***
Inv	0.08	0.06	0.08	0.06		0.07	0.06	0.08	0.06	**
Div	0.02	0.02	0.04	0.03	***	0.02	0.02	0.04	0.03	***
CR	0.00	0.00	0.01	0.00		0.00	0.00	0.01	0.00	
ND	0.02	0.00	0.01	0.00		0.01	-0.00	0.01	0.00	
NQ	-0.01	-0.00	-0.02	-0.00	***	-0.01	0.00	-0.02	-0.01	***
CF	0.10	0.10	0.12	0.12	***	0.10	0.10	0.13	0.12	***
DIF	0.00	0.00	0.00	0.00	***	0.00	0.00	0.00	0.00	***
CF_Transit	-0.00	-0.00	0.00	-0.00		-0.00	0.00	-0.00	-0.00	
CF_Permnt	0.10	0.10	0.12	0.12	***	0.10	0.10	0.13	0.12	***

* $p < .10$, ** $p < .05$, *** $p < .01$

1.4 Results

1.4.1 Dividends and the cash flow allocation

We estimate Equations (1.2)–(1.6), where constraints (1.7)–(1.8) are simultaneously imposed, for the full sample and for the two subsamples separately. We control for other variables that may affect the allocation of cash flow, add year dummy variables to control for time trends in the data, and demean all variables to account for possible unobservable variables that may affect the relationship of interest. First, we compare our results outlined in Table 1.3 with the findings outlined in CDWY (Table 3). Economically, in response to a one dollar increase in the overall cash flow, sample firms, on average, pay out 1 cent as dividends, invest 26 cents, retain 28 cents as cash, reduce equity finance by 23 cents and retire 22 cents of debt. Except for the coefficient on net equity issuance, our results are close to the findings of CDWY. Signs, statistical significance (t-stats) and the magnitude of the coefficients on the lagged control variables are also in line with the output reported in CDWY.[14]

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[14] In terms of the permanent and transitory components of cash flow, we document that firms pay almost three times more dividends (2 cents) out of the permanent component than they do from the transitory component (0.4 cents). CDWY find that firms pay 1 cent out of each additional dollar of either the transitory or permanent components. That is, our results are more aligned with the literature [Lintner, 1963; Fama and Babiak, 1968; Skinner, 2008] that shows firms paying more dividends out of permanent earnings. We verify the main findings of CDWY that firms, in response to transitory shocks, tend to retain more cash rather than spend on investments. However, in terms of outside finance, we observe that net equity issuance is more active in responding to both components of cash flow in our results compared with CDWY, although the qualitative role of external finance remains unchanged.

Table 1.3: Dividend payout–allocation of cash flow in the full sample. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. The table reports the allocation of internally generated cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Div is cash dividend, CR is cash reserve, ND is net debt issuance and NQ is net equity issuance. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. All control variables are lagged to control for contemporaneous effects. SaleG is the annual growth rate in sales, Leverage is defined as total debt (sum of short-term and long-term debt) divided by total assets, MB is defined as the market value of assets divided by the book value of assets, LnAT is the natural logarithm of total assets and Tangibility is the net PPE over total assets. All variables are demeaned to account for unobservable heterogeneity (firm fixed effects). Year dummies are included to reduce the effect of time trends on our results (year fixed effects).

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ
CF	0.258***	0.008***	0.278***	-0.223***	-0.234***										
	(54.04)	(13.48)	(69.68)	(-54.26)	(-54.73)										
CF_Permnt						0.323***	0.020***	0.152***	-0.163***	-0.342***					
						(31.90)	(16.14)	(17.71)	(-18.62)	(-37.68)					
CF_Transit											0.235***	0.004***	0.318***	-0.241***	-0.201***
											(42.33)	(6.34)	(68.99)	(-50.65)	(-40.27)
SaleG$_{t-1}$	0.022***	-0.001***	-0.001	0.014***	0.006***	0.021***	-0.001***	-0.001	0.014***	0.005***	0.023***	-0.001***	-0.002	0.014***	0.005***
	(15.76)	(-6.87)	(-1.04)	(11.73)	(4.41)	(15.05)	(-6.37)	(-0.69)	(11.56)	(4.13)	(15.98)	(-6.63)	(-1.58)	(11.86)	(4.10)
Leverage$_{t-1}$	-0.122***	-0.009***	0.020***	-0.179***	0.069***	-0.119***	-0.008***	0.013***	-0.176***	0.063***	-0.117***	-0.009***	0.015***	-0.179***	0.068***
	(-30.79)	(-18.04)	(6.08)	(-52.62)	(19.42)	(-29.26)	(-16.31)	(3.90)	(-50.15)	(17.30)	(-29.31)	(-18.24)	(4.57)	(-52.31)	(19.10)
MB$_{t-1}$	0.020***	0.001***	0.006***	0.007***	0.020***	0.019***	0.001***	0.007***	0.007***	0.020***	0.020***	0.001***	0.006***	0.007***	0.019***
	(40.68)	(18.72)	(14.37)	(17.29)	(44.68)	(38.75)	(18.34)	(15.84)	(16.39)	(44.95)	(40.12)	(18.99)	(14.53)	(17.41)	(44.02)
LnAT$_{t-1}$	-0.018***	0.001***	-0.014***	-0.002***	-0.028***	-0.019***	0.001***	-0.012***	-0.003***	-0.027***	-0.019***	0.001***	-0.013***	-0.003***	-0.028***
	(-23.82)	(13.87)	(-21.72)	(-3.54)	(-41.54)	(-23.92)	(11.89)	(-18.71)	(-4.50)	(-38.56)	(-25.28)	(14.15)	(-19.89)	(-3.81)	(-40.95)
Tangibility$_{t-1}$	0.027***	-0.007***	0.070***	0.059***	0.032***	0.024***	-0.007***	0.076***	0.056***	0.037***	0.022***	-0.006***	0.075***	0.058***	0.032***
	(4.56)	(-9.46)	(14.47)	(11.71)	(6.04)	(4.07)	(-10.29)	(15.06)	(10.85)	(6.98)	(3.69)	(-9.05)	(15.43)	(11.52)	(6.14)
Constant	0.013***	-0.001***	-0.009***	0.009***	-0.004	0.011***	-0.002***	-0.008**	0.009***	-0.002	0.014***	-0.001***	-0.006*	0.007**	-0.006*
	(3.14)	(-3.73)	(-2.89)	(2.91)	(-1.29)	(2.78)	(-4.20)	(-2.45)	(2.73)	(-0.67)	(3.54)	(-3.47)	(-1.85)	(2.22)	(-1.85)
N	46136					46136					46136				
R^2	0.117	0.072	0.100	0.112	0.124	0.095	0.074	0.030	0.073	0.104	0.104	0.070	0.100	0.107	0.105

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Next, we estimate the same system of equations in the two subsamples of dividend-paying and non-dividend-paying firms. Table 1.4 summarises the results. Although all of the control variables and time dummies are included in the model, for brevity, they are not reported in the output tables. The results are conclusive. Consistent with the prediction, investment–cash flow sensitivity is 20% higher for dividend-paying firms compared with non-dividend payers. To mitigate unobserved growth options, it is beneficial to study how firms allocate their transitory cash flow, because the transitory component is unlikely to be correlated with growth options. The investment–transitory cash flow sensitivity of dividend-paying firms is almost 48% higher compared with non-dividend-paying firms, and 32% higher compared with the full sample. This verifies our first hypothesis, that cash flow sensitivity of investment in dividend-paying firms is higher relative to non-dividend payers.

Out of each additional dollar of cash flow, dividend-paying firms spend 30 cents on investment, 3 cents on dividends and retain 32 cents as cash reserves, while repaying 28 cents of outstanding debt and buying back 7 cents of outstanding equity. In this sense, there is a stark difference between the way dividend-paying and non-dividend-paying firms allocate their internal cash flow. Non-dividend payers allocate 25 cents of an additional dollar of internal cash flow to investment, spend zero on dividends, retain 26 cents as cash, repay 21 cents of outstanding debt and spend much more on buying back shares, almost 28 cents out of each dollar. Although dividend-paying firms have a higher cash flow sensitivity of cash compared with non-dividend payers, the difference is not as severe as in the case of investment–cash flow sensitivity. On average, a dividend-paying firm retains 24% more cash out of transitory cash flow than a non-dividend-paying firm. The net equity issuance is not so active in responding to transitory cash flow (only 4 cents out of each dollar), whereas non-dividend-paying firms spend almost 27 cents out of each additional dollar of transitory cash flow to buy back shares. It is worth noting that once we condition on dividend payment, the differences between cash and investment sen-

Table 1.4: Dividends payout–allocation of cash flow in the two subsamples of dividend-paying and non-dividend-paying firms. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. We divide the sample and report the results for two subsamples of dividend-paying firms that pay dividends for at least 10 years (Panel A) and non-dividend-paying firms that do not pay dividends for at least 10 years (Panel B), separately. The table reports the allocation of internally generated cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Div is cash dividend, CR is cash reserve, ND is net debt issuance and NQ is net equity issuance. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. All control variables are lagged to control for contemporaneous effects. SaleG is the annual growth rate in sales, Leverage is defined as total debt (sum of short-term and long-term debt) divided by total assets, MB is defined as the market value of assets divided by the book value of assets, LnAT is the natural logarithm of total assets, and Tangibility is the net PPE over total assets. All variables are demeaned to account for unobservable heterogeneity (firm fixed effects). Year dummies are included to reduce the effect of time trends on our results (year fixed effects). For brevity, all control variables are included in the model during estimation but are not reported in the output.

Panel A - Dividend-Paying Firms

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ
CF	0.299***	0.027***	0.321***	-0.284***	-0.069***										
	(30.98)	(15.23)	(47.82)	(-31.28)	(-12.60)										
CF_Permnt						0.278***	0.080***	0.123***	-0.337***	-0.181***					
						(12.06)	(19.01)	(7.45)	(-15.54)	(-14.16)					
CF_Transit											0.305***	0.015***	0.363***	-0.273***	-0.044***
											(28.57)	(7.71)	(49.22)	(-27.15)	(-7.28)
Constant	0.004	-0.002***	-0.004	-0.000	0.003	0.008*	-0.002***	0.001	-0.004	0.003	0.008	-0.002***	-0.001	-0.004	0.002
	(0.71)	(-3.15)	(-1.59)	(-0.05)	(1.30)	(1.65)	(-3.39)	(0.19)	(-0.85)	(1.29)	(1.61)	(-2.58)	(-0.53)	(-0.97)	(0.77)
N			16477					16477					16477		
R^2	0.118	0.167	0.124	0.108	0.080	0.092	0.174	0.021	0.080	0.082	0.112	0.158	0.129	0.098	0.074

Panel B - Non-Dividend Paying Firms

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ
CF	0.249***	0.000	0.260***	-0.209***	-0.282***										
	(32.42)	(1.14)	(37.88)	(-33.63)	(-36.84)										
CF_Permnt						0.351***	0.000	0.180***	-0.151***	-0.317***					
						(22.33)	(0.91)	(12.59)	(-11.81)	(-20.13)					
CF_Transit											0.214***	0.000	0.288***	-0.228***	-0.270***
											(23.79)	(0.48)	(35.91)	(-31.56)	(-30.11)
Constant	0.022**	-0.000	-0.009	0.014**	-0.001	0.015	-0.000	-0.012	0.017**	0.005	0.023**	-0.000	-0.005	0.011*	-0.004
	(2.40)	(-0.12)	(-1.13)	(2.14)	(-0.10)	(1.61)	(-0.14)	(-1.56)	(2.53)	(0.59)	(2.55)	(-0.08)	(-0.61)	(1.65)	(-0.40)
N			16713					16713					16713		
R^2	0.113	0.003	0.095	0.116	0.157	0.094	0.003	0.042	0.072	0.125	0.095	0.003	0.090	0.110	0.141

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

sitivities to cash flow become marginal, which is another indication that dividend policy significantly affects cash flow allocation within firms.

The response of investment to the permanent and transitory parts of cash flow is almost the same (28% versus 31%, respectively) for dividend-paying firms. At the same time, the response within non-dividend-paying firms differs drastically (35% versus 21%, respectively). This shows that non-dividend payers rely more on the permanent component of cash flow to finance their investment, and that the higher investment–cash flow sensitivity of dividend payers prevails through both transitory and permanent cash flow components.[15]

One might argue, and we concur in Table 1.1, that the two subsamples are fundamentally different. However, one must not conclude that the comparisons drawn in this section are hollow. As discussed earlier, literature dating back to Fazzari et al. [1988] claims that the cash flow sensitivity of investment is higher among non-dividend payers. While we refute that claim, the results presented here verify the theoretical reason why this is not the case, making the comparison provided in this section relevant. In addition, we tackle potential comparability concerns directly by applying a propensity score matching technique as described in Appendix C, and find that the results remain qualitatively the same.

1.4.2 Dividend smoothing and the cash flow allocation

Our second hypothesis is that the higher marginal cost of dividends should be positively associated with investments. If the marginal cost of the dividend stream is positive, then the investment–cash flow sensitivity to the wedge between the reten-

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[15] We further observe that the cash sensitivity of permanent cash flow among dividend-paying firms is 12%, which is much lower than that documented by CDWY (29%). Concurrently, the dividend sensitivity of permanent cash flow is much higher (8% compared with a trivial 1% documented by CDWY). This is consistent with the notion that cash flow sensitivity of cash is reduced in dividend-paying firms because the excess cash is distributed through dividends, thereby increasing the dividend sensitivity of cash flow. Alternatively, it is equally possible that dividend-paying firms smooth their cash holdings, which results in reduced sensitivity. Although the majority of dividends is paid out of the permanent component, dividends are still significantly sensitive to the transitory component of cash flow (1.4 cents of transitory cash flow is paid out as dividends).

tion and distribution of funds should be positive. For firms that incur a higher cost of altering dividends, changing the stream is less than a fully available option when attempting to neutralise cash flow volatility. This could expose investments, which are long term in nature and determined by available growth options, to cash flow variation. In contrast, for firms that can cut dividends at a lower cost, changing the stream could shield investments from variation.

One of the major concerns raised by Kaplan and Zingales [1997] is that an investment–cash flow sensitivity measure is inherently cross-sectional, ignoring any changes in investment options over time. We conjecture that because of the multi-period nature of dividend smoothing, our measures represent a proxy for the marginal cost of cutting dividends over time. Therefore, the smoothing cost and its association with investment is a firm-year measure and suitable for a panel of sample firms.

We investigate the effect of dividend smoothing on the allocation of cash flow by including two measures of smoothing (and their interactions with cash flow), namely the SOA and relative volatility, in the simultaneous system described in Equations (1.9)–(1.13), while imposing restrictions in Equations (1.14)–(1.17). A lower (higher) SOA or relative volatility represents more (less) smoothing. The model is estimated for the overall level of cash flow, as well as its permanent and transitory components. This approach has two main advantages. First, it enables us to study the effect of smoothing on each cash flow variable separately. Second, the two measures enter the system in lagged terms. That is, they are determined in the previous year ($t-1$), and thus exist beyond the budgetary constraints of the current year (t). This avoids the concerns about concurrency errors raised by Dhrymes and Kurz [1967].

Consistent with our prediction, Table 1.5 shows that the interaction term (CF × SOA_{t-1}) is negative and statistically significant (t-stat = 2.64) in investment regressions, indicating that more (less) dividend smoothing increases (decreases) investment–cash flow sensitivity. To give economic sense to this result, note that the effect of a 10% decrease in lagged SOA (more smoothing) is associated with a 2.6 cent increase in investment–cash flow sensitivity. This is approximately 65% of the average dividend paid out of each additional dollar of cash flow (4 cents). Firms finance the 10% decrease by issuing 3.1 cents of additional debt. The other cash flow variables remain unresponsive and insignificant. In contrast, firms with a more flexible dividend policy rely less on debt and benefit from lower investment–cash flow sensitivity. Further, we follow Leary and Michaely [2011] and assume that a dividend payer has an average SOA of 0.14. This means that it takes almost 4.6 years to close half the gap between actual and target dividends. Now, assume that a firm decides to close this gap faster, say, by almost 1.7 years. This means that the firm must increase the SOA to 0.21 to close half the gap in 2.9 years. The 50% increase in the lagged SOA (less smoothing) is associated with a 3.9 cent decrease in investment–cash flow sensitivity, which is almost the same as the average effect of dividends on cash flow.

Because the lagged SOA and relative volatility measures are both positively associated with dividends, we can conclude that firms that smooth dividends more (less) have a smaller (larger) dividend payout ratio. That is, lower dividends allow firms to sustain a smoother dividend stream for a prolonged period relative to firms that smooth less. This verifies the findings reported in Table 1.2 and is consistent with Leary and Michaely [2011]. Yet, even after setting lower dividends, smoothing still significantly affects investment and net debt issuance sensitivities to cash flow. Although the scale of the relative volatility measure differs from the SOA (causing the coefficients to differ in magnitude), it qualitatively confirms these conclusions. The only exception is that the net debt issuance is short of fully capturing the investment–cash flow sensitivity induced by smoothing.

The transitory component of cash flow is unlikely to be correlated with growth options of a firm that are long term in nature, and thus financed with the permanent component [Chang et al., 2014]. This is why we focus on the transitory component. Given that the investments are determined by investment opportunities that are determined prior to setting other cash flow policy, firms must finance smoothing

Table 1.5: Dividend smoothing and the allocation of cash flow. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. The table reports the allocation of internally generated cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Div is cash dividend, CR is cash reserve, ND is net debt issuance and NQ is net equity issuance. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. SOA$_{t-1}$ is the lagged speed of adjustment, and Rel-Vol$_{t-1}$ is the lagged relative volatility, estimated by the method described in Leary and Michaely [2011]. All variables are demeaned to account for unobservable heterogeneity (firm fixed effects). Control variables, year dummy variables and the constants are included in the model during estimation but are suppressed in the output for brevity.

Panel A - Speed-of-Adjustment (SOA) of Dividends and the Allocation of Internal Cash Flow

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ
CF	0.299***	0.041***	0.267***	-0.312***	-0.082***										
	(18.99)	(12.41)	(25.78)	(-20.52)	(-10.03)										
SOA$_{t-1}$	-0.018***	0.006***	0.001	-0.012**	0.001	-0.019***	0.006***	0.001	-0.013**	0.001	-0.018***	0.006***	0.001	-0.012**	0.001
	(-3.25)	(5.47)	(0.20)	(-2.28)	(0.44)	(-3.30)	(5.49)	(0.15)	(-2.39)	(0.45)	(-3.22)	(5.34)	(0.25)	(-2.24)	(0.47)
CF × SOA$_{t-1}$	-0.264***	0.024	-0.081	-0.307***	-0.015										
	(-2.64)	(1.13)	(-1.23)	(-3.18)	(-0.29)										
CF_Permnt						0.239***	0.136***	0.076***	-0.359***	-0.191***					
						(6.35)	(17.74)	(2.99)	(-9.92)	(-10.01)					
CF_Permnt × SOA$_{t-1}$						-0.146	-0.004	0.116	-0.144	0.111					
						(-0.67)	(-0.08)	(0.79)	(-0.69)	(1.00)					
CF_Transit											0.315***	0.019***	0.304***	-0.304***	-0.058***
											(18.28)	(5.23)	(26.97)	(-18.23)	(-6.45)
CF_Transit × SOA$_{t-1}$											-0.352***	0.028	-0.113	-0.392***	-0.045
											(-2.89)	(1.06)	(-1.42)	(-3.34)	(-0.71)
N			5656					5656					5656		
R^2	0.128	0.213	0.127	0.133	0.135	0.097	0.234	0.037	0.097	0.134	0.122	0.195	0.133	0.120	0.126

Panel B - Relative Volatility (Rel-Vol) of Dividends and the Allocation of Internal Cash Flow

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ
CF	0.315***	0.044***	0.256***	-0.298***	-0.087***										
	(21.92)	(14.47)	(27.79)	(-21.48)	(-11.81)										
Rel-Vol$_{t-1}$	-0.003***	0.002***	-0.001	-0.001	-0.001	-0.003***	0.002***	-0.001	-0.002	-0.001	-0.003***	0.002***	-0.001	-0.001	-0.001
	(-2.79)	(7.94)	(-1.20)	(-1.35)	(-1.08)	(-2.76)	(7.58)	(-1.18)	(-1.52)	(-0.98)	(-2.94)	(7.73)	(-1.01)	(-1.40)	(-1.04)
CF × Rel-Vol$_{t-1}$	-0.061***	-0.001	0.018	-0.047**	0.004										
	(-3.07)	(-0.13)	(1.44)	(-2.45)	(0.35)										
CF_Permnt						0.212***	0.146***	0.055**	-0.368***	-0.218***					
						(6.32)	(20.85)	(2.51)	(-11.39)	(-12.91)					
CF_Permnt × Rel-Vol$_{t-1}$						0.019	0.009	0.036	0.049	0.015					
						(0.48)	(1.10)	(1.41)	(1.30)	(0.75)					
CF_Transit											0.341***	0.020***	0.297***	-0.285***	-0.057***
											(21.61)	(5.80)	(29.56)	(-18.72)	(-6.96)
CF_Transit × Rel-Vol$_{t-1}$											-0.092***	-0.008	0.019	-0.084***	0.004
											(-3.85)	(-1.47)	(1.28)	(-3.64)	(0.31)
N			7192					7192					7192		
R^2	0.128	0.192	0.117	0.121	0.138	0.095	0.217	0.033	0.092	0.140	0.123	0.173	0.126	0.108	0.127

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

through cash reserves or outside finance. Hence, significant loadings on the lagged smoothing measures in a transitory cash flow setting (CF_Transit) and its interaction with transitory cash flow (CF_Transit × SOA_{t-1}) with respect to the investment regression implies that dividend smoothing affects investment when external finance and cash reserves fail to neutralise the variations in cash flow. We observe that the coefficient on the interaction term not only remains significant but increases in significance. A 10% decrease in the measure (more smoothing) corresponds to a 3.5 cent increase in investment–transitory cash flow sensitivity, financed entirely through a 3.9 cent increase in net debt issuance. Given that firms pay 2 cents out of each additional dollar of transitory cash flow as dividends, the economic significance of smoothing is clear.

This inseparability result is at odds with established residual theories of dividends, first proposed by Preinreich [1932], which assert that firms distribute excess cash after satisfying their positive NPV investment needs and retain next to nothing in each period. We show that dividend smoothing disrupts this separation because investment and dividend policies become jointly determined. Moreover, we show that investment–cash flow sensitivity increases monotonically with the degree of smoothing. Figure 1.2 illustrates the functional form of this relationship, indicating a strictly positive association between the two variables. However, to show that smoothing frictions are financially binding for dividend-paying firms, we need to ensure that the strictly positive association is preserved in the presence of financial constraints. This query is explored in the following section.

In addition, the cost arising from smoothing dividends is binding even if the firm is not financially constrained as a result of a credible retaliation threat posed by investors. DeAngelo and DeAngelo [2006] conclude that, even in a frictionless setting, the dividend irrelevancy proposition breaks down once firms are allowed to retain cash. In the context of our study, smoothing can incentivise firms to retain more cash to satisfy a stable dividend stream that shareholders expect to continue

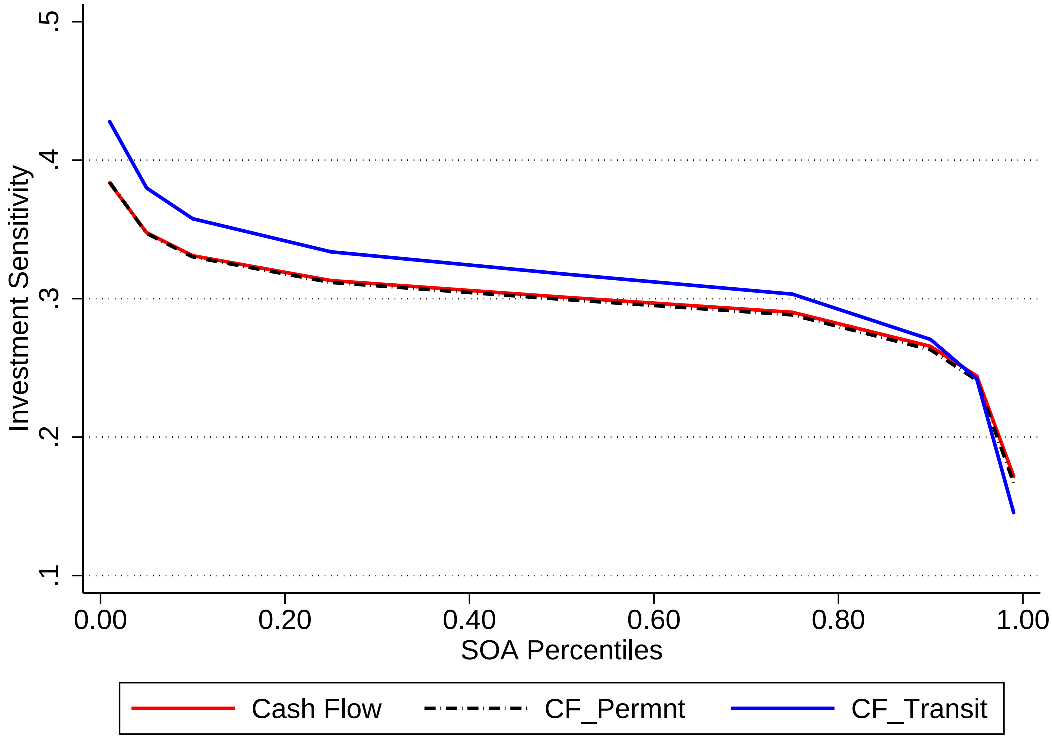

Figure 1.2: The sensitivity of investment to internally generated cash flow (CF) and its two components (CF_Transit and CF_Permnt) at different percentiles of the speed of adjustment (SOA). The graph shows coefficients on CF, CF_Transit and CF_Permnt in the investment regression, estimated at different percentiles of the SOA. CF is decomposed by applying the Butterworth filter. We estimate Equations (1.9)–(1.13) while simultaneously imposing constraints in Equations (1.14)–(1.17).

beyond the current period.

1.4.3 Dividend smoothing in the presence of financial constraints

We document that net debt issuance become more responsive to cash flow variations among dividend smoothing firms. Then, how does dividend smoothing affect the degree of financial constraint? Our third hypothesis implies that financial constraints increase with smoothing.

To examine this matter, we apply the HP index of financial constraints[16], which is constructed following Hadlock and Pierce [2010]. We apply this measure to differentiate between firms that are more financially constrained and those that are less constrained. Then, applying our model, we examine how dividend smoothing is financed in firms with different degrees of constraint. For each year, a given firm is classified as more (less) financially constrained if its HP index falls in the top (bottom) four deciles of the distribution. Then, similar to the previous analysis, we estimate Equations (1.9)–(1.13), while imposing restrictions in Equations (1.14)–(1.17) for firms that are categorised as more (less) constrained. Table 1.6 illustrates the results of applying the HP index to the SOA measure of smoothing. Table 1.7 summarises the results of applying the HP index to the relative volatility measure of smoothing. We report the size and significance of the loadings within the cash flow framework, including its two components (CF_Permnt and CF_Transit).

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[16] The results are robust to alternative measures of financial constraints such as the WW index, constructed following Whited and Wu [2006]. We do not consider the Kaplan and Zingales [1997] index, constructed according to Lamont et al. [2001], because of criticisms raised by Hadlock and Pierce [2010]. The concerns focus on the validity of the measure in capturing constrained firms and the fact that the Kaplan and Zingales [1997] index relies on the dividend level rather than changes.

As outlined in Table 1.6, lagged SOA and the interaction term are no longer significant across the cash flow variable regressions for less constrained firms. Conversely, for more constrained firms, CF_Transit × SOA_{t-1} remains significant for both investment and net debt issuance. In fact, the coefficient on the interaction term in investment regressions drops from -0.352 (t-stat = -2.89) in Table 1.5 to -0.680 (t-stat = -4.13). That is, limited access to external finance, combined with costly dividend adjustments, results in adjustments to investment in response to transitory shocks. Importantly, the variations in net debt (-0.427, t-stat = 2.78) or in the other cash flow variables are not helpful in insulating investments from smooth dividends. These results remain qualitatively consistent for both measures of smoothing.

Figure 1.3 depicts the relationship between the investment–transitory cash flow sensitivity and the lagged SOA for more (less) financially constrained firms. While the association between the two variables remains unchanged for the less constrained, there is a strongly positive association between the two variables, ensuring monotonicity. This implies that smoothing frictions are indeed financially binding for more constrained firms that are unable to insulate investments from transitory cash flow shocks by accessing external funds.[17]

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[17] The results of the alternative IBC specification, whereby the simultaneity between the uses and the sources of funds is not explicitly imposed, are presented in Tables A.3 and A.4 in Appendix B. The results remain qualitatively consistent with the main findings and confirm prior conclusions.

Table 1.6: . Financial constraints (HP index), dividend smoothing (SOA) and the allocation of cash flow. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. A firm is categorised as more (less) financially constrained if its HP index falls into the top (bottom) 40%. The results are reported for total cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Div is cash dividend, CR is cash reserve, ND is net debt issuance and NQ is net equity issuance. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. The table uses SOA$_{t-1}$ as the lagged SOA dividend smoothing measure, estimated by the method described in Leary and Michaely [2011]. All variables are demeaned to account for unobservable heterogeneity (firm fixed effects). Control variables, year dummy variables and the constants are included in the model during estimation but are suppressed in the output for brevity.

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ
More Financially Constrained Firms															
CF	0.291***	0.037***	0.254***	-0.316***	-0.102***										
	(12.67)	(6.82)	(15.38)	(-14.54)	(-8.42)										
SOA$_{t-1}$	-0.038***	0.006***	0.016***	-0.017**	0.000	-0.040***	0.006***	0.016***	-0.018**	0.000	-0.037***	0.006***	0.015***	-0.016**	0.000
	(-5.16)	(3.30)	(2.93)	(-2.40)	(0.02)	(-5.23)	(3.27)	(2.81)	(-2.53)	(0.01)	(-5.01)	(3.17)	(2.90)	(-2.32)	(0.07)
CF × SOA$_{t-1}$	-0.497***	0.029	0.042	-0.356***	-0.070										
	(-3.68)	(0.90)	(0.43)	(-2.79)	(-0.98)										
CF_Permnt						0.337***	0.127***	0.063	-0.244***	-0.231***					
						(6.11)	(9.81)	(1.56)	(-4.65)	(-8.03)					
CF_Permnt × SOA$_{t-1}$						-0.196	-0.062	-0.034	-0.380	0.088					
						(-0.65)	(-0.87)	(-0.15)	(-1.32)	(0.55)					
CF_Transit											0.281***	0.018***	0.295***	-0.332***	-0.074***
											(11.10)	(2.87)	(16.33)	(-13.87)	(-5.50)
CF_Transit × SOA$_{t-1}$											-0.680***	0.038	0.120	-0.427***	-0.095
											(-4.13)	(0.94)	(1.02)	(-2.74)	(-1.08)
N			2229					2229					2229		
R^2	0.139	0.261	0.138	0.149	0.186	0.104	0.277	0.059	0.096	0.183	0.127	0.248	0.145	0.140	0.172
Less Financially Constrained Firms															
CF	0.286***	0.035***	0.275***	-0.342***	-0.062***										
	(11.00)	(7.61)	(17.15)	(-13.49)	(-4.51)										
SOA$_{t-1}$	0.007	0.004**	-0.014**	-0.004	0.001	0.007	0.005***	-0.015**	-0.004	0.001	0.008	0.004**	-0.015**	-0.005	0.001
	(0.71)	(2.43)	(-2.32)	(-0.44)	(0.26)	(0.67)	(2.77)	(-2.34)	(-0.43)	(0.14)	(0.77)	(2.26)	(-2.46)	(-0.47)	(0.25)
CF × SOA$_{t-1}$	0.044	-0.039	0.002	-0.029	0.036										
	(0.22)	(-1.07)	(0.02)	(-0.15)	(0.34)										
CF_Permnt						0.197***	0.139***	0.134***	-0.347***	-0.182***					
						(3.35)	(13.75)	(3.58)	(-6.04)	(-5.95)					
CF_Permnt × SOA$_{t-1}$						0.298	0.052	0.384	0.551	0.183					
						(0.72)	(0.73)	(1.47)	(1.37)	(0.85)					
CF_Transit											0.315***	0.008	0.299***	-0.343***	-0.034**
											(11.09)	(1.61)	(17.11)	(-12.38)	(-2.25)
CF_Transit × SOA$_{t-1}$											-0.129	-0.069	-0.041	-0.237	-0.002
											(-0.51)	(-1.50)	(-0.26)	(-0.96)	(-0.02)
N			2214					2214					2214		
R^2	0.162	0.146	0.149	0.155	0.113	0.136	0.194	0.052	0.117	0.117	0.158	0.126	0.146	0.144	0.106

t statistics in parentheses
* $p < .10$, ** $p < .05$, *** $p < .01$

Table 1.7: Financial constraints (HP index), dividend smoothing (Relative Volatility) and the allocation of cash flow. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. A firm is categorised as more (less) financially constrained if its HP index falls into the top (bottom) 40%. The results are reported for total cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Div is cash dividend, CR is cash reserve, ND is net debt issuance and NQ is net equity issuance. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. The table uses Rel-Vol$_{t-1}$, the lagged relative volatility dividend smoothing measure, estimated by the method described in Leary and Michaely [2011]. All variables are demeaned to account for unobservable heterogeneity (firm fixed effects). Control variables, year dummy variables and the constants are included in the model during estimation but are suppressed in the output for brevity.

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ	Inv	Div	CR	ND	NQ
More Financially Constrained Firms															
CF	0.333***	0.046***	0.236***	-0.276***	-0.109***										
	(16.10)	(8.89)	(16.05)	(-14.16)	(-9.96)										
Rel-Vol$_{t-1}$	-0.004**	0.004***	0.001	0.000	0.001	-0.004***	0.004***	0.002	-0.000	0.001*	-0.004***	0.004***	0.002	0.000	0.001
	(-2.58)	(10.11)	(1.22)	(0.08)	(1.39)	(-2.59)	(9.54)	(1.49)	(-0.09)	(1.72)	(-2.59)	(10.09)	(1.38)	(0.19)	(1.46)
CF × Rel-Vol$_{t-1}$	-0.037	0.002	0.042**	-0.004	0.011										
	(-1.52)	(0.39)	(2.42)	(-0.19)	(0.89)										
CF_Permnt						0.307***	0.151***	0.039	-0.231***	-0.272***					
						(6.29)	(12.75)	(1.11)	(-5.02)	(-10.77)					
CF_Permnt × Rel-Vol$_{t-1}$						0.009	0.022*	0.058	0.028	0.061**					
						(0.18)	(1.81)	(1.56)	(0.59)	(2.31)					
CF_Transit											0.339***	0.020***	0.280***	-0.289***	-0.072***
											(14.81)	(3.45)	(17.32)	(-13.39)	(-5.90)
CF_Transit × Rel-Vol$_{t-1}$											-0.075**	-0.013	0.068***	-0.025	0.005
											(-2.18)	(-1.54)	(2.82)	(-0.79)	(0.30)
N			2825					2825					2825		
R^2	0.139	0.264	0.125	0.133	0.180	0.097	0.288	0.056	0.093	0.183	0.128	0.248	0.134	0.124	0.161
Less Financially Constrained Firms															
CF	0.301***	0.042***	0.276***	-0.314***	-0.066***										
	(12.62)	(9.28)	(19.00)	(-13.47)	(-5.18)										
Rel-Vol$_{t-1}$	-0.000	0.000	-0.002*	-0.001	-0.001	0.000	0.000	-0.002**	-0.001	-0.001	-0.000	0.000	-0.002**	-0.001	-0.001
	(-0.02)	(1.03)	(-1.95)	(-0.53)	(-0.91)	(0.02)	(0.98)	(-2.10)	(-0.58)	(-1.07)	(-0.19)	(0.88)	(-1.96)	(-0.72)	(-0.92)
CF × Rel-Vol$_{t-1}$	-0.014	0.010	0.040*	0.014	0.023										
	(-0.36)	(1.38)	(1.74)	(0.38)	(1.11)										
CF_Permnt						0.213***	0.148***	0.083**	-0.367***	-0.189***					
						(4.00)	(15.03)	(2.48)	(-7.06)	(-6.71)					
CF_Permnt × Rel-Vol$_{t-1}$						0.121*	0.024*	0.063	0.175***	0.034					
						(1.77)	(1.91)	(1.47)	(2.61)	(0.95)					
CF_Transit											0.328***	0.014***	0.316***	-0.305***	-0.036**
											(12.54)	(2.81)	(19.92)	(-11.94)	(-2.55)
CF_Transit × Rel-Vol$_{t-1}$											-0.085*	0.005	0.047*	-0.052	0.019
											(-1.87)	(0.54)	(1.72)	(-1.18)	(0.78)
N			2802					2802					2802		
R^2	0.159	0.134	0.138	0.136	0.116	0.133	0.175	0.039	0.109	0.120	0.155	0.110	0.144	0.125	0.110

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

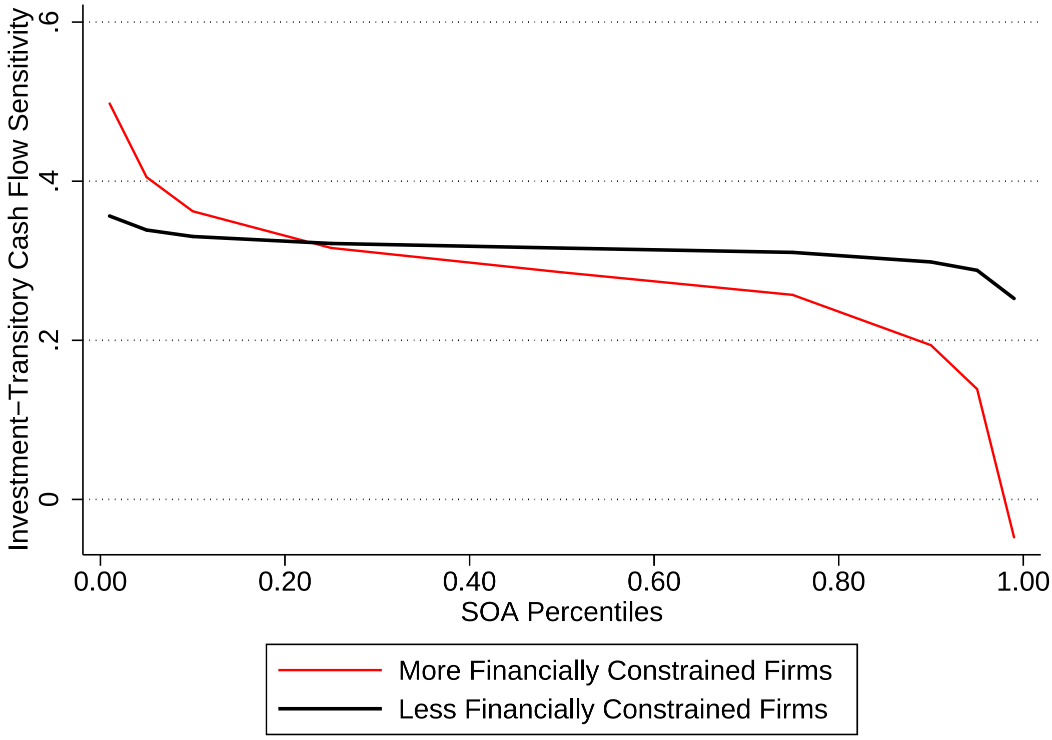

Figure 1.3: The sensitivity of investment to transitory cash flow (CF_Transit) at different percentiles of the speed of adjustment (SOA) and various degrees of financial constraint. The graph shows coefficients on CF_Transit in investment regressions, estimated at different percentiles of the SOA for a sample of more (less) financially constrained firms. CF is decomposed by applying the Butterworth filter. A firm is categorised as more (less) financially constrained if its HP index falls into the top (bottom) 40%. We estimate Equations (1.9)–(1.13) while simultaneously imposing constraints in Equations (1.14)–(1.17).

1.4.4 Causal inference

So far, we document that dividend-paying firms have higher investment–cash flow sensitivity, and that this sensitivity increases with the degree of smoothing. However, a further implication of our study, focusing on smoothing negatively affecting investment in the presence of financial constraints, is a causal argument that requires additional scrutiny. Establishing this relationship is non-trivial because, as we show, firms that smooth dividends more also tend to be different on many observable dimensions (leverage, volatility, ROA, cash flows), meaning that they are likely different across numerous unobservable dimensions as well. One concern is that the level of dividend smoothing could be spuriously correlated with the link between current cash flows and investment opportunities. This is especially the case if the decomposition into permanent and temporary cash flows does not achieve a cash flow that is perfectly orthogonal to investment opportunities. This, in turn, raises the concern that (temporary) cash flows could be more informative of investment opportunities for firms that smooth dividends. One can also make a related reverse causality argument: if a firm knows that its cash flows are highly correlated with investment opportunities, then it can better afford to smooth its dividends because it has a "natural hedge" in terms of the firm's investment policy. As such, even if the quantity of investment is held constant, we might observe higher dollars of investment spent in high cash flow states. This story could cause the correlations we report. However, given that our cash flow decomposition procedure produces an orthogonal decomposition of permanent and temporary cash flow by construction, we are less concerned about this. The fact that we find the correlation between the two components of cash flow to be 2% (insignificant) in the full sample reinforces this assertion.

Finally, we treat the cash flows as exogenous. However, Bonaimé et al. [2013] show that firms that pay more dividends also hedge more, in which case operating cash flows can no longer be taken as given. This can also cause the cash flow sensitivities for dividend-paying firms to have a different interpretation to the one we present. To mitigate these confounding effects, we apply various empirical strategies and several measures of smoothing to study whether dividend smoothing affects investments. First, we use the GFC as an exogenous shock to credit markets, where sticky dividend firms are matched to controls (non-dividend payers), and investigate the effect of smoothing on investment. Further, an alternative difference-in-difference empirical strategy is presented in Appendix C, where the GFC is assumed to provide us with a quasi-experimental design. Firms that keep their DPS fixed through the GFC decrease their investment-to-asset ratio by 2.9% (see Table C.1) compared with firms that do not pay dividends. This indicates that firms with a strong preference for fixed dividends (extreme smoothing) cut their investments to finance their dividends when their access to credit markets is curtailed. Hence, a rigid payout policy in the presence of financial constraints has real consequences for corporate decision-making.

Second, we identify a novel instrument and employ it to establish a causal inference. Dividend strips are claims to dividends paid over a prespecified interval in the future [Brennan, 1998]. That is, if the total return on an index (S&P500) consists of both capital gains and dividends, then dividend strips isolate the dividend component. At each point in time, the index is an infinite sum of dividends over the life of the index, and dividend strips separate it into portions of dividends with finite frequencies (e.g. a year's dividends on the index). We apply a long–short position in dividend strips that shorts near-dated dividends (T_1) and goes long on far-dated (T_2) dividends ($T_1 < T_2$). This strategy is called a dividend steepener and entitles the holder to dividends paid out between the two periods. We argue (and formally verify later) that the return on a dividend steepener strategy is positively associated with the degree of dividend smoothing but independent of firm investment, making it a relevant instrument. As such, firms with more smooth dividends will have a more predictable dividend series. Therefore, the dividend steepener return will load more on such firms. Simultaneously, the return on the dividend steepener is uncorrelated with the investment policy of the firm. Hence, such an instrument satisfies both the relevance and exclusion restrictions, enabling us to investigate the causality between dividend smoothing and investment policy.

Van Binsbergen et al. [2012] were the first to empirically estimate the price of dividend strips from intra-day options data, imposing a no-arbitrage condition. As a result of data limitations, we employ the return time series data for a dividend steepener strategy from January 1996 to October 2009, while controlling for dividend strip returns for 6-, 12-, 18- and 24-month maturities in the future to isolate the effect of the long–short position on smoothing. The series is available at a monthly frequency that we annualise, resulting in approximately 13 years of return data.

We apply the IV to the SOA and Rel-Vol measures of dividend smoothing, as well as in instances of dividend stickiness (extreme smoothing). In addition to our previous set of controls, we account for cash flow, changes in cash and the dividend payout ratio. Table 1.8 reports the output of the first and second stages of the IV regression. We calculate the first-stage F-statistic as the standard test of instrument relevance. Moreover, following Sanderson and Windmeijer [2016], we estimate the Angrist–Pischke first-stage chi-squared statistic, which is a test of under-identification of the individual regressors, and the Sanderson and Windmeijer [2016] F-statistic test of weak identification using Newey and West (HAC) standard errors. The first-stage test statistics reject the null hypotheses of a weak or under-identified model at the 1% level. The signs of the coefficients on the dividend steepener are also in line with our expectations. The second-stage J-statistic for overidentification [Sargan, 1958; Hansen, 1982], the Kleibergen and Paap [2006] test for under-identification and the Wald F-statistic of weak identification [Cragg and Donald, 1993] fail to detect evidence of misspecification in the model.

Table 1.8: Instrumental variable–dividend strips, dividend smoothing and investment. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1996–2009 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. More (less) extreme dividend stickiness phases are defined as periods during which a firm keeps its DPS unchanged for at least (at most) 10 consecutive years. The table reports the results of regressing investment (Inv) on different dividend smoothing measures (SOA, Rel-Vol and a stickiness dummy), instrumented by the returns on S&P500 dividend strips. Controls are included in the first and second stages of the regression. CF is annual cash flow and CR is cash reserve. Flow-of-funds data in Compustat are used to calibrate the cash flow variables according to Chang et al. [2014].

	First-stage			Second-stage		
	SOA$_t$	Rel-Vol$_t$	Sticky$_t$	Inv$_t$	Inv$_t$	Inv$_t$
SOA$_t$				0.274**		
				(2.08)		
Rel-Vol$_t$					0.049**	
					(2.13)	
Sticky$_t$						-0.074**
						(-2.26)
mShortdiv	-0.135***	-0.785**	0.540***			
	(-2.68)	(-2.33)	(4.33)			
R$_{m6}$	0.052	0.206	-0.231			
	(0.95)	(0.50)	(-1.56)			
R$_{m12}$	-0.195*	-1.062**	1.037***			
	(-1.89)	(-2.53)	(3.72)			
R$_{m18}$	0.232*	1.307*	-1.023**			
	(1.72)	(1.67)	(-2.97)			
R$_{m24}$	-0.007	0.044	-0.162			
	(-0.16)	(0.27)	(-1.41)			
SaleG$_t$	0.002	0.028	-0.069	0.116***	0.122***	0.119***
	(0.10)	(0.20)	(-1.35)	(7.06)	(7.91)	(7.70)
Leverage$_t$	-0.006	-0.01	0.253**	0.306***	0.330***	0.350***
	(-0.15)	(-0.06)	(2.54)	(8.18)	(10.12)	(10.12)
MB$_t$	0.021**	0.093**	-0.025**	-0.004	-0.003	0.000
	(3.24)	(2.94)	(-2.37)	(-0.87)	(-0.67)	(0.17)
LnAT$_t$	-0.027*	0.174	0.001	0.030***	0.011	0.020***
	(-2.22)	(1.55)	(0.05)	(3.82)	(1.27)	(3.72)
Tangibility$_t$	0.013	-0.481*	0.012	0.097**	0.092**	0.071**
	(0.20)	(-1.71)	(0.08)	(2.81)	(2.71)	(2.43)
CF$_t$	0.049	0.150	-0.378**	0.654***	0.703***	0.683***
	(0.78)	(0.46)	(-2.46)	(13.69)	(15.39)	(15.24)
CR$_t$	-0.0211	-0.698*	0.170	-0.756***	-0.774***	-0.797***
	(-0.31)	(-1.86)	(1.03)	(-16.02)	(-15.32)	(-17.41)
Repurchase$_t$	-0.0970	0.778	-0.878***	-0.512***	-0.613***	-0.630***
	(-0.89)	(0.82)	(-3.58)	(-7.80)	(-7.79)	(-8.85)
Div_ratio$_t$	-0.001	0.069**	0.036**	-0.002	-0.006**	-0.000
	(-0.18)	(2.39)	(2.75)	(-1.16)	(-2.20)	(-0.07)
N	2927	3778	3768	2927	3778	3768

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results are consistent across all measures of smoothing. Firms with more (less) smooth dividends have a lower (higher) investment-to-asset ratio. Given that the average cross-sectional standard deviation of the SOA over the sample period is 0.196, a one-standard-deviation increase above zero (less smoothing) increases the investment-to-asset ratio by 5.5% (19.6% × 0.274). The same estimate is 4.9% for the Rel-Vol measure (100% × 0.049). Firms that hold their dividends fixed for two consecutive years or more (dividend stickiness) experience a 7.4% decrease in their investment-to-asset ratio compared with firms with a more flexible payout. Therefore, as before, firms are willing to trade-off their investments for more smooth dividends.

1.4.5 Total payout smoothing and the allocation of cash flow

So far, our analysis has focused on dividend policy. Although we have controlled for changes in share repurchases through net equity issuance, one cannot ignore the fact that there has been a sharp increase in share repurchases as a method with which firms distribute cash back to shareholders. Grullon and Michaely [2002] and Skinner [2008] document that share repurchases are substituting dividend payments and are becoming a more dominant form of payout. This leads us to examine whether the smoothing friction we document in the case of dividends persists once we add share repurchases to the payout mix.

We include share repurchases in our analysis by adding them to dividends and generating a total payout measure. The measure is subsequently applied in our system of equations, which is now adjusted for total payout smoothing. In particular, we modify the cash flow identity in (1.1) to account for total payout instead of dividends alone. We define NQ as the Sale of Common and Preferred Stock (Compustat item "SSTK") minus the Purchase of Common and Preferred Stock (Compustat item "PRSTKC"). Then, NQ^{Adj} is defined as the Sale of Common and Preferred Stock. Purchase of Common and Preferred Stock is sent to the left-hand side of the cash flow identity and added up with cash dividends to form total payout (Tpay). Hence, we have:

$$\mathrm{Inv}_t + \mathrm{CR}_t + \mathrm{Tpay}_t - \mathrm{ND}_t - \mathrm{NQ}_t^{Adj} = \mathrm{CF}_t \tag{1.28}$$

where net debt issuance (ND_t) and net equity issuance excluding share repurchases (NQ_t^{Adj}) are considered sources of funds. The uses of funds include investment (Inv_t), cash reserves (CR_t) and total payout (Tpay_t), which includes both cash dividends and share repurchases. CF_t is the internally generated cash flow of the firm. The model specifications are similar to the previous setup in Equations (1.9)–(1.13) and the simultaneous imposition of constraints in Equations (1.14)–(1.17) for the added dividend smoothing measures. The equations are estimated by applying the same methodology as before.

Table 1.9 illustrates the results of applying the baseline model to the cash flow, as well as its transitory and permanent components. As expected, the coefficients of cash flow and its components in Tpay regressions increase and remain statistically significant compared with the dividends-only setup. Firms pay 3.6 cents out of each additional dollar of cash flow as total payout, which is much larger than 1 cent out of each additional dollar of cash flow paid out as dividends, as documented earlier. Moreover, firms pay almost 7.7 cents out of each additional dollar of permanent cash flow compared with only 2 cents for dividend payout. Total payout from the transitory cash flow component is 2.4 cents out of each dollar, 2 cents more than that for dividends only. The loadings for the uses and sources of funds in all cash flow settings do not change substantially from Table 1.3.

Table 1.9: Total payout–allocation of cash flow in the full sample. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. The table reports the allocation of internally generated cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Tpay is a measure of total payout (i.e.. cash dividends plus share buybacks), CR is cash reserve, ND is net debt issuance and NQ^{Adj} is net equity issuance adjusted for share buybacks. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. All control variables are lagged to control for contemporaneous effects. SaleG is the annual growth rate in sales, Leverage is defined as total debt (sum of short-term and long-term debt) divided by total assets, MB is defined as the market value of assets divided by the book value of assets, LnAT is the natural logarithm of total assets and Tangibility is the net PPE over total assets. All variables are demeaned to account for unobservable heterogeneity (firm fixed effects). Year dummies are included to reduce the effect of time trends on our results (year fixed effects).

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}
CF	0.258***	0.036***	0.277***	-0.223***	-0.206***										
	(54.06)	(23.26)	(69.62)	(-54.17)	(-49.69)										
CF_Permnt						0.322***	0.077***	0.150***	-0.162***	-0.289***					
						(31.84)	(23.45)	(17.38)	(-18.53)	(-32.90)					
CF_Transit											0.235***	0.024***	0.319***	-0.241***	-0.180***
											(42.42)	(13.41)	(69.13)	(-50.60)	(-37.31)
SaleG$_{t-1}$	0.022***	-0.005***	-0.001	0.014***	0.002	0.022***	-0.005***	-0.001	0.014***	0.002	0.023***	-0.005***	-0.002*	0.014***	0.002
	(15.93)	(-10.99)	(-1.15)	(11.65)	(1.51)	(15.23)	(-10.47)	(-0.81)	(11.49)	(1.39)	(16.16)	(-10.73)	(-1.70)	(11.79)	(1.26)
Leverage$_{t-1}$	-0.121***	-0.038***	0.021***	-0.181***	0.042***	-0.118***	-0.036***	0.014***	-0.177***	0.037***	-0.116***	-0.039***	0.016***	-0.180***	0.041***
	(-30.69)	(-29.53)	(6.40)	(-52.97)	(12.24)	(-29.18)	(-27.42)	(4.15)	(-50.49)	(10.65)	(-29.24)	(-29.85)	(4.89)	(-52.69)	(11.88)
MB$_{t-1}$	0.020***	0.003***	0.006***	0.007***	0.021***	0.019***	0.003***	0.007***	0.007***	0.022***	0.020***	0.003***	0.006***	0.007***	0.021***
	(40.51)	(18.01)	(14.48)	(17.19)	(50.20)	(38.61)	(17.57)	(15.94)	(16.29)	(50.37)	(39.96)	(18.57)	(14.64)	(17.31)	(49.71)
LnAT$_{t-1}$	-0.018***	0.007***	-0.014***	-0.002***	-0.022***	-0.019***	0.006***	-0.012***	-0.003***	-0.021***	-0.019***	0.007***	-0.013***	-0.003***	-0.022***
	(-23.60)	(27.77)	(-21.74)	(-3.62)	(-33.94)	(-23.70)	(25.25)	(-18.67)	(-4.60)	(-31.61)	(-25.05)	(28.09)	(-19.92)	(-3.89)	(-33.35)
Tangibility$_{t-1}$	0.026***	-0.010***	0.069***	0.060***	0.026***	0.024***	-0.012***	0.075***	0.057***	0.030***	0.021***	-0.009***	0.074***	0.059***	0.027***
	(4.51)	(-5.20)	(14.25)	(11.97)	(5.04)	(4.03)	(-6.33)	(14.87)	(11.11)	(5.76)	(3.66)	(-4.94)	(15.21)	(11.80)	(5.21)
Constant	0.013***	0.004***	-0.009***	0.009***	-0.001	0.011***	0.003***	-0.008**	0.009***	0.001	0.014***	0.004***	-0.006*	0.007**	-0.003
	(3.17)	(3.84)	(-2.89)	(2.90)	(-0.33)	(2.81)	(3.20)	(-2.43)	(2.71)	(0.17)	(3.58)	(4.13)	(-1.85)	(2.21)	(-0.85)
N			46005					46005					46005		
R^2	0.118	0.094	0.100	0.112	0.111	0.095	0.095	0.030	0.073	0.091	0.104	0.087	0.100	0.107	0.095

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 1.10 reports the results of dividing the full sample into dividend-paying and non-dividend-paying firms. Consistent with our expectation developed in our first hypothesis, investment–transitory cash flow sensitivity remains 42% higher for dividend-paying firms compared with the non-dividend-paying subsample. Firms that pay regular dividends have a total payout of 8 cents out of each additional dollar of total cash flow, 24 cents out of each additional dollar of permanent cash flow and 5 cents out of each additional dollar of transitory cash flow. The corresponding numbers for non-dividend payers are 2 cents, 3 cents and 1 cent, respectively.

To test the second hypothesis in the context of total payout, we re-estimate the payout smoothing measures based on total payout. Figure 1.4 illustrates the time series evolution of the median SOA^{Tpay} and the median Rel-Vol^{Tpay}, calculated based on total payout ratios, and their related empirical distributions for the period 1980–2018. There is a pronounced upwards trend in both of the payout smoothing measures in the early 1980s as a result of a surge in share repurchases among firms over the last three decades. The empirical distribution of the two measures shows a sizeable variation in the cross-section, more than in the case of dividends only, likely because of the variability and flexibility of buybacks.

Next, we include the two measures of payout smoothing and their interaction with cash flow in the model and estimate the response of each use and source of cash flow variable, separately. Table 1.11 summarises the results for SOA^{Tpay} in Panel A and the alternative measure, $\text{Rel-Vol}^{\text{Tpay}}$, in Panel B. Interestingly, the signs of the coefficients on the lagged SOA measure in investment and dividend regressions flip compared with the dividends-only framework. That is, we find that the degree of total payout smoothing (SOA^{Tpay}) is negatively associated with investments (t-stat = -1.87) and dividends (t-stat = -1.43) in the transitory cash flow setting. Moreover, the interaction term remains insignificant throughout cash flow and its two components, including when the alternative smoothing measure is applied. This shows that our findings apply only to dividends and not to total payout.

Table 1.10: Total payout–allocation of cash flow in the two subsamples of dividend-paying and non-dividend-paying firms. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. We divide the sample into two subsamples of dividend-paying firms that pay dividends for at least 10 years (Panel A) and non-dividend-paying firms that do not pay dividends for at least 10 years (Panel B). The table reports the allocation of internally generated cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Tpay is cash dividends plus share buybacks, CR is cash reserve, ND is net debt issuance and NQ^{Adj} is net equity issuance adjusted for share buybacks. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. All control variables are lagged to control for contemporaneous effects. SaleG is the annual growth rate in sales, Leverage is defined as total debt (sum of short-term and long-term debt) divided by total assets, MB is defined as the market value of assets divided by the book value of assets, LnAT is the natural logarithm of total assets and Tangibility is the net PPE over total assets. All variables are demeaned to account for unobservable heterogeneity (firm fixed effects). Year dummies are included to reduce the effect of time trends on our results (year fixed effects). All control variables are included in the model during estimation but are not reported in the output for brevity.

Panel A - Dividend-Paying Firms

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}
CF	0.298^{***}	0.082^{***}	0.320^{***}	-0.283^{***}	-0.017^{***}										
	(30.69)	(19.41)	(47.60)	(-31.05)	(-4.10)										
CF_Permnt						0.270^{***}	0.238^{***}	0.120^{***}	-0.332^{***}	-0.041^{***}					
						(11.66)	(24.09)	(7.25)	(-15.25)	(-4.06)					
CF_Transit											0.305^{***}	0.047^{***}	0.363^{***}	-0.273^{***}	-0.013^{***}
											(28.44)	(10.07)	(49.07)	(-27.03)	(-2.68)
Constant	0.004	0.004^{**}	-0.004	-0.001	0.004^{**}	0.009^{*}	0.004^{**}	0.001	-0.004	0.004^{**}	0.008^{*}	0.005^{***}	-0.001	-0.004	0.004^{**}
	(0.77)	(2.42)	(-1.54)	(-0.12)	(2.47)	(1.72)	(2.19)	(0.25)	(-0.93)	(2.35)	(1.66)	(3.11)	(-0.49)	(-1.04)	(2.22)
N			16420					16420					16420		
R^2	0.118	0.153	0.124	0.109	0.034	0.092	0.163	0.022	0.081	0.034	0.112	0.139	0.129	0.098	0.034

Panel B - Non-Dividend Paying Firms

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}
CF	0.249^{***}	0.016^{***}	0.261^{***}	-0.208^{***}	-0.265^{***}										
	(32.64)	(8.70)	(38.03)	(-33.61)	(-35.19)										
CF_Permnt						0.352^{***}	0.026^{***}	0.177^{***}	-0.152^{***}	-0.294^{***}					
						(22.44)	(7.15)	(12.43)	(-11.83)	(-18.91)					
CF_Transit											0.215^{***}	0.012^{***}	0.289^{***}	-0.228^{***}	-0.256^{***}
											(23.97)	(5.83)	(36.18)	(-31.52)	(-28.95)
Constant	0.022^{**}	0.004^{**}	-0.009	0.014^{**}	0.003	0.015	0.003^{*}	-0.012	0.017^{**}	0.009	0.024^{***}	0.004^{**}	-0.005	0.011^{*}	0.000
	(2.43)	(2.02)	(-1.14)	(2.14)	(0.30)	(1.63)	(1.71)	(-1.56)	(2.54)	(0.95)	(2.58)	(2.08)	(-0.61)	(1.66)	(0.01)
N			16678					16678					16678		
R^2	0.114	0.050	0.096	0.116	0.148	0.094	0.049	0.042	0.073	0.117	0.096	0.048	0.090	0.110	0.133

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

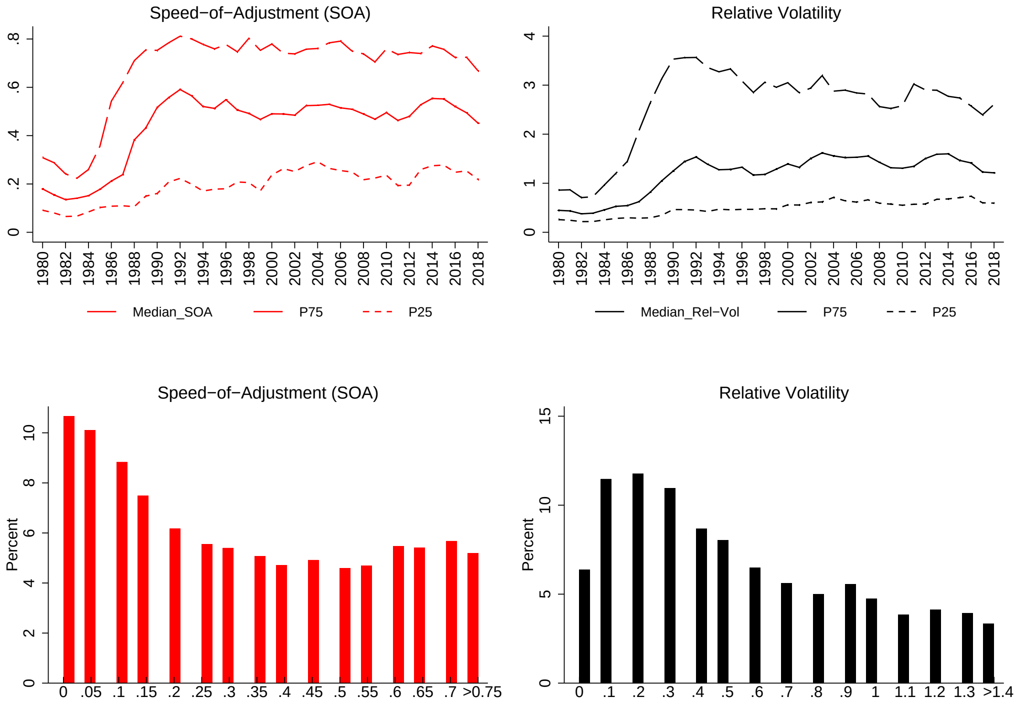

Figure 1.4: Time series and empirical distribution of the speed of adjustment (left) and relative volatility (right). For the period 1980–2018, a sample of dividend-paying industrial firms with at least 10 years of non-missing data on dividends is divided into panels of 10-year overlapping windows. Total payout (Tpay) is defined as cash dividends plus share buybacks. The SOA^{Tpay} and Rel-Vol^{Tpay} measures of total payout smoothing are estimated within each panel following Leary and Michaely [2011]. If SOA$^{Tpay} < 0$ or SOA$^{Tpay} >= 1$, the corresponding observation is set to missing. Measures are winsorised at the top 1%. Time trends show median SOA^{Tpay} and Rel-Vol^{Tpay} measures for each year.

Table 1.11: Total payout smoothing and the allocation of cash flow. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. The table reports the allocation of internally generated cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Tpay is cash dividends plus share buybacks, CR is cash reserve, ND is net debt issuance and NQ^{Adj} is net equity issuance adjusted for share buybacks. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. SOA_{t-1}^{Tpay} is the lagged speed of adjustment of total payouts, and $\text{Rel-Vol}_{t-1}^{Tpay}$ is the lagged relative volatility of total payouts, estimated by the method described in Leary and Michaely [2011]. All variables are demeaned to account for unobservable heterogeneity (firm fixed effects). Control variables, year dummy variables and the constants are included in the model during estimation but are suppressed in the output for brevity.

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}
Panel A - Speed-of-Adjustment (SOA) of Total Payout and the Allocation of Internal Cash Flow															
CF	0.288^{***}	0.116^{***}	0.267^{***}	-0.328^{***}	-0.002										
	(17.44)	(14.16)	(24.59)	(-20.74)	(-0.45)										
$\text{SOA}_{t-1}^{\text{Tpay}}$	0.009^{**}	-0.003^{*}	-0.003	0.001	0.002^{***}	0.009^{**}	-0.004^{**}	-0.002	0.001	0.002^{***}	0.009^{**}	-0.003	-0.002	0.001	0.003^{***}
	(2.57)	(-1.72)	(-1.21)	(0.28)	(3.09)	(2.43)	(-2.13)	(-0.65)	(0.36)	(2.90)	(2.36)	(-1.39)	(-0.88)	(0.42)	(3.19)
CF × $\text{SOA}_{t-1}^{\text{Tpay}}$	-0.100	-0.067^{*}	-0.007	-0.159^{**}	-0.014										
	(-1.31)	(-1.78)	(-0.14)	(-2.19)	(-0.89)										
CF_Permnt						0.296^{***}	0.321^{***}	0.076^{***}	-0.322^{***}	0.015^{*}					
						(7.69)	(17.18)	(2.92)	(-8.70)	(1.82)					
CF_Permnt × $\text{SOA}_{t-1}^{\text{Tpay}}$						-0.052	0.100	-0.116	-0.032	-0.037					
						(-0.34)	(1.34)	(-1.12)	(-0.21)	(-1.14)					
CF_Transit											0.288^{***}	0.068^{***}	0.309^{***}	-0.329^{***}	-0.006
											(15.80)	(7.46)	(25.85)	(-18.77)	(-1.43)
CF_Transit × $\text{SOA}_{t-1}^{\text{Tpay}}$											-0.113	-0.107^{**}	0.007	-0.208^{**}	-0.006
											(-1.27)	(-2.40)	(0.12)	(-2.43)	(-0.29)
N			5087					5087					5087		
R^2	0.129	0.228	0.124	0.134	0.046	0.105	0.240	0.035	0.095	0.047	0.121	0.208	0.132	0.124	0.046
Panel B - Relative Volatility (Rel-Vol) of Total Payout and the Allocation of Internal Cash Flow															
CF	0.314^{***}	0.119^{***}	0.259^{***}	-0.305^{***}	-0.003										
	(23.69)	(17.39)	(29.52)	(-23.99)	(-1.17)										
$\text{Rel-Vol}_{t-1}^{\text{Tpay}}$	0.000	-0.000^{**}	-0.000^{***}	-0.000	-0.000	0.000^{**}	-0.000^{*}	-0.000^{***}	-0.000	-0.000	0.000^{*}	-0.000^{**}	-0.000^{***}	-0.000	-0.000
	(1.51)	(-2.01)	(-2.87)	(-1.33)	(-0.71)	(2.43)	(-1.88)	(-3.11)	(-0.49)	(-0.72)	(1.87)	(-2.26)	(-2.80)	(-1.03)	(-0.71)
CF × $\text{Rel-Vol}_{t-1}^{\text{Tpay}}$	-0.000	-0.000	-0.000	-0.000^{**}	-0.000										
	(-1.34)	(-0.47)	(-1.02)	(-2.31)	(-0.15)										
CF_Permnt						0.306^{***}	0.322^{***}	0.059^{***}	-0.324^{***}	0.010					
						(9.67)	(20.22)	(2.75)	(-10.65)	(1.51)					
CF_Permnt × $\text{Rel-Vol}_{t-1}^{\text{Tpay}}$						-0.000	-0.000	-0.000	-0.000	-0.000					
						(-0.68)	(-0.55)	(-0.77)	(-1.45)	(-0.44)					
CF_Transit											0.318^{***}	0.073^{***}	0.301^{***}	-0.301^{***}	-0.007^{**}
											(21.81)	(9.65)	(31.39)	(-21.48)	(-2.02)
CF_Transit × $\text{Rel-Vol}_{t-1}^{\text{Tpay}}$											-0.000	-0.000	-0.000	-0.000	-0.000
											(-0.73)	(-0.65)	(-0.69)	(-1.57)	(-0.05)
N			7598					7598					7598		
R^2	0.126	0.230	0.119	0.123	0.040	0.095	0.239	0.032	0.088	0.040	0.118	0.210	0.129	0.112	0.041

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

We argue that this points to the rigidity of dividend policy as being the primary driver of the documented effect, and once we allow payout to fluctuate more freely, many of the results reported previously disappear. This finding is also consistent with Bonaimé et al. [2013], who find that a flexible payout policy, one that favours repurchases over dividends, and hedging are substitutes. This means that the excessive variation in cash flow that is not captured by a rigid dividend policy is being absorbed by flexible share repurchases, which in turn provides an organic (in-house) hedging tool for managers.

To investigate how financial constraints affect total payout smoothing and the allocation of cash flow, we undertake the procedure outlined previously. The results from adding total payout smoothing ($\mathrm{SOA}^{\mathrm{Tpay}}$) and its interaction with cash flow into our system of equations, while differentiating between more (less) constrained firms by using the HP index, are summarised in Table A.1 (see Appendix A). For brevity, we only report the loadings of cash flow (CF) and its two components (CF_Permnt and CF_Transit). Again, we focus on the allocation of transitory cash flow. Being financially constrained does not significantly effect total payout smoothing or the allocation of transitory cash flow in the same way as it does under dividend smoothing. When the HP index is applied, total payout smoothing does not significantly affect investment–cash flow sensitivity, even if a firm is more financially constrained. This holds for total cash flow, as well as its two components.

The results of adding the alternative total payout smoothing measure (Rel-Vol^{Tpay}) and its interaction with cash flow into our system of equations, while differentiating between more (less) constrained firms, are summarised in Table A.2 (see Appendix A). The results verify that the smoothing measure does not have a material effect on the allocation of cash flow. This asserts that the costs arising from dividend, not total payout, smoothing is the main driver of the frictions in the allocation of cash flow.

1.4.6 Extreme smoothing and the allocation of cash flow

An implicit assumption underlying either of our smoothing measures is that dividend-paying firms continuously commit to a target dividend payout ratio. However, a non-trivial number of firms (25% of non-financial US firms in Compustat) keep dividends fixed for two consecutive years or more, implying that they already operate at their target DPS. This distinct dividend policy, which we call "dividend stickiness", is differentiable from dividend smoothing because it takes the practice to the extreme (SOA =1). Therefore, one could expect the effects outlined previously to amplify for a subsample of firms with sticky dividends.[18]

One shortfall of the Lintner [1956] model is that it ignores firms with sticky dividends because it implicitly assumes that firms gradually adjust dividends to close the gap between target and actual payouts. Therefore, addressing dividend stickiness adds back this subsample of previously ignored firms. Moreover, a sticky dividend is a far more restrictive version of dividend smoothing because it implies that target payout is already achieved and there is no expectation of material changes in current (or future) cash flow.

We start with the previous sample of dividend-paying firms that pay dividends for at least 10 years. The strict measure of dividend smoothing (stickiness) is defined with a dummy variable that takes a value of 1 if a firm keeps its DPS unchanged for at least two consecutive years, and zero otherwise.[19] To avoid spurious changes in dividends caused by rounding errors, trivial changes in DPS (0.5% threshold) are set to zero [e.g. see Amihud and Li, 2006; Andres and Hofbaur, 2017]. Once a firm changes its DPS (increase or decrease), we end its stickiness phase, which can resume if the same firm keeps its DPS unchanged for a following set of two consecutive years.

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[18] The contrast between sticky and smooth dividends has its roots in both theory and practice. Theoretically, Kumar [1988], Kumar and Lee [2001] and Guttman et al. [2010] develop coarse signalling models that result in a partial pooling equilibria whereby dividends remain unchanged regardless of earnings volatility. Empirically, it is well documented that dividends can remain fixed for substantially long periods [Fama and Babiak, 1968; Pettit, 1972; Cyert et al., 1996; Kumar and Lee, 2001].

[19] The definition of dividend stickiness follows Guttman et al. [2010]. However, in defining the episodes of stickiness, we also apply 3, 4, 5 and up to 10 years of fixed DPS. The initially established results hold.

Given this strategy, we identify 3,345 firm-year observations. This means that almost 30% of the total dividend-paying sample engages in dividend stickiness, a significant empirical prevalence of extreme smoothing that is consistent with the survey results of Brav et al. [2005].

Table 1.12 shows how a sticky dividend firm, on average, allocates its cash flow. Compared with the full sample of dividend-paying firms, the average sensitivity of investment to cash flow in sticky dividend firms is larger. However, the difference is not significant, with 0.14 cents more sensitivity in the total cash flow regression and 0.4 cents more sensitivity in the transitory cash flow setting. Consistent with the finding that firms that smooth more (less) pay out less (more) dividends, we observe that sticky payers distribute only 0.6 cents (t-stat = 2.46) of transitory cash flow compared with 1.5 cents (t-stat = 7.71) for dividend payers, verifying that dividend stickiness is an extreme smoothing practice. The cash sensitivity of cash flow is smaller (31 cents) compared with the average dividend-paying firm (36 cents out of every dollar). Moreover, net debt and equity issuance are more active in capturing transitory variations in cash flow (30 cents) compared with the average dividend payer (27 cents).

To describe the distribution of the response variable among sticky dividend firms, we divide the sample into two groups of firms with more extreme stickiness (10 years or more of fixed DPS) and firms with less extreme stickiness (less than 10 years of fixed DPS).[20] Table 1.13 depicts how these two groups of firms allocate their internal cash flow. The difference among the two groups is evident. Investment–transitory cash flow sensitivity in firms with extreme stickiness is 36 cents out of each additional dollar, almost 48% larger than investment–transitory cash flow sensitivity in the less extreme stickiness scenario (25 cents). Interestingly, the cash flow sensitivity of cash remains approximately comparable for the two subsamples: 33 and 39 cents out of each additional dollar of transitory cash flow for more and less extreme smoothers,

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[20] While we acknowledge that the 10-year threshold is arbitrary, applying other thresholds (e.g. 5, 6, 7) does not change the outcome of this analysis.

Table 1.12: Dividend stickiness and the allocation of cash flow. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. Dividend stickiness phases are defined as periods during which a firm keeps its DPS unchanged for at least two consecutive years. The table reports the allocation of internally generated cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Div is cash dividend, CR is cash reserve, ND is net debt issuance and NQ is net equity issuance. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. All variables are demeaned to account for unobservable heterogeneity (firm fixed effects). Control variables, year dummy variables and the constants are included in the model during estimation but are suppressed in the output for brevity.

	Panel A - Dividend Payout				
	Inv	Div	CR	ND	NQ
CF	0.313***	0.014***	0.312***	-0.310***	-0.051***
	(17.62)	(6.51)	(26.29)	(-18.64)	(-5.08)
CF_Permnt	0.388***	0.052***	0.056*	-0.355***	-0.148***
	(9.04)	(10.01)	(1.90)	(-8.82)	(-6.21)
CF_Transit	0.301***	0.006**	0.360***	-0.301***	-0.032***
	(15.57)	(2.46)	(28.09)	(-16.58)	(-2.89)
N			4944		
	Panel B - Total Payout				
	Inv	Tpay	CR	ND	NQ^{Adj}
CF	0.311***	0.059***	0.312***	-0.309***	-0.008
	(17.50)	(9.60)	(26.30)	(-18.56)	(-0.97)
CF_Permnt	0.383***	0.165***	0.053*	-0.351***	-0.049**
	(8.90)	(11.25)	(1.77)	(-8.70)	(-2.40)
CF_Transit	0.301***	0.036***	0.361***	-0.301***	-0.001
	(15.51)	(5.37)	(28.16)	(-16.55)	(-0.14)
N			4929		

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

respectively. Therefore, by applying an extreme dividend smoothing practice, we again find that the cost of adjusting dividends does indeed induce a friction in cash flow allocation. Firms that prolong (reduce) dividend stickiness have higher (lower) investment–cash flow sensitivity, confirming that investments are more exposed to transitory cash flow variations because changes to dividends are no longer available.

Table 1.13: Extreme dividend stickiness and the allocation of cash flow. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. More (less) extreme dividend stickiness phases are defined as periods during which a firm keeps its DPS unchanged for at least (at most) 10 consecutive years. The table reports the allocation of internally generated cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Div is cash dividend, CR is cash reserve, ND is net debt issuance and NQ is net equity issuance. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. All variables are demeaned to account for unobservable heterogeneity (firm fixed effects). Control variables, year dummy variables and the constants are included in the model during estimation but are suppressed in the output for brevity.

Panel A - More Extreme Dividend Stickiness

	Dividend Payout					Total Payout				
	Inv	Div	CR	ND	NQ	Inv	Tpay	CR	ND	NQ^{Adj}
CF	0.371***	0.018***	0.287***	-0.280***	-0.044***	0.353***	0.057***	0.292***	-0.295***	-0.003
	(14.12)	(6.50)	(17.28)	(-11.38)	(-2.84)	(14.22)	(7.03)	(18.52)	(-12.67)	(-0.26)
CF_Permnt	0.418***	0.059***	0.067	-0.359***	-0.097**	0.350***	0.145***	0.076*	-0.411***	-0.019
	(6.28)	(8.52)	(1.55)	(-5.78)	(-2.50)	(5.50)	(7.04)	(1.81)	(-6.88)	(-0.58)
CF_Transit	0.362***	0.010***	0.329***	-0.265***	-0.034**	0.353***	0.041***	0.333***	-0.273***	-0.000
	(12.60)	(3.20)	(18.22)	(-9.84)	(-2.01)	(13.03)	(4.57)	(19.42)	(-10.73)	(-0.03)
N			2571					2571		

Panel B - Less Extreme Dividend Stickiness

	Dividend Payout					Total Payout				
	Inv	Div	CR	ND	NQ	Inv	Tpay	CR	ND	NQ^{Adj}
CF	0.260***	0.011***	0.334***	-0.334***	-0.060***	0.266***	0.063***	0.334***	-0.324***	-0.014
	(10.84)	(3.43)	(19.77)	(-14.86)	(-4.66)	(10.40)	(6.78)	(18.63)	(-13.56)	(-1.20)
CF_Permnt	0.368***	0.045***	0.054	-0.349***	-0.184***	0.413***	0.177***	0.039	-0.299***	-0.072***
	(6.59)	(5.86)	(1.32)	(-6.63)	(-6.29)	(7.10)	(8.53)	(0.92)	(-5.48)	(-2.88)
CF_Transit	0.245***	0.004	0.388***	-0.331***	-0.032**	0.242***	0.035***	0.392***	-0.329***	-0.002
	(9.37)	(0.97)	(21.33)	(-13.47)	(-2.32)	(8.70)	(3.38)	(20.34)	(-12.66)	(-0.15)
N			2178					2178		

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

What about extreme smoothing in the presence of financial constraints? Intuitively, extreme smoothers that are financially constrained are wary of raising dividends, likely exacerbating the occurrence of dividend stickiness. Under such circumstances, the aforementioned results could be driven by constrained firms that keep their DPS fixed. However, this largely goes against prior literature that treats dividend payment as a sign of firms being less constrained. It is even less clear why more financially constrained firms should continue paying dividends. In response, we test the effect of varying degrees of financial constraint on investment–cash flow sensitivity for firms with extreme smoothing habits. We find that the abovementioned results are not driven by the degree of financial constraint. None of the sample firms with sticky dividends fall into the constrained category, implying that extreme smoothers are less financially constrained firms. This is consistent with our expectation that engaging in extreme smoothing increases investment–cash flow sensitivity by denying firms the ability to change dividends in an attempt to absorb variations in cash flow.

1.5 Conclusion

Dividend smoothing is prevalent among dividend-paying firms, but little is known about its effect on cash flow allocation. We hypothesise that investment–cash flow sensitivity is higher for dividend-paying firms, and this sensitivity is positively associated with dividend smoothing. Moreover, if smoothing introduces friction in the cash flow allocation, then more (less) financial flexibility should decrease (increase) this previously unexplored cost.

We show that the investment–transitory cash flow sensitivity of dividend-paying firms is up to 30% higher compared with the full sample of firms. By adding two measures of dividend smoothing into our system, we verify that smoothing significantly affects investment and net debt issuance policies. A 10% decrease in the SOA of dividends (more smoothing) increases the investment–cash flow sensitivity by 2.6 cents that firms finance through net debt issuance. Further, we apply two widely used measures of financial constraint to differentiate more (less) constrained firms and show that the frictions arising from dividend smoothing weaken once firms are less constrained. For the more constrained, a 10% decrease in the SOA translates into a 5 cent increase in investment–cash flow sensitivity. Moreover, the effect prevails through transitory cash flow allocation, indicating that dividend policy continues to affect investment decisions within firms. Specifically, a 10% decrease in the SOA causes a 6.8 cent increase in investment–transitory cash flow sensitivity that is not fully funded by net debt issuance. That is, frictions arising from smoothing impose an additional cost on cash flow allocation that firms are unable to neutralise by accessing external funds, thereby exposing investments to additional (transitory) cash flow shocks. Further, the relationship between investment–cash flow sensitivity and dividend smoothing, in the presence of financial constraints, increases monotonically.

Dividend smoothing bears real consequences. We apply a novel IV and document a negative relationship between the degree of smoothing and investments. Specifically, we use the estimate of Van Binsbergen et al. [2012] of the return time series data for a dividend steepener strategy from January 1996 to October 2009, while controlling for dividend strip returns for 6-, 12-, 18- and 24-month maturities in the future. The authors derive the price of S&P500 dividend strips from intra-day options data, imposing a no-arbitrage condition. After statistically satisfying relevancy and exclusivity conditions of the IV, we show that a one-standard-deviation increase in the SOA (less smoothing) is associated with a 5.5% increase in the investment-to-asset ratio. The results are robust to an array of controls and different measures of smoothing.

Last, we observe that the results we report apply solely to dividend smoothing, not total payout smoothing. That is, a more flexible dividend payout policy could serve as a substitute for hedging activities, and thus neutralise the excessive changes in cash flow caused by rigid dividends. The results are robust to an array of control variables, time and firm fixed effects, alternative budgetary constraint specifications, varied measures of dividend smoothing, and several other filtering alternatives for cash flow decomposition.

An implication that we leave for future work is the debt overhang problem of Myers [1977]. We already document that firms that smooth dividends more tend to be more levered than those that smooth dividends less. Given the rigidity of dividend smoothing, do firms pass on positive NPV projects because of their debt overhang problem? The survey results of Brav et al. [2005] point to "yes"; however, researchers should investigate this matter empirically. Further, we are unable to observe the shape of the dividend cost function. However, there is one way to infer its curvature, information that would allow us to take the theoretical development discussed in this paper further. DeAngelo et al. show that almost half of the 167 dividend-paying firms with losses reduce dividends during their initial loss year, while only 15% of such firms omit dividends. Eventually, faced with economic turmoil and volatile earnings, firms in their sample either cut or omit dividends. The extent to which a firm can tolerate shocks to cash flow without cutting dividends provides a plausible indication of the curvature of the dividend cost function. Examining this would also shed more light on the dividend puzzle introduced by Black [1976].

Chapter 2

Dividend Hibernation and Future Earnings: When No Dividend News Is Good News

2.1 Introduction

In 1958, while Merton H. Miller was explaining the dividend irrelevance proposition to the research department of a Wall Street brokerage firm, the American Telephone and Telegraph Corporation (AT&T) announced an increase in the $9.00 annual dividend *it had maintained for the previous 30 years* . Miller [1987] reports, "when trading (and my lecture) was resumed a half hour later, AT&T had jumped in price by over 10%!" Acknowledging this discrepancy, Miller and Modigliani [1961] posit that it is the information content of dividends on earnings that moves prices. Since then, studies have examined the link between the information content of dividend changes and future earnings. However, important questions largely remained unexplored. Do fixed dividends mean no future earnings news, or do they convey other information? Is it good news or bad news? These are important questions, because a non-trivial number of firms pay constant dividends over consecutive quarters, making dividend changes the exception rather than the norm.

In particular, we define dividend hibernation as periods during which dividends are kept fixed for two consecutive quarters or more (up to 20). Hence, a firm that hibernates its dividends for two consecutive years maintains the same dividend for the current quarter (referred to as the dividend announcement in this paper), as well as for the past seven quarters. Non-hibernating firms are those that change their dividends at least once during a comparative horizon. We find that no dividend changes for an extended period are followed by positive news in the future. Specifically, compared with non-hibernators, firms that hibernate their dividends for the past seven quarters and continue to hibernate in the current quarter experience a 1.0%, 1.6%, 2.2% and 2.4% increase in future unexpected earnings in the second, third, fourth and fifth years (significant at 1%), respectively. Further, we show that during hibernation, firms become more opaque.

Our findings help to explain why no dividend changes are met by positively significant market reactions [e.g. Eades et al., 1985; Kalay and Loewenstein, 1985; Bajaj and Vijh, 1995]. We show that the puzzling favourable market reaction to no changes in dividends stems from market expectation of higher future profitability for hibernating firms. This study is the first to provide evidence that no dividend change is, on average, good news. Our results can also contribute to theories in the field. Guttman et al. [2010] build a variant of an established dividend signalling model [Miller and Rock, 1985] and conclude that firms strategically pool their dividends together by holding them fixed. Dividend hibernation allows firms to save on costly signalling and invest the proceeds into profitable investment opportunities. Consequently, the authors predict that hibernating firms should exhibit higher future profitability. Further, they assert that fixed dividends should increase the information asymmetry gap between insiders and outsiders for hibernators because they do not communicate private information via dividend changes. However, given that investors and managers coordinate to maintain these partial equilibria, investors perceive the hibernation favourably. Consistent with Guttman et al. [2010], we document that hibernating firms are, on average, more profitable and simultaneously more opaque relative to non-hibernators. Compared with regular dividend changes, the change in dividends after hibernation reduces the information asymmetry gap by a greater amount. Although our results support the signalling theories of dividend smoothing, we do not observe higher investment opportunities for hibernating firms, nor do we document additional investments during hibernation periods compared with non-hibernators. Then, why does hibernation precede higher future profitability?

According to Guttman et al. [2010], strategic pooling of dividends in the form of hibernation also mitigates the underinvestment problem, resulting in higher future profitability. To investigate this assertion, we employ three measures of investment efficiency. Following Hou et al. [2019], we define one profitability dummy and two indicators measuring changes in operational efficiency. The results indicate that hibernating firms employ their investments more efficiently, resulting in higher unexpected future earnings. Although we provide some evidence that hibernating firms employ their scarce resources more efficiently, one should remain cautious because (ex ante) the investment first-best decision taken by a manager is not observable. However, ex post, we can infer that the output of a decision indicates more efficient usage of resources.

We also test the newly proposed theory that investments serve as an opportunity cost of dividend signalling proposed by Kaplan and Perez-Cavazos [2020]. The authors suggest that the link between earnings and dividends is more pronounced in firms with lower investment options. That is, firms with lower investment options finance their dividends from a greater proportion of earnings relative to investments. In contrast, firms with greater investment opportunities save on costly signalling to fund their investment options, making the link between earnings and dividends weaker. Therefore, finding higher profitability for hibernating firms may result from the fact that these firms fund their dividends by their earnings rather than spending on investments. The results are not conclusive. We do not find overwhelming support for this theory and cannot conclude that hibernators with lower investment opportunities report higher future unexpected earnings. We employ Tobin's q as a measure of investment opportunities, but the results remain qualitatively the same if cash holdings or dividend yield are used as alternatives. Therefore, we infer that hibernation is followed by higher profitability not because of superior investment options, but more because of efficient investment.

Numerous studies [Watts, 1973; Gonedes, 1978; Benartzi et al., 1997; Grullon et al., 2005] find little or no support for the signalling theories of dividends.[1] DeAngelo et al. [2009] conclude that the signalling role of payout policy is of second-order importance because firms have more efficient methods of communication, such as earnings announcements and direct engagement with outsiders. Recently, Ham et al. [2020] challenged these findings and showed that dividend changes do convey information about future unexpected earnings. All of these studies consider dividend changes newsworthy events, ignoring the majority of sample firms that retain a fixed dividend policy between consecutive quarters. We intend to fill this gap in the literature.

We show that a considerable number of sample firms hold their dividends fixed over consecutive quarters. Specifically, 81%, 41% and 27% of sample firms hold their dividends fixed for two, four and eight consecutive quarters, respectively. The dividend hibernation habit is persistent. Almost 60% of firms that hibernate for eight quarters remain in hibernation for the next four quarters. We study the relationship between hibernation and future earnings by applying the same dividend event strategy outlined by Ham et al. [2020]. Instead of the fiscal year, the authors apply a novel calendar quarter approach and show that dividend changes predict future earnings

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[1] If, as Miller and Modigliani [1961] posit, dividends carry information about future earnings, then pronounced stock market responses to dividend changes reflect reactions to earnings news rather than the dividends themselves. Dividend cuts and omissions are met with a 6–10% decrease in share prices, whereas there is a positive 1% reaction to dividend increases and a positive 3% reaction to dividend initiations [DeAngelo et al., 2009]. Therefore, dividends remain irrelevant but for the presence of information asymmetry. Applying this concept, Bhattacharya [1979] provides seminal work on the signalling theories of dividends. The author draws upon adverse selection arising from the information asymmetry between corporate insiders and outsiders to arrive at perfectly separating equilibria, one in which dividends serve as a costly signal to outsiders. Later works expand on this and develop various models based on the same concept of information asymmetry, whereby managers use dividends to communicate their private information to less-informed outsiders, making dividends value-relevant [e.g. Miller and Rock, 1985; John and Williams, 1985; Ofer and Thakor, 1987; Ambarish et al., 1987; Kumar, 1988; Bernheim, 1991; Allen et al., 2000; Kumar and Lee, 2001; Guttman et al., 2010; Baker et al., 2015].

for up to three years.

We document that a simple dummy variable that captures dividend hibernation helps to predict higher unexpected future earnings. The results are persistent and last for up to five years. Firms that hibernate for four quarters or more experience a 2.2% (t-stat = 5.23) higher unexpected earnings growth five years from the constant dividend announcement. That is, hibernating firms that announce another quarter of fixed dividends experience higher future unexpected earnings relative to non-hibernators. More importantly, the effect is persistent over time. Ham et al. [2020] report that the relationship between positive dividends and future earnings deteriorates once the authors control for the earnings in the first year immediately after the dividend change. Based on this, the authors further conclude that the signalling theories of dividends are less likely to find support empirically because the benefits of signalling do not justify the associated costs. Yet, we find that higher unexpected earnings remain even after controlling for the earnings in the first year after the constant dividend declaration, indicating that the information content of hibernation does not attenuate over time in our sample. Moreover, the economic (as well as statistical) significance of dividend hibernation exceeds the effect of dividend changes. That is, Ham et al. [2020] report that a 50% increase in dividends is associated with a 0.9% increase in unexpected future earnings in the three years. We find that firms that hibernate their dividends for two years experience a 2.2% increase in unexpected future earnings in the three years after adhering to a constant dividend stream. The findings are robust to a matched sample analysis, the inclusion of dividend changes, linear and non-linear controls for earnings, and past stock market returns.[2] Hence, the results suggest that dividend hibernation contains information

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[2] Reverse causality is less of a concern in our analysis because unexpected future earnings are less likely to affect current dividend decisions. First, unexpected future earnings, or earnings innovations, are calculated as the difference between future earnings and earnings before the dividend announcement, and thus are unexpected. Second, because our empirical strategy is designed to avoid look-ahead bias, all future innovations in earnings are unknown in the current period. Last, even if future earnings news is privately known by managers, it is consistent with the information channel we propose, because insiders reveal their information about unexpected future earnings through a dividend hibernation strategy.

about future earnings, consistent with the signalling theories of dividend smoothing.

We also ask whether prolonged hibernation periods are associated with less information transmission to the market. Given that dividends serve as a signalling instrument, it may be that firms are holding dividends fixed because there is no information to begin with, and therefore no information gap between insiders and outsiders. This paper is the first to provide evidence on the relationship between fixed dividends and the information environment of the firm. To investigate this conjecture, we adopt several measures of information asymmetry from the market microstructure literature and construct an information asymmetry index. We also develop a separate illiquidity index to control for liquidity, because Jiang et al. [2017] show that payout policy and liquidity are positively correlated. After ensuring the economic merits of these indexes, we show that longer hibernation is associated with higher information asymmetry. For example, firms whose information asymmetry index is a unit greater than the mean (in the last quarter) are 11.9% more likely to hold their dividends fixed for the next four quarters. The corresponding estimate is 6.9% for firms that hold their dividends fixed for only the next quarter.

Moreover, we construct a hibernation ratio, measured as the number of quarters that a firm engages in hibernation divided by the total number of quarters that the firm appears in the sample (up to the calculation point), and show that this ratio is also positively associated with the information asymmetry index. Firms that change their dividends frequently load insignificantly (0.02%) on the index, while a 1%increase in information asymmetry translates into a 0.17% (t-stat = 2.08) increase in the dividend hibernation ratio (constant dividends for four quarters). The results are robust to different specifications and arrays of controls to account for the agency costs of free cash flow [Jensen, 1986]. We therefore conclude that there is a perceived information gap between insiders and outsiders in hibernating firms, relative to firms that change dividends.

Given that the information asymmetry gap is larger for hibernators, we hypothesise that dividend changes after hibernation are more informative in closing this gap relative to comparable non-hibernating firms. Further, we expect that investors reward (punish) dividend increases (decreases) more forcefully compared with a non-hibernator. Consistent with this hypothesis, we find that dividend changes in hibernating firms always reduce information asymmetry by more (significant at 1%), regardless of the sign of the dividend change or the length of hibernation. Firms that increase their dividends after eight quarters of hibernation experience a 0.7% higher cumulative abnormal return (over a five-day event window) compared with non-hibernating firms, on average. While investors do not penalise dividend cuts more severely if a firm fails to deliver after short periods of hibernation, the tolerance for cuts decreases with the length of hibernation. Dividend cuts after 20 quarters of hibernation result in a 71% more negative market reaction (five days before and after the dividend change) compared with cuts by matched non-hibernators. In fact, we observe that the market reaction to a dividend increase (decrease) by a hibernator is more positive (negative) than a comparable increase (decrease) by a non-hibernating firm over longer periods of hibernation, making each additional dollar more informative.

This study provides several contributions to the corporate payout policy literature. First, given that the majority of firms keep their dividends fixed over consecutive quarters, examining the widely applied fixed dividend policy sheds light on a previously unexplored subject. Prior literature applies a short-lived variant of hibernation (a constant dividend for two consecutive quarters) as a robustness check. We show that constant dividends for two quarters are fundamentally different from dividend hibernation in terms of the information content and within-firm information asymmetry. Second, the necessary condition of signalling theories, the existence of an information gap itself, has remained largely neglected. We show that dividend policy does indeed alter this gap.

It is worth noting that theories based on agency costs propose an alternative to our hypothesis. This line of literature argues that the agency costs of free cash flow [Jensen, 1986] are the main force behind smooth dividends. Lambrecht and Myers [2017] build a dynamic agency model whereby risk-averse managers underinvest and smooth their rents and payout proportionally. Evidently, the predictions of this model are different from those presented in Guttman et al. [2010], as well as our empirical findings. Specifically, despite predictions proposed by the dynamic agency models, we do not find hibernators to be cash cow firms. We control for cash buffers in our tests and confirm our initial results. Ham et al. [2020] conclude that their results do not necessarily support the signalling theories of dividends because the information content of dividend changes barely passes the first year post-change, rendering the costs of signalling larger than the marginal benefits. The authors subsequently suggest that their results are consistent with the notion that reputation costs prevent less profitable firms from misleading the market by increasing their dividends, leaving profitable firms that experience a permanent positive shock to their earnings as the sole group of dividend raisers. Because hibernating firms keep their dividends fixed, the reputation costs channel is less likely to drive our results. Moreover, given that the information content of hibernation lasts for up to five years after the constant dividend announcement, the signalling motive behind hibernation remains the main contributor to our findings. We control for agency costs and continue to observe that hibernating firms are more likely to have a wider information asymmetry gap.

2.2 Data and variables

The sample consists of quarterly ordinary dividend declarations (distribution code 1232) over 1972–2019 from CRSP. A firm must have dividend declarations for each quarter over the past 180 days to be included in the sample. Following Benartzi et al. [1997], Nissim and Ziv [2001], and Ham et al. [2020], we focus on ordinary common stocks (share code 10 or 11) and non-financial firms[3] that are listed on the New York

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[3] We exclude financial firms by removing those with a four-digit SIC code beginning with six.

Stock Exchange (NYSE), American Stock Exchange (AMEX) and Nasdaq exchanges. Further, we drop observations for which stock splits occur in the same dividend declaration quarter to avoid conflating the effect of splits on dividend changes and future earnings (564 firm-quarter observations). If the earnings announcement coincides with a dividend declaration, we treat such earnings as the previous quarter's earnings (741 incidents). Last, we only keep observations with one quarterly dividend declaration (14,722 firm-quarter observations deleted). Stock bid-ask data, return data and other variables necessary to estimate the information asymmetry measures are sourced from CRSP. The number of analysts following sample firms is from the Institutional Brokers' Estimate System (IBES). Earnings and accounting data are from the CRSP/Compustat merged database. We require 12 quarters of consecutive non-missing earnings data to construct the change in future earnings and other controls for expected earnings changes [Fama and French, 2000]. Tests pertaining to future earnings require non-missing earnings data for up to 20 consecutive quarters. All variables are winsorised at the top (bottom) 1%. Following Ham et al. [2020], we set the extreme dividend changes to 200% (315 observations).

Next, dividend change is defined as the current dividend minus the past dividend, divided by the past dividend [Benartzi et al., 1997; Ham et al., 2020]. To mitigate rounding errors caused by the cumulative adjustment factor, absolute dividend changes less than 0.1% are set to zero.[4] Since we require all firms to have dividend announcements, dividend series are by definition non-zero. This ensures that our estimate of dividend changes is not zero. Further, as discussed earlier, prior literature applies a short-lived variant of hibernation (a constant dividend for two consecutive quarters) as a sidebar robustness check. For example,Benartzi et al. [1997] and Ham et al. [2020] identify control firms as those that hold dividends constant for two consecutive periods and designate firms that change their dividends as treatment firms. Thus, to differentiate dividend hibernation from ordinary constant dividends, we define two sets of dummy variables. A dummy variable called "Cons_Div" is

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[4] The results remain qualitatively the same in the absence of this modification.

set equal to one if a firm reports no dividend changes for the current quarter for the dividend-paying firms, and zero otherwise. Further, we define another dummy variable, "H_t", which takes the value of one for firms that hold their dividends fixed for more than two (up to 20) consecutive quarters ($t \in \{2, 3, \ldots, 20\}$), and zero otherwise. This means that a firm with $H_2 = 1$ holds its dividends fixed for three consecutive quarters (i.e. $q \rightarrow q - 2$). It follows that if a firm holds its dividends fixed for the past nine quarters (i.e. $q \rightarrow q - 8$), then $H_8 = 1$. If the same firm changes its dividend during any quarter over the past two calendar years, then $H_8 = 0$.

2.2.1 Dividend event window

To show the relationship between dividend hibernation and future earnings, we require an estimate of unexpected earnings. Following Ham et al. [2020], we define the dividend event window as dividends declared during a calendar year t. Differentiating calendar year from fiscal year is an important consideration. Ham et al. [2020] argue that an identification strategy based on fiscal year conflates earnings announced after dividend changes with current or past earnings. Figure 2.1 illustrates the unexpected earnings variable construction at a yearly frequency in cases where dividends are declared during the fourth calendar quarter of a dividend event year t.

Specifically, unexpected earnings for the year immediately after the dividend announcement are equal to the difference between the sum of earnings for that year and the sum of earnings announced for the four quarters before the dividend announcement year. Therefore, unexpected earnings for the first, second, third and fourth years are the sum of four quarters of earnings starting from the fifth, ninth, thirteenth and seventeenth quarters after a constant dividend announcement minus the sum of earnings announced during the year before the dividend announcement, respectively. All unexpected earnings variables are scaled by the market value of equity in the year before the dividend declaration.

Figure 2.1: Schematic design of the unexpected earnings (E), constructed for a case in which the dividends are declared in the fourth (calendar) quarter. The calendar year during which dividends are declared is defined as the dividend event window (y represents yearly frequencies). The dividend event for a hibernating firm is the announcement of no dividend changes. A non-hibernating is a firm that changes its dividends at some point during the comparable period at least once. A non-hibernator may announce dividend changes in the current quarter or keep the same dividend as in the prior quarter, having changed dividends previously. $\Delta E_{y+1} = (E_{t+1} + E_{t+2} + E_{t+3} + E_{t+4}) - (E_{t-4} + E_{t-5} + E_{t-6} + E_{t-7})$. Unexpected earnings for the quarter immediately after a dividend announcement (in this case, the fourth quarter) is defined as the next quarter's earnings minus the earnings for the same quarter in the year before the dividend event window. Therefore, $\Delta E_{q+1} = E_{t+1} - E_{t-7}$ and $\Delta E_{q+2} = E_{t+2} - E_{t-6}$. All earnings variables are deflated by the market value of equity in the year before the dividend change.

To account for the changes in expected earnings, we define three sets of control variables [Fama and French, 2000; Grullon et al., 2005; Ham et al., 2020]. First, we define a set of controls to account for the linearity in past levels and changes in earnings. We calculate the past earnings level by dividing earnings announced in each quarter before the dividend announcement year by the market value of equity in the year before the announcement. Past earnings changes are the difference between earnings announced in each quarter prior to the dividend declaration year and earnings announced for the same quarter a year before, divided by the market value of equity in the year before the dividend announcement. Second, we define a set of controls to account for the non-linearity in past levels and changes in earnings. For each of the past earnings levels and changes, we calculate three variables: (1) an interaction of a negative dummy variable (set to one if earnings levels/changes are negative and zero otherwise) with the earnings levels/changes; (2) an interaction of a negative dummy variable and the earnings levels/changes squared; and (3) an interaction between a positive dummy variable (set to one if the earnings levels/changes are positive and zero otherwise) and the earnings levels/changes squared. In total, there are six control variables to account for the mean-reversion attributes of earnings. Finally, we estimate a set of control variables to account for the fact that past stock returns may mirror expected earnings [Ball and Brown, 1968; Ham et al., 2020]. Following Ham et al. [2020], we estimate cumulative stock returns over five different maturities, 240 trading days before the dividend announcement. Again, according to our definition of hibernators, these are firms that keep their dividends fixed in the current quarter as well as in previous quarters. Non-hibernators are firms that change their dividends at least once during a comparative horizon. Hence, the announcement event for a hibernator is the confirmation of no change in dividends in the current quarter, while non-hibernators may also announce constant dividends in the current quarter but have changed their dividends at some point over a comparable horizon.

2.2.2 Index construction

The primary constituents of the information asymmetry index (INF$_{it}$) are seven measures of adverse selection. The daily measures include the daily total stock return volatility (VOL$_{it}$), the percent quoted spread (PQS$_{it}$) developed by George et al. [1991], the average effective bid-ask spread (ABAS$_{it}$), and two other measures of bid-ask spread developed by Abdi and Ranaldo [2017] and Corwin and Schultz [2012], AR$_{it}$, and HL$_{it}$, respectively. We also employ analyst forecast dispersion, scaled by the mean monthly price (AD$_{it}$), which is constructed on a monthly basis following Garfinkel [2009]. We average these measures for each firm i at quarter t. Therefore, the index has cross-sectional variations as well as long time series attributes.

Jiang et al. [2017] show that payout policy is positively associated with liquidity. Yet, market liquidity is a multifaceted concept, and it is unlikely that a single measure can capture its dimensions [Amihud, 2002; Hasbrouck, 2009]. Therefore, we also construct an illiquidity index (ILLIQ$_{it}$) that includes the illiquidity ratio (AH$_{it}$) of Amihud [2002], *minus* the Amivest liquidity ratio (AV$_{it}$) estimated following Hasbrouck [2009], the zero-return proportion measure (ZR$_{it}$) as in Lesmond et al. [1999], and *minus* the number of analysts following each firm i (NOA$_{it}$).[5]

To construct the information asymmetry (INF$_{it}$) and illiquidity (ILLIQ$_{it}$) indexes, we follow Bharath et al. [2008] and apply principal component analysis to estimate the common component of the cross-sectional variation of the two index constituents for each firm i during each quarter t.[6] For each quarter, we estimate the first principal

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[5] We also estimate the quarterly probability of an informed trade (PIN) as in Easley et al. [1996, 2000] for non-financial firms listed on NYSE/AMEX for the period 1993–2014 from high-frequency TAQ data. The constructed INF$_{it}$ benefits from PIN, and all results reported in this paper become more pronounced. However, the use of PIN reduces the sample size (by 76.62%). As a result, it is provided as robustness. Moreover, we estimate the Pástor and Stambaugh [2003] liquidity measure (γ) and use it to construct the illiquidity index (ILLIQ$_{it}$). The added measure of liquidity is not highly correlated with the other liquidity measures, reducing the explanatory power of the first principal component, which is consistent with the recent critique of γ [see Pontiff and Singla, 2019]. In any case, the results using an alternative construction of the index remain qualitatively the same.

[6] Alternatively, one can apply a dynamic principal component procedure that combines cross-sectional and time series aspects of the sample in a descriptive (not a probabilistic) way. However, combining the cross-sectional and time series dimensions of the data requires an ad hoc methodology (usually a linear regression model). To avoid this and to maintain comparability with the literature, we follow the Bharath et al. [2008] procedure.

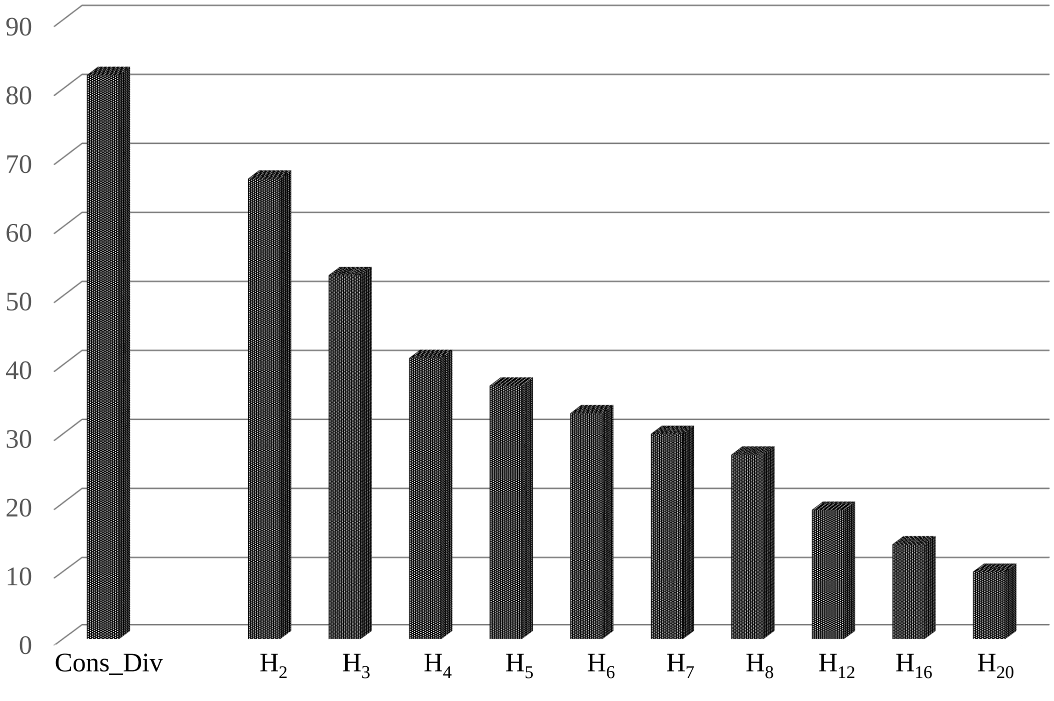
components of the correlation matrix of the firm-level standardised measures of adverse selection and illiquidity. The first principal components of the adverse selection and illiquidity proxies explain, on average, more than 60% and 50% of the total cross-sectional sample variance, respectively. Therefore, we set the information asymmetry (INF_{it}) and illiquidity (ILLIQ_{it}) indexes equal to the first principal components of the asymmetric information and illiquidity variables, respectively. The two indexes enable us to investigate the information and liquidity environments of firms for each quarter before and after the dividend declaration window.

2.2.3 Summary statistics

To show the prevalence of constant dividend and hibernation categories, we plot their percentages. Figure 2.2 depicts the number of firm-quarter observations in each category divided by the total number of observations (213,043). Approximately, 82% of dividend changes remain the same for two consecutive quarters. The concentration of the distribution at Cons_Div indicates that dividend changes are the exception rather than the norm. Noting that existing studies focus on the information content of dividend changes [Watts, 1973; Gonedes, 1978; Benartzi et al., 1997; Grullon et al., 2005; Amihud and Li, 2006; Ham et al., 2020], the prevalence of constant dividends highlights a gap in the literature that this paper aims to fill. In line with intuition, the prevalence of hibernation monotonically decreases over time. For example, while 40% of sample firms are likely to keep their dividend fixed for four quarters, only 10% would keep their dividends fixed for 20 quarters or more. This shows that hibernation for an extended period is less likely.

Table 2.1 provides a univariate analysis of firm characteristics for the full sample, as well as the three groups of constant, increasing and decreasing dividend firms. Consistent with the previous literature [Lintner, 1956; Fama and Babiak, 1968; Skinner, 2008], firms appear extremely reluctant to cut dividends (only 1.51% of the total sample), occasionally increase dividends (17.16%) and typically keep them fixed

Figure 2.2: Percentage of constant dividend and hibernation categories. The sample consists of ordinary quarterly dividend declarations (distribution code 1232) over the period 1972–2019, obtained from CRSP. Constant dividend firms (Cons_Div) are the firms that keep their dividends fixed for the current quarter. H_t $(t \in \{4, 8, \ldots, 20\})$ is a dummy variable equal to one if a firm reports fixed dividends for two (H_2), three (H_3), four (H_4), five (H_5), six (H_6), seven (H_7), eight (H_8), 12 (H_{12}), 16 (H_{16}) or 20 (H_{20}) quarters, and zero otherwise. Each bar represents the number of firm-quarter observations in each category divided by the total number of observations (213,043).



for consecutive quarters (81.33%). A dividend increase results in a cumulative abnormal return of 1.3%, 1.7% and 2.1% for two-, five- and ten-day windows around the dividend announcement, respectively. The corresponding results for a dividend cut are -3.0%, -3.5% and -4.3%, respectively. Moreover, dividend-cutting firms have the lowest median Tobin's q (1.07), followed by constant dividend firms (1.18) and firms that increase their dividends (1.32).

The table further shows the information asymmetry and illiquidity indexes for firms within each category. The higher (lower) values of the two indexes translate into higher (lower) information asymmetry and illiquidity. Firms with constant dividends have, on average, higher information asymmetry and illiquidity compared with firms that increase their dividends. Firms that cut their dividends have the highest information asymmetry and illiquidity. This is consistent with the argument of Miller and Rock [1985] that the best place for empirical research on signalling theories is where firms fall from grace because they stop signalling through dividends. In this sense, dividend-cutting firms become more opaque because dividends are no longer available to disclose the insider's information to outsiders.

Table 2.5 summarises the statistical properties of each index, as well as their components for the period 1972–2019. The number of observations for NOA_{it} and AD_{it} is smaller compared with the other variables because most of the IBES earnings coverage started in 1982. Moreover, we set the missing values for the number of analyst forecasts to zero, although the results are not sensitive to this adjustment. Both the Amivest (AV_{it}) and the number of analyst forecasts (NOA_{it}) measures are multiplied by minus one to allow for a straightforward interpretation. That is, larger values for the two measures correspond to less liquidity.

Panel B in Table 2.5 illustrates the means of the quarterly Spearman rank correlations between cross-sectionally standardised levels of the constituents over the sample period. The proxies for information asymmetry and the proxies for illiquidity are positively and significantly correlated. However, the correlation between

Table 2.1: Summary statistics of the main variables. The sample includes all firms with quarterly (ordinary) dividend declarations (distribution code 1232) over the period 1972–2019 in CRSP. ΔD is the dividend change, calculated as the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. Information asymmetry (INF) and illiquidity (ILLIQ) indexes are the first principal components of several adverse selection and illiquidity measures developed by the market microstructure literature. MC is the log of the market value of equity. Leverage is total debt (DLTTQ + DLCQ) divided by total assets (ATQ). Cash is cash and short-term investments (CHEQ), scaled by total assets. The capital investment (CAPX) and operating cash flow (CF) variables are both taken from the statement of cash flows and are normalised by the beginning-of-period total assets. Tobin's q is measured as the market value of equity plus the book value of assets minus the book value of equity plus deferred taxes, all divided by the book value of assets. Tangibility is net property, plant and equipment (PPENTQ) divided by the beginning-of-period total assets. The institutional ownership ratio is collected from Thomson Reuters 13F. CAR is the cumulative abnormal return relative to the value-weighted market return. Panel A represents the full sample. Panels B, C and D report the statistics for the constant, increasing and decreasing dividend subsamples, respectively.

	Panel A: Full Sample					
	N	Mean	Stdev	P25	Median	P75
ΔD	200,714	0.026	0.150	0.000	0.000	0.000
INF	128,990	-0.000	1.922	-1.391	-0.355	1.064
ILLIQ	172,342	-0.000	1.474	-0.910	0.022	0.875
MC	215,769	6.186	2.133	4.616	6.141	7.648
Leverage	190,033	0.254	0.167	0.129	0.251	0.363
Tobin's q	201,752	1.499	1.004	0.956	1.199	1.690
Cash	182,031	0.089	0.120	0.016	0.045	0.115
CAPX/Lagged Total Assets	129,920	0.019	0.270	0.006	0.012	0.021
CashFlows/Lagged Total Assets	112,487	0.028	0.055	0.010	0.025	0.043
Tangibility	184,815	0.390	0.253	0.191	0.333	0.580
Institutional Ownership Ratio	201,954	0.379	0.318	0.024	0.363	0.641
CAR[-2,+2]	213,324	0.003	0.053	-0.022	0.002	0.027
CAR[-5,+5]	213,259	0.005	0.072	-0.033	0.003	0.040
CAR[-10,+10]	213,153	0.006	0.093	-0.044	0.004	0.054
CAR[-20,-2]	212,961	0.002	0.084	-0.044	0.000	0.046
CAR[-40,-21]	212,596	0.002	0.084	-0.044	-0.001	0.045
CAR[-60,-41]	212,248	0.004	0.085	-0.043	0.002	0.048
CAR[-120,-61]	211,122	0.010	0.142	-0.070	0.007	0.086
CAR[-240,-121]	208,706	0.023	0.201	-0.092	0.017	0.130
E_{q-1}	195,260	0.022	0.050	0.011	0.019	0.031
E_{q-2}	194,714	0.021	0.057	0.011	0.018	0.031
E_{q-3}	193,545	0.020	0.057	0.011	0.018	0.030
E_{q-4}	191,731	0.020	0.056	0.011	0.018	0.030
ΔE_{q-1}	188,631	0.003	0.111	-0.004	0.002	0.008
ΔE_{q-2}	185,694	0.002	0.107	-0.004	0.002	0.008
ΔE_{q-3}	182,760	0.001	0.124	-0.004	0.002	0.007
ΔE_{q-4}	179,768	0.000	0.062	-0.004	0.002	0.007

Table 2.2: Summary statistics - Constant dividend sample.

	Panel B: ΔD $= 0$					
	N	Mean	Stdev	P25	Median	P75
ΔD	163,239	0.000	0.000	0.000	0.000	0.000
INF	104,971	0.039	1.936	-1.363	-0.319	1.115
ILLIQ	141,571	0.032	1.483	-0.881	0.052	0.917
MC	163,195	6.147	2.118	4.583	6.107	7.601
Leverage	143,965	0.254	0.166	0.131	0.251	0.361
Tobin's q	152,849	1.458	0.933	0.946	1.178	1.641
Cash	147,918	0.088	0.116	0.016	0.044	0.113
CAPX/Lagged Total Assets	105,076	0.017	0.022	0.006	0.012	0.021
CashFlows/Lagged Total Assets	90,654	0.027	0.040	0.009	0.025	0.043
Tangibility	148,690	0.388	0.249	0.193	0.332	0.571
Institutional Ownership Ratio	155,431	0.385	0.317	0.039	0.371	0.646
CAR[-2,+2]	162,363	0.002	0.051	-0.024	0.000	0.025
CAR[-5,+5]	162,323	0.002	0.070	-0.034	0.001	0.037
CAR[-10,+10]	162,271	0.003	0.091	-0.047	0.001	0.051
CAR[-20,-2]	162,152	0.001	0.084	-0.046	-0.001	0.044
CAR[-40,-21]	161,901	0.001	0.084	-0.045	-0.001	0.044
CAR[-60,-41]	161,672	0.003	0.085	-0.043	0.001	0.047
CAR[-120,-61]	160,894	0.007	0.142	-0.074	0.005	0.084
CAR[-240,-121]	159,283	0.017	0.200	-0.098	0.012	0.125
E_{q-1}	158,855	0.021	0.049	0.010	0.018	0.030
E_{q-2}	158,438	0.020	0.060	0.010	0.018	0.030
E_{q-3}	157,474	0.019	0.060	0.010	0.018	0.030
E_{q-4}	156,088	0.019	0.058	0.010	0.018	0.029
ΔE_{q-1}	153,858	0.003	0.119	-0.005	0.002	0.008
ΔE_{q-2}	151,468	0.002	0.115	-0.005	0.002	0.007
ΔE_{q-3}	149,088	0.001	0.136	-0.004	0.002	0.007
ΔE_{q-4}	146,754	-0.000	0.065	-0.004	0.002	0.007

Table 2.3: Summary statistics - Dividend increase sample.

	Panel C: ΔD > 0					
	N	Mean	Stdev	P25	Median	P75
ΔD	34,453	0.189	0.279	0.057	0.111	0.200
INF	21,596	-0.327	1.738	-1.575	-0.640	0.616
ILLIQ	27,079	-0.230	1.394	-1.090	-0.183	0.609
MC	34,442	6.536	2.117	4.979	6.501	7.988
Leverage	30,418	0.256	0.169	0.130	0.251	0.366
Tobin's q	32,335	1.670	1.173	1.010	1.322	1.911
Cash	31,325	0.094	0.136	0.016	0.047	0.120
CAPX/Lagged Total Assets	21,118	0.019	0.032	0.007	0.013	0.022
CashFlows/Lagged Total Assets	18,460	0.032	0.042	0.014	0.028	0.047
Tangibility	31,399	0.413	0.263	0.202	0.356	0.629
Institutional Ownership Ratio	30,490	0.366	0.321	0.000	0.348	0.634
CAR[-2,+2]	34,128	0.013	0.051	-0.014	0.009	0.035
CAR[-5,+5]	34,116	0.017	0.067	-0.021	0.013	0.050
CAR[-10,+10]	34,080	0.021	0.086	-0.028	0.017	0.066
CAR[-20,-2]	34,048	0.009	0.077	-0.035	0.006	0.049
CAR[-40,-21]	33,989	0.006	0.077	-0.038	0.003	0.046
CAR[-60,-41]	33,915	0.008	0.076	-0.035	0.005	0.048
CAR[-120,-61]	33,696	0.024	0.128	-0.053	0.017	0.092
CAR[-240,-121]	33,168	0.051	0.184	-0.060	0.039	0.146
E_{q-1}	33,509	0.028	0.039	0.013	0.021	0.036
E_{q-2}	33,400	0.026	0.037	0.013	0.020	0.033
E_{q-3}	33,215	0.024	0.034	0.012	0.019	0.032
E_{q-4}	32,819	0.024	0.040	0.012	0.019	0.031
ΔE_{q-1}	32,016	0.008	0.056	-0.000	0.003	0.010
ΔE_{q-2}	31,525	0.006	0.052	-0.001	0.003	0.009
ΔE_{q-3}	31,023	0.005	0.040	-0.001	0.003	0.008
ΔE_{q-4}	30,434	0.004	0.047	-0.001	0.002	0.008

Table 2.4: Summary statistics - Dividend decrease sample.

Panel D: Δ**D** < 0

	N	Mean	Stdev	P25	Median	P75
ΔD	3,022	-0.421	0.254	-0.600	-0.437	-0.214
INF	1,248	1.274	2.303	-0.470	0.913	2.631
ILLIQ	1,832	0.422	1.553	-0.511	0.453	1.303
MC	3,022	5.817	2.087	4.230	5.732	7.237
Leverage	2,702	0.265	0.207	0.063	0.265	0.404
Tobin's q	2,824	1.601	1.712	0.836	1.053	1.596
Cash	2,774	0.108	0.172	0.015	0.046	0.124
CAPX/Lagged Total Asset	2,001	0.015	0.022	0.003	0.009	0.019
CashFlows/Lagged Total Assets	1,902	0.029	0.060	0.005	0.021	0.044
Tangibility	2,764	0.410	0.291	0.170	0.371	0.660
Institutional Ownership Ratio	1,975	0.374	0.310	0.080	0.337	0.617
CAR[-2,+2]	2,996	-0.030	0.100	-0.066	-0.017	0.019
CAR[-5,+5]	2,993	-0.035	0.118	-0.085	-0.022	0.026
CAR[-10,+10]	2,990	-0.043	0.151	-0.111	-0.033	0.034
CAR[-20,-2]	2,978	-0.013	0.120	-0.068	-0.010	0.047
CAR[-40,-21]	2,968	-0.018	0.121	-0.071	-0.014	0.042
CAR[-60,-41]	2,965	-0.017	0.123	-0.075	-0.015	0.046
CAR[-120,-61]	2,934	-0.029	0.207	-0.126	-0.024	0.074
CAR[-240,-121]	2,877	-0.017	0.251	-0.158	-0.024	0.108
E_{q-1}	2,896	-0.002	0.151	-0.006	0.011	0.024
E_{q-2}	2,876	0.012	0.093	0.003	0.014	0.028
E_{q-3}	2,856	0.020	0.080	0.006	0.016	0.030
E_{q-4}	2,824	0.020	0.071	0.007	0.017	0.031
ΔE_{q-1}	2,757	-0.017	0.102	-0.025	-0.006	0.005
ΔE_{q-2}	2,701	-0.010	0.078	-0.020	-0.003	0.007
ΔE_{q-3}	2,649	-0.005	0.072	-0.016	-0.002	0.007
ΔE_{q-4}	2,580	-0.007	0.069	-0.015	-0.001	0.007

our illiquidity and information asymmetry indexes remains relatively low (0.23). The constituents of each index also have low levels of correlation with each other. This supports the fact that our information asymmetry index captures a distinct information feature.

Table 2.5: Information asymmetry (INF_{it}), illiquidity indexes (ILLIQ_{it}) and their constituents. INF_{it} constituents include the absolute bid-ask spread (BAS_{it}), the percent quoted spread (PQS_{it}), the average effective bid-ask spread (ABAS_{it}), as well as the Abdi and Ranaldo [2017] and Corwin and Schultz [2012] measures of adverse selection based on the bid-ask spread (AR_{it} and HL_{it}, respectively). The estimates are measured for each firm i at quarter t. The illiquidity index (ILLIQ_{it}) includes the illiquidity ratio (AH_{it}) of Amihud [2002], *minus* the Amivest liquidity ratio (AV_{it}) estimated following Hasbrouck [2009], the zero-return proportion measure (ZR_{it}) from Lesmond et al. [1999], and *minus* the number of analysts following the sample firm (AF_{it}). Panel A reports the summary statistics and Panel B shows the Spearman rank correlation matrix of the cross-sectionally standardised measures.

Panel A: Summary Statistics

	(1) INF_{it}	(2) ILLIQ_{it}	(3) ABAS_{it}	(4) PQS_{it}	(5) AR_{it}	(6) HL_{it}	(7) AH_{it}	(8) AV_{it}	(9) ZR_{it}	(10) NOA_{it}	(11) AD_{it}	(12) VOL_{it}
N	128,990	172,342	193,254	184,052	181,682	184,052	184,052	184,052	184,052	160,604	100,495	193,254
Mean	-0.000	-0.000	0.017	0.025	0.009	0.006	0.816	-31.448	0.132	-4.968	0.071	0.021
SD	1.922	1.474	0.017	0.013	0.007	0.006	8.018	83.009	0.120	6.081	3.912	0.010
P25	-1.391	-0.910	0.003	0.017	0.006	0.003	0.002	-30.250	0.017	-7.688	0.001	0.014
Median	-0.355	0.022	0.015	0.022	0.008	0.005	0.024	-8.542	0.111	-2.677	0.003	0.019
P75	1.064	0.875	0.024	0.030	0.011	0.007	0.254	-2.760	0.208	0.000	0.006	0.025

Panel B: Correlation Matrix

	(1) INF_{it}	(2) ILLIQ_{it}	(3) ABAS_{it}	(4) PQS_{it}	(5) AR_{it}	(6) HL_{it}	(7) AH_{it}	(8) AV_{it}	(9) ZR_{it}	(10) NOA_{it}	(11) AD_{it}	(12) VOL_{it}
INF_{it}	1											
ILLIQ_{it}	0.23^{a}	1										
ABAS_{it}	0.71^{a}	0.30^{a}	1									
PQS_{it}	0.93^{a}	0.01^{a}	0.61^{a}	1								
AR_{it}	0.80^{a}	0.49^{a}	0.49^{a}	0.63^{a}	1							
HL_{it}	0.83^{a}	0.08^{a}	0.49^{a}	0.82^{a}	0.62^{a}	1						
AH_{it}	0.21^{a}	0.73^{a}	0.28^{a}	0.00	0.48^{a}	-0.01^{a}	1					
AV_{it}	0.32^{a}	0.90^{a}	0.32^{a}	0.09^{a}	0.54^{a}	0.10^{a}	0.74^{a}	1				
ZR_{it}	0.04^{a}	0.69^{a}	0.12^{a}	-0.08^{a}	0.25^{a}	0.08^{a}	0.38^{a}	0.48^{a}	1			
NOA_{it}	0.14^{a}	0.82^{a}	0.39^{a}	0.03^{a}	0.31^{a}	0.08^{a}	0.51^{a}	0.71^{a}	0.36^{a}	1		
AD_{it}	0.34^{a}	0.06^{a}	0.19^{a}	0.27^{a}	0.24^{a}	0.21^{a}	0.08^{a}	0.11^{a}	0.08^{a}	-0.05^{a}	1	
VOL_{it}	0.86^{a}	0.21^{a}	0.54^{a}	0.73^{a}	0.69^{a}	0.51^{a}	0.24^{a}	0.30^{a}	0.00	0.15^{a}	0.28^{a}	1

Dividend hibernation is prevalent and persistent. Table 2.6 illustrates the prevalence of each hibernation category ($\text{H}_2, \ldots, \text{H}_{20}$) by tabulating the percentage of dividend observations that fall within each category. Specifically, we calculate the number of observations in each hibernation category in the current quarter and then follow the proportion of firm quarters that keep their dividends fixed in the following four quarters. For example, we divide the number of fixed dividends for four consecutive quarters by the total number of dividend payment occurrences in the sample to find that approximately 41% of dividend observations are held fixed for four consecutive quarters (H_4). The hibernation behaviour is quite sticky. Approximately 85% of sample firms in the H_4 category are likely to hold their dividends fixed in the next quarter (q_{t+1}), and 55% of the same category maintain the same level of dividends for the next four quarters (q_{t+4}). Consistent with Guttman et al. [2010], we find that at least 27% of sample firms hibernate their dividends for eight consecutive quarters, indicating that hibernation is prevalent and non-trivial. The persistency increases along the hibernation horizon. Approximately 88% of firms with fixed dividends over the past two years (H_8) hold their dividends fixed in the next quarter, and 60% of such firms maintain a fixed dividend during the next four quarters. Although we only trace the hibernators, it is worth mentioning that 19% and 22% of firms that hold their dividends fixed in the past three and four quarters, respectively, increase their earnings in the current quarter. At the same time, dividend cuts are extremely rare (approximately 1% of observations), making it difficult to infer any discernible pattern with sufficient statistical power.

Table 2.6: Dividend hibernation prevalence and consistency. The table traces the frequency (%) of sample firms in each dividend hibernation category that keep their dividends fixed ($\Delta D = 0$) in the following five quarters. H_t ($t \in \{2, 3, \ldots, 8\}$) is a set of dummy variables that take the value of one for firms that hold their dividends fixed for more than two (up to eight) consecutive quarters, and zero otherwise. The third and the fourth columns provide the number of observations in each category (N) and their proportion in the overall sample, respectively.

				$\mathbf{\Delta D = 0}$			
	Hibernation	**N**	**(%) of Sample**	q_{t+1}	q_{t+2}	q_{t+3}	q_{t+4}
q_t	H_2	142,696	66.98	74.59	55.08	47.01	40.47
	H_3	106,443	53.36	73.85	63.02	54.22	46.74
	H_4	78,604	41.25	85.34	73.42	63.30	54.83
	H_5	67,081	36.79	86.04	74.17	64.25	56.38
	H_6	57,715	33.07	86.20	74.68	65.53	57.71
	H_7	49,753	29.77	86.63	76.02	66.95	59.02
	H_8	43,102	26.88	87.75	77.28	68.12	60.05
	H_{12}	25,881	18.91	88.62	78.58	69.72	61.88
	H_{16}	16,016	13.61	89.07	79.35	70.62	62.84
	H_{20}	10,065	9.90	89.11	79.40	70.68	63.05

2.3 Method and results

In a theoretical setting, Guttman et al. [2010] argue that constant dividends emerge as partial pooling equilibria that Pareto dominates, fully revealing equilibria developed in Miller and Rock [1985]. Guttman et al. [2010] show that a manager's investment decision is closer to the first-best outcome, mitigating the underinvestment problem. The model then predicts that periods of dividend hibernation (stickiness) are followed by higher future productivity. We follow two empirical strategies to test the prediction of this model. First, we employ a matched sample analysis to partially control for observables by creating control and treatment groups. Next, we estimate OLS regressions, employing a set of control variables that are likely to affect the impact of dividend hibernation on future unexpected earnings.[7]

Reverse causality is less of a concern in this study. Whether it is the hibernation that increases the information asymmetry gap or the other way around does not change our conclusion that the hibernation episodes coincide with a wider information asymmetry gap between corporate insiders and outsiders. Moreover, we employ unexpected future earnings as our main dependent variable while controlling for variables that help to predict future earnings. The dependent variable in our analysis is set such that it represents future earnings news that is exogenous and thus unexpected by managers.

2.3.1 Matched sample analysis

We apply a sample matching procedure to ensure that the relationship between dividend hibernation and future earnings is robust to time and industry effects. Further, it enables us to present our results graphically in Figures 2.3 and 2.4. We estimate the probability that a firm will change its dividends with a probit model, in which a dividend change dummy is the dependent variable and the previous four (quarterly)

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[7] Although we condition on dividend-paying firms, we must acknowledge that the most prominent critique of dividend signalling theories remains. That is, old firms with lower growth options are more likely to be dividend payers compared with younger and more opaque firms [DeAngelo et al., 2009].

earnings levels and changes are the independent variables. Applying the estimated probability, we calculate propensity scores that are used to match each firm in each hibernation category ($\text{H}_t = 1, t \in \{2, 3, \ldots, 20\}$) to a non-hibernating firm ($\text{H}_t = 0$) with the closest propensity score within the same dividend declaration quarter and industry (two-digit SIC). First, we match each sample of firms in each quarter.[8] We do not separate dividend increases from dividend decreases because of the limited sample size of the latter. The inclusion of dividend cuts in our analysis is unlikely to affect the interpretation but, if it does, it will bias against a finding.

Figures 2.3 and 2.4 illustrate the evolution of the earnings levels from four quarters prior to the dividend announcement ($q - 4$) through to 20 quarters after the announcement ($q + 20$) for hibernating firms and their matched non-hibernating counterparts. Compared with the non-hibernators, hibernating firms have, on average, lower earnings four quarters before the dividend announcement. Approaching the dividend announcement in the current quarter, the earnings for the hibernators increase, reaching similar levels as those for the non-hibernators in the year immediately after the announcement. From $q + 4$ onwards, hibernating firms have distinctly higher earnings compared with non-hibernators, a gap that widens and remains persistent through $q + 20$. We also plot the same series for firms that keep their dividends fixed for two consecutive quarters (Cons_Div), along with their matched non-hibernators (Non_Cons_Div), to show that the effect increases with the hibernation horizon. This provides initial support to the argument that news of no dividend changes for an extended period (at least more than a year) is positive. Firms that hibernate their dividends for two years or more (H_8) report higher unexpected future earnings compared with firms that change their dividends at least once during the same period (Non_H_8). Because we match along time and industry dimensions, our results are not driven by time trends or industry specificity.

Interestingly, the top panel illustrates that an H_8 hibernator would report higher

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[8] Although Ham et al. [2020] apply a yearly frequency, we employ a quarterly frequency to match hibernators and non-hibernators because our hibernation category updates on a quarterly basis. We allow for replacement, imposing a Caliper distance of 0.03, following Ham et al. [2020].

unexpected future earnings compared to Non_H_8 after $q+4$. In the bottom panel, we see that an H_{12} hibernator reports lower earnings compared to Non_H_{12} at quarter 0. As H_{12} firms are a subsample of H_8 firms (as a firm would be an H_8 firm before they can be an H_{12}), what is illustrated in the bottom panel implies that it is the firm that becomes a non-hibernator that lifts up the future earnings, otherwise we would see a reduction in the gap in the bottom panel at quarter 0 as what would be predicted from the top panel at $q+4$.

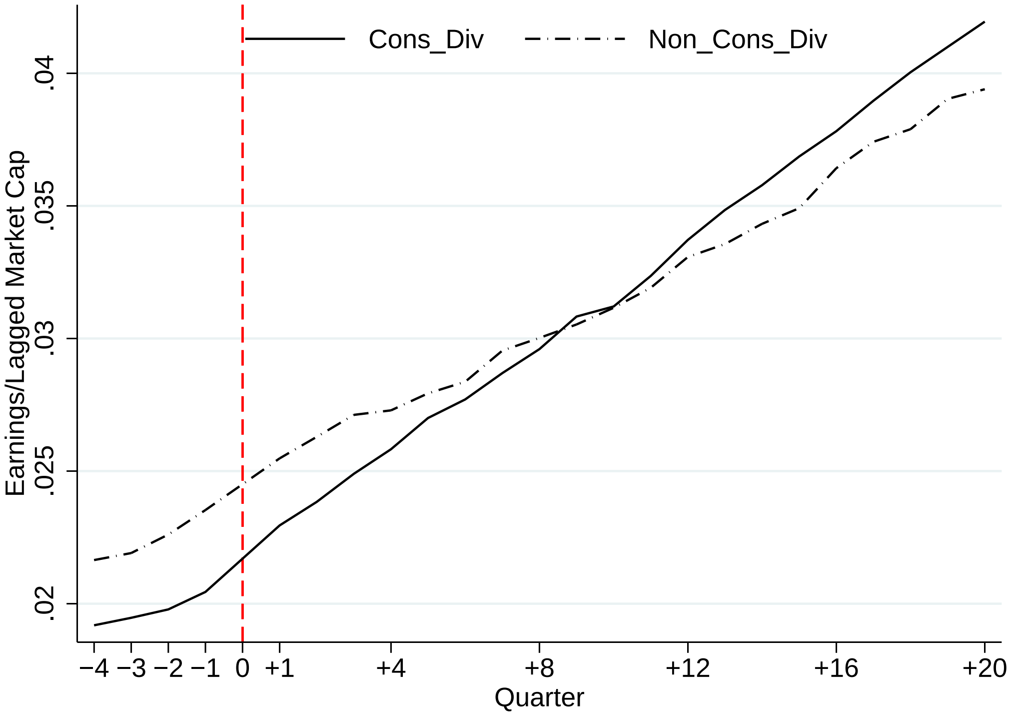
2.3.2 Dividend hibernation and future earnings

We formally test the prediction of Guttman et al. [2010] by applying the empirical strategy of Ham et al. [2020]. The authors employ a dividend event window approach and study whether changes in dividends help to explain unexpected future earnings. The main difference in our approach is achieved by adding dummy variables that capture dividend hibernation. Further, Ham et al. [2020] estimate their model for up to three years, while we estimate the model for up to 20 quarters to test the long-term predictability and persistence of hibernation. Hence, we estimate the following regression:

$$\Delta \mathrm{E}_{iy+j} = \alpha_i + \beta \mathrm{H}_{it} + \gamma \Delta \mathrm{D}_{iq} + \delta \mathrm{E}_{iq-j} + \zeta \Delta \mathrm{E}_{iq-j} + \eta \mathrm{E}_{NL} + \theta \mathrm{CAR}_{[a,b]} + \epsilon_{iy+j} \tag{2.1}$$

where $\Delta \mathrm{E}_{iy+j}$ is the difference between the sum of earnings for the four quarters j years ($j \in 1,2,3,4,5$) after the dividend announcement and the sum of earnings for the four quarters one year before the announcement, scaled by the market value of equity in the year before the announcement. H_t $(t \in \{4,8,12\})$ is a dummy variable equal to one if a firm reports zero dividend changes for four (H_4), eight (H_8) and twelve (H_{12}) quarters. $\Delta \mathrm{D}_{iq}$ is the dividend change, equal to the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. E_{iq-j} is the earnings level of firm i, j quarters prior to the dividend announcement, scaled by the market value of equity in the year before the announcement. $\Delta \mathrm{E}_{iq-j}$ is the

Figure 2.3: Dividend hibernation and future earnings–a matching analysis. This figure reports the matching analysis results over the period 1972–2019. Hibernators are firms that keep their dividends fixed for four quarters (H_4). Non-hibernators are firms that change their dividends at least once during the last four quarters (Non-H_4). Constant dividend firms (Cons_Div) are firms that keep their dividends fixed for the current quarter, and Non_Cons_Div firms are firms that change their dividends in the current quarter. At each quarter, each hibernating firm is matched to a non-hibernating firm in the same industry. The level and change in earnings over quarters $q-4$ to $q-1$ are used to set up a propensity score model to match the firms. Both graphs plot the earnings levels (scaled by lagged market capitalisation) over quarters $q-4$ to $q+20$.



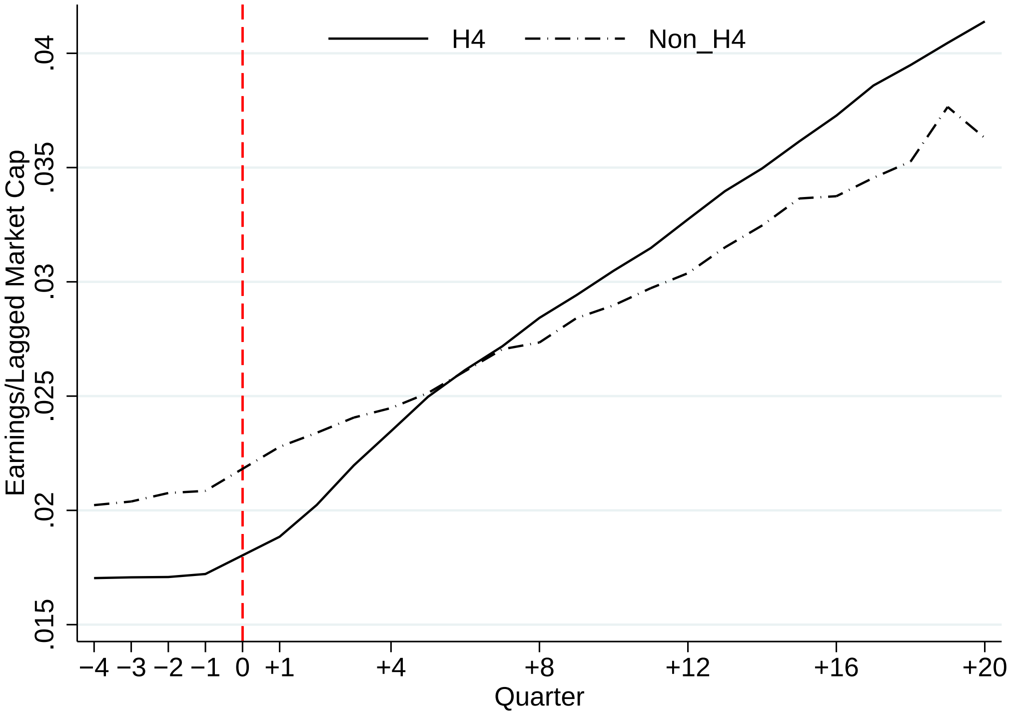
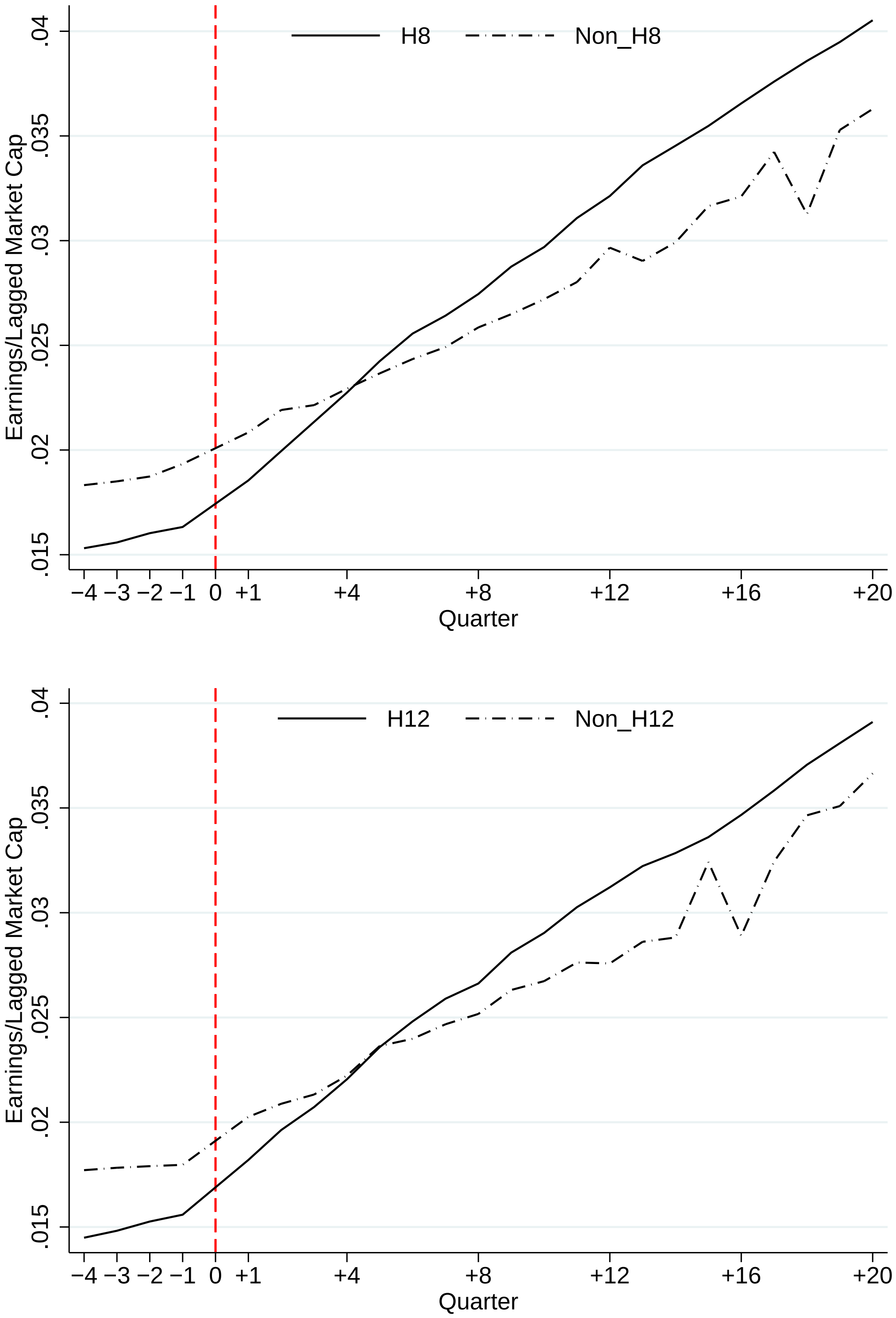


Figure 2.4: Dividend hibernation and future earnings–a matching analysis. This figure reports the matching analysis results over the period 1972–2019. Hibernators are firms that keep their dividends fixed for eight (H_8) or twelve quarters (H_{12}). Non-hibernators are firms that change their dividends at least once during the last eight (Non-H_8) or twelve quarters (Non-H_{12}). At each quarter, each hibernating firm is matched to a non-hibernating firm in the same industry. The level and change in earnings over quarters $q-4$ to $q-1$ are used to set up a propensity score model to match the firms. Both graphs plot the earnings levels (scaled by lagged market capitalisation) over quarters $q-4$ to $q+20$.



difference between the earnings j quarters prior to the dividend announcement and earnings during the same quarter one year before the announcement, scaled by the market value of equity in the year before the announcement. E_{NL} consists of six variables[9] to control for non-linearity in Eq. 2.1. Following Ham et al. [2020], we define $CAR_{[a,b]}$ $(a \in \{-20, -40, -60, -120, -240\}, b \in \{-2, -21, -41, -61, -121\})$ as a set of cumulative abnormal (daily) stock returns, indexed by the daily compounded return of the value-weighted market portfolio over the same period. We run pooled OLS regressions to extract betas over the estimation window.

Table 2.7 reports the estimation results of Eq. 2.1. Following Ham et al. [2020], the standard errors are clustered for each calendar year. The non-linear controls of earnings are included in the regression during estimation but are not reported in the table for brevity. In non-tabulated results, we are able to qualitatively replicate the coefficient estimates of dividend changes (ΔD) reported in Ham et al. [2020].[10] Once we estimate Eq. 2.1 with the Cons_Div dummy variable, which takes the value of one if the firm keeps its dividends fixed in the current quarter relative to the previous quarter, and zero otherwise, the loadings on ΔD weaken for the first (0.014; t-stat = 1.92) and second (0.019; t-stat = 1.87) regressions, disappearing thereafter. This indicates that a constant dividend policy is informative, and merely relying on ΔD to capture this information is insufficient.

For the first year after the dividend announcement, the coefficients on the hibernation dummies remain positive but insignificant, indicating that there is no statistical difference between the hibernators and non-hibernators as per their unexpected future earnings. This is consistent with the matched sample results, whereby the

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[9] For each of the past earnings levels and changes, we calculate three variables. An interaction of a negative dummy variable (set to one if earnings levels/changes are negative and zero otherwise) with the earnings levels/changes, an interaction of a negative dummy variable and the earnings levels/changes squared, and an interaction between a positive dummy variable (set to one if the earnings levels/changes are positive and zero otherwise) and the earnings levels/changes squared. In total, there are six control variables to account for the mean-reversion attributes of earnings.

[10] The coefficient estimates of ΔD reported in Panel A, Table 2 of Ham et al. [2020] are 0.025 (t-stat = 5.134), 0.018 (t-stat = 3.183) and 0.018 (t-stat = 2.674) for the first, second and third years of unexpected earnings, respectively. Our estimates for the same coefficients are 0.031 (t-stat = 4.86), 0.027 (t-stat = 3.59) and 0.017 (t-stat = 1.81).

Table 2.7: Dividend hibernation and unexpected future earnings. ΔE_{iy+j} are the unexpected earnings changes during *j* years ($j \in 1,2,3,4,5$) after the dividend announcement quarter. It is estimated by taking the difference between annual earnings *j* years after the dividend announcement ($y+j$) and annual earnings one year prior to the dividend declaration, scaled by the market value of equity in the year prior to the dividend announcement. H_t ($t \in \{4,8,12\}$) is a dummy variable equal to one if a firm reports fixed dividends for four (H_4), eight (H_8) and twelve (H_{12}) quarters, and zero otherwise. ΔD_{iq} is the dividend change, calculated as the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. E_{iq-j} is the earnings level *j* quarters prior to the dividend declaration, scaled by the market value of equity in the quarter prior to the dividend announcement event. ΔE_{iq-j} is the difference between the earnings *j* quarters prior to the dividend announcement and earnings at the same quarter one year before the dividend announcement window, scaled by the market value of equity in the year before the dividend event. $CAR_{[a,b]}$ is a set of cumulative abnormal daily stock market returns relative to the value-weighted market return. Non-linearity in earnings is controlled for by including six variables representing both levels and changes in earnings, a set of dummy variables for capturing positive (negative) earnings, their squared terms and the interactions between levels and changes in earnings and the dummies. CARs and the non-linear controls of earnings are included in the regression during estimation but are not reported in the table for brevity. Standard errors are clustered by the dividend declaration year.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	ΔE_{y+1}	ΔE_{y+2}	ΔE_{y+3}	ΔE_{y+4}	ΔE_{y+5}	ΔE_{y+1}	ΔE_{y+2}	ΔE_{y+3}	ΔE_{y+4}	ΔE_{y+5}	ΔE_{y+1}	ΔE_{y+2}	ΔE_{y+3}	ΔE_{y+4}	ΔE_{y+5}	ΔE_{y+1}	ΔE_{y+2}	ΔE_{y+3}	ΔE_{y+4}	ΔE_{y+5}
Cons_Div	-0.004**	-0.004	-0.001	0.003	-0.003															
	(-2.07)	(-1.42)	(-0.53)	(0.81)	(-0.60)															
H_4						0.001	0.009***	0.014***	0.020***	0.022***										
						(0.56)	(2.91)	(4.75)	(5.30)	(5.23)										
H_8											0.002	0.010***	0.016***	0.022***	0.024***					
											(0.90)	(3.29)	(5.39)	(5.56)	(4.66)					
H_{12}																0.002	0.009***	0.015***	0.018***	0.023***
																(0.52)	(2.55)	(4.05)	(3.45)	(3.68)
ΔD_q	0.014*	0.019*	0.016	0.010	0.003	0.021***	0.017	0.014	0.013	0.011	0.017***	0.017*	0.015	0.008	-0.004	0.016**	0.008	0.003	-0.010	-0.013
	(1.92)	(1.87)	(1.21)	(0.67)	(0.17)	(3.03)	(1.61)	(1.18)	(1.05)	(0.73)	(2.80)	(1.76)	(1.23)	(0.64)	(-0.29)	(2.16)	(0.87)	(0.32)	(-1.13)	(-1.37)
N	176,667	162,924	150,379	139,008	128,611	153,342	141,435	130,526	120,507	111,419	142,798	131,660	121,388	112,031	103,619	122,492	112,914	104,163	96,291	89,210
R^2	0.549	0.405	0.416	0.417	0.431	0.113	0.073	0.069	0.053	0.043	0.144	0.086	0.073	0.056	0.044	0.156	0.124	0.075	0.060	0.048
Non-linear Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

predictability increases at the end of the first year. If a firm hibernates its dividends for four quarters (H_4), it exhibits a 0.9% (t-stat = 2.91) increase in unexpected future earnings (scaled by the market value of equity at the beginning of the year) during the second year after the dividend announcement. Interestingly, the magnitude of the coefficients on the hibernation dummy increases over time and becomes more persistent. A H_4 hibernator experiences a 1.4% (t-stat = 4.75), 2.0% (5.30) and 2.2% (5.23) increase in future earnings in the third, fourth and fifth years after the dividend announcement compared with its non-hibernating counterpart, respectively. The effect remains qualitatively the same for H_8, becoming stronger for H_{12} before weakening for longer-term hibernators (H_{16} and H_{20}). Later, we verify that long-term hibernators are fundamentally different in terms of their information gaps compared with H_4 and H_8 firms. In regard to the results reported by Ham et al. [2020], the effect of dividend hibernation on unexpected future earnings is larger and more persistent over time. Therefore, consistent with the strategic pooling argument of dividend hibernation, we observe that firms that hold their dividends fixed for consecutive periods have higher profitability in the future.

While the information content of dividend changes barely passes the first year, the information content of dividend hibernation is long term in nature. Ham et al. [2020] report that once they include the unexpected earnings for the year immediately after the dividend change in the regression, the predictability of the dividend change vanishes. The authors conclude that the predictability is not driven by signalling motives, because the benefits of signalling do not justify the costs. We show that the predictability of dividend hibernation extends beyond the first year by including the unexpected future earnings for the first year after the dividend announcement (ΔE_{y+1}) in Eq. 2.1 and re-estimating the regression. Table 2.8 summarises the results. It is evident that the loadings on the hibernation dummies remain significant at traditional levels of significance, indicating that, despite the dividend change, the information content of hibernation does not attenuate over time. For example, a H_4-

type hibernator experiences a 0.7%, 1.1%, 1.7% and 2.0% higher unexpected earnings-to-asset ratio (significant at 1%) compared with a non-hibernator for the second, third, fourth and fifth years after the dividend announcement, respectively.

2.3.3 Dividend hibernation and information asymmetry

To investigate the information environment of hibernating firms, we run a series of logit regressions where the dependent variables are dummy variables representing constant dividends for two consecutive quarters (Cons_Div) and dividend hibernation for two or more quarters ($H_2, H_8, \ldots, H_{20}$). Information asymmetry (INF_{it-1}) and illiquidity ($ILLIQ_{it-1}$) indexes in the last quarter are both independent variables. We apply lagged values of the indexes to ensure that the information applied in the model is available at the time of dividend declaration, mitigating look-ahead bias. In all logit models, the standard errors are clustered along the firm and time (quarter) dimensions. Moreover, quarter and industry dummy variables are included to control for unobservable industry effects, as well as to remove possible time trends in the data series.[11]

Table 2.9 reports the results for the baseline model, which includes the dependent dummy variables as well as the lagged information asymmetry (INF_{it-1}) and illiquidity ($ILLIQ_{it-1}$) indexes. The information asymmetry index positively and significantly (at 1%) predicts the state of dividend policy in the current quarter. It implies that, on average, firms that are 7.3% more likely to hold their dividends fixed this quarter tend to have their information asymmetry index a unit greater than the mean during the last quarter. The coefficient on information asymmetry peaks at 14.6% for firms that hold their dividends fixed for four quarters (H_4). The estimated coefficient reverts to 7.3% for firms that hold their dividends fixed for 20 quarters (H_{20}). An inverted U-shape emerges. This is likely due to the expectation of market participants to observe a dividend increase every four quarters consistent with the

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[11] The reported results are not sensitive to the inclusion of this set of controls.

Table 2.8: **Dividend hibernation and unexpected future earnings–signalling efficiency.** ΔE_{iy+j} is the unexpected earnings changes during j years ($j \in 2,3,4,5$) after the dividend announcement quarter. It is estimated by taking the difference between annual earnings j years after the dividend announcement ($y+j$) and annual earnings one year prior to the dividend declaration, scaled by the market value of equity in the year prior to the dividend announcement. H_t ($t \in \{4,8,12\}$) is a dummy variable equal to one if a firm reports fixed dividends for the past four (H_4), eight (H_8) and twelve (H_{12}) quarters, and zero otherwise. ΔD_{iq} is the dividend change, calculated as the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. E_{iq-j} is the earnings level j quarters prior to the dividend declaration, scaled by the market value of equity in the quarter prior to the dividend announcement event. ΔE_{iq-j} is the difference between the earnings j quarters prior to the dividend announcement and earnings at the same quarter one year before the dividend announcement window, scaled by the market value of equity in the year prior to the dividend event. $CAR_{[a,b]}$ is a set of cumulative abnormal daily stock market returns relative to the value-weighted market return. Non-linearity in earnings is controlled for by including six variables representing both levels and changes in earnings, a set of dummy variables for capturing positive (negative) earnings, their squared terms and the interactions between levels and changes in earnings and the dummies. CARs and the non-linear controls of earnings are included in the regression during estimation but are not reported in the table for brevity. Standard errors are clustered by the dividend declaration year.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	ΔE_{y+2}	ΔE_{y+3}	ΔE_{y+4}	ΔE_{y+5}	ΔE_{y+2}	ΔE_{y+3}	ΔE_{y+4}	ΔE_{y+5}	ΔE_{y+2}	ΔE_{y+3}	ΔE_{y+4}	ΔE_{y+5}	ΔE_{y+2}	ΔE_{y+3}	ΔE_{y+4}	ΔE_{y+5}
ΔE_{y+1}	0.720***	0.650***	0.600***	0.632***	0.744***	0.779***	0.742***	0.764***	0.686***	0.898***	0.881***	0.779***	0.801***	0.924***	0.889***	0.837***
	(5.06)	(4.15)	(4.52)	(4.38)	(5.19)	(5.44)	(5.40)	(6.84)	(4.14)	(7.50)	(7.46)	(6.59)	(7.61)	(7.11)	(7.08)	(7.05)
Cons_Div	-0.002	-0.000	0.004	-0.001												
	(-0.79)	(-0.01)	(1.23)	(-0.36)												
H_4					0.007***	0.011***	0.017***	0.020***								
					(2.87)	(5.06)	(5.81)	(5.44)								
H_8									0.007***	0.012***	0.018***	0.020***				
									(2.71)	(4.88)	(5.83)	(4.60)				
H_{12}													0.006**	0.011***	0.014***	0.017***
													(2.15)	(3.12)	(3.50)	(3.45)
ΔD_q	0.010	0.009	0.002	-0.007	0.002	0.002	0.001	-0.002	0.006	0.001	-0.006	-0.017	-0.004	-0.014**	-0.028***	-0.029***
	(1.55)	(0.81)	(0.12)	(-0.43)	(0.25)	(0.24)	(0.05)	(-0.13)	(0.82)	(0.13)	(-0.56)	(-1.23)	(-0.78)	(-2.12)	(-3.71)	(-3.02)
N	162,264	149,729	138,367	127,977	140,849	129,946	119,925	110,847	131,128	120,859	111,494	103,097	112,482	103,742	95,866	88,795
R^2	0.559	0.518	0.487	0.482	0.303	0.269	0.188	0.144	0.256	0.305	0.217	0.154	0.451	0.326	0.244	0.184
Non-linear Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

prior findings in Andres and Hofbaur [2017]. From our previous results, we know that dividend changes decrease the information gap. However, if the expectation of a dividend increase is not realised, it is likely that there is no information gap to begin with. Therefore, we observe that the magnitude of the coefficient on the information asymmetry index peaks in the fourth quarter of hibernation and then decreases. The coefficient on the illiquidity index is positive and significant, implying that less liquid firms are more likely to hold their dividends fixed. However, the baseline model does not control for firm characteristics and, as we later observe, the sign of the coefficient on the illiquidity index flips once the heterogeneity in firm characteristics is controlled for.

It is possible that dividend policy is endogenously determined, affected by an array of firm characteristics. We estimate several of these variables and include them in the baseline logit regression to control for firm heterogeneity. The control variables include the log of the market value of equity (MC_{it-1}), Tobin's q as a measure of the investment options ($\text{Tobin\_q}_{\ it-1}$), leverage ($\text{Leverage}_{\ it-1}$), the asset growth rate ($\text{Assets Growth}_{\ it-1}$), an estimate of the firm's cash flow (CashFlow_{it-1}), a measure of the firm's tangible assets ($\text{Tangibility}_{it-1}$) and an estimate of the cash holdings of the firm, calculated as cash divided by total assets in the previous quarter (Cash_{it-1}). We calculate two variables to specifically account for agency costs [Jensen, 1986], which are the most prominent rivals to the signalling theories we are exploring. First, the CashCow variable (CashCow_{it-1}), proposed by Brav et al. [2005], is a dummy variable that takes the value of one for firms that are profitable, have high credit ratings and low P/E ratios, and zero otherwise. Second, the institutional ownership ratio, IOR_{it-1} captures the extent to which the agency costs of cash flow are mitigated by the monitoring mechanism exerted by institutional owners [Leary and Michaely, 2011]. To control for the dividend level, the dividend payout ratio, estimated as a ratio of dividends divided by income before extraordinary items (Div_Ratio_{it-1}), is estimated and included. Moreover, in recent decades, the role of share repurchases as

Table 2.9: Logistic regression (without controls). Cons_Div is set equal to one if a firm reports zero dividend changes for the past quarter and zero otherwise. H_t ($t \in \{4, 8, \ldots, 20\}$) is a set of dummy variables that take the value of one for firms that hold their dividends fixed for four (up to 20) consecutive quarters, and zero otherwise. Information asymmetry (INF) and illiquidity (ILLIQ) indexes are the first principal components of several adverse selection and illiquidity measures developed by the market microstructure literature. Standard errors are clustered along firm and dividend declaration quarter dimensions. Quarter and industry dummy variables are also included in the model to control for trends in the data and unobservable industry attributes.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Cons_Div	**H_2**	**H_3**	**H_4**	**H_5**	**H_6**	**H_7**	**H_8**	**H_{12}**	**H_{16}**	**H_{20}**
INF_{it-1}	0.073^{***}	0.086^{***}	0.106^{***}	0.146^{***}	0.139^{***}	0.131^{***}	0.124^{***}	0.118^{***}	0.101^{***}	0.085^{***}	0.073^{***}
	(13.13)	(14.17)	(14.25)	(15.07)	(13.80)	(12.50)	(11.38)	(10.31)	(7.24)	(5.08)	(3.57)
$ILLIQ_{it-1}$	0.081^{***}	0.116^{***}	0.150^{***}	0.202^{***}	0.206^{***}	0.209^{***}	0.211^{***}	0.216^{***}	0.234^{***}	0.257^{***}	0.283^{***}
	(8.64)	(11.59)	(11.93)	(11.59)	(11.42)	(11.21)	(10.80)	(10.45)	(9.38)	(8.46)	(7.72)
Constant	1.146^{***}	0.273^{*}	-0.327^{*}	-0.887^{***}	-1.024^{***}	-1.166^{***}	-1.303^{***}	-1.415^{***}	-1.905^{***}	-2.540^{***}	-3.906^{***}
	(8.21)	(1.85)	(-1.90)	(-3.96)	(-4.29)	(-4.56)	(-4.71)	(-4.80)	(-4.92)	(-5.12)	(-4.09)
N	126,960	125,854	119,023	114,836	110,966	107,255	103,707	100,412	88,502	78,030	68,669
Pseudo R^2	0.034	0.051	0.085	0.085	0.085	0.085	0.085	0.085	0.087	0.094	0.102
Year & Industry Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

an alternative mechanism for distribution has become more prominent. To account for this effect, we estimate the total payout ratio, calculated as the sum of dividends and repurchases over income before extraordinary items (TP_Ratio$_{it-1}$), and add it to the model. The net repurchases are estimated following Fama and French [2001]. To complement this measure, an indicator variable that takes the value of one if a firm buys back shares, and zero otherwise (Repurchase$_{it-1}$), is also included. Because many of the control variables start appearing in Compustat on a quarterly basis from 1986, the sample is shortened from 1972–2019 to 1986–2019.

Table 2.10 summarises the results of the baseline model with the full set of controls included. The coefficient on the information asymmetry index remains positive and significant for up to 12 quarters (H_{12}) of hibernation, but loses significance thereafter. On average, firms whose information asymmetry index is a unit greater than the mean from the last quarter are 6.9% more likely to hold their dividends fixed this quarter. The coefficient estimate peaks at 11.9% following four quarters of hibernation (H_4) and reverts to 8.1% following eight quarters of hibernation (H_8). Thus, we again observe the inverted U-shape identified previously. The size of the coefficient on illiquidity (ILLIQ$_{it-1}$) flips, turning negative and significant (at 1%) for the constant dividend model and up to H_8 hibernation. However, once we pass the eighth quarter, the coefficients on illiquidity become insignificant. This indicates that, controlling for known observables, more liquid firms are more likely to become H_4 hibernators. Control variables are informative in their own right. Larger firms that are identified as cash cows with higher growth options and higher cash-flow-to-asset ratios are less likely to hold their dividends fixed. The monotonic decrease on the CashCow coefficient with higher hibernation periods deserves further attention. A cash cow firm is less likely to hold its dividends fixed, which is consistent with the agency costs of the free cash flow theory of dividends. However, the fact that we still observe a significant coefficient on information asymmetry is an indication that the model captures an aspect that is not explained by the competing agency costs theories. The positive loadings on the institutional ownership ratio (IOR_{it-1}) are also noteworthy. Institutional owners prefer firms that keep their dividends fixed. The literature assumes that institutional owners are more likely to be on the informed side of the trade. If yes, then it is plausible to assume that a higher information asymmetry environment provides a nourishing habitat for this group of investors that seek to leverage their private information. The dividend theories of tax clientele [Allen et al., 2000] provide an alternative explanation for the observed effect of institutional owners, but this story is not compelling. As theory suggests, institutional owners knowingly avoid the double-taxation inefficiency of dividends. Thus, they prefer investing in firms that pay lower dividends. In this sense, firms that keep their dividends fixed may have less taxation inefficiency, causing a positive relationship between the institutional ownership ratio and dividend hibernation. If true, one should observe a significantly lower dividend payout ratio for hibernating firms compared with non-hibernators. This is true for longer hibernation periods (beyond H_8). However, the results show that the coefficient estimates for the dividend payout ratio (Div_Ratio_{it-1}) remain insignificant in the regression for hibernations shorter than eight quarters, suggesting that there is no statistical difference between the dividend payout ratio of hibernating and non-hibernating firms. Therefore, the tax clientele theory of dividends does not provide a plausible alternative. Moreover, firms that repurchase are less likely to hold their dividends fixed, and therefore less likely to hibernate for longer periods.

So far, the results indicate that the information environment among firms that subscribe to dividend hibernation is significantly different relative to non-hibernating firms in the cross-section. We also apply an alternative approach with a different regression model to ensure a robust result. At each quarter t, we divide the number of quarters that a firm holds its dividends fixed by the total number of quarters that the firm appears in the sample up to quarter t. For example, if a firm reports zero changes for dividends ($\Delta D = 0$) during the past four quarters, then H_4 is set to one

Table 2.10: **Logistic regression (with controls).** Cons_Div is set equal to one if a firm reports zero dividend changes for the past quarter and zero otherwise. H$_t$ ($t \in \{4, 8, \ldots, 20\}$) is a set of dummy variables that take the value of one for firms that hold their dividends fixed for four (up to 20) consecutive quarters and zero otherwise. Information asymmetry (INF) and illiquidity (ILLIQ) indexes are the first principal components of several adverse selection and illiquidity measures developed by the market microstructure literature. MC is the log of the market value of equity. Tobin's q is measured as the market value of equity plus the book value of assets minus the book value of equity plus deferred taxes, all divided by the book value of assets. Leverage is total debt (DLTTQ + DLCQ) divided by total assets (ATQ). The operating cash flow (CashFlow) variable is taken from the statement of cash flows and is normalised by the beginning-of-period total assets. Tangibility is net property, plant and equipment (PPENTQ) divided by the beginning-of-period total assets. Cash is cash and short-term investments (CHEQ), scaled by total assets. CashCow$_{it-1}$ is a dummy variable that takes the value of one for firms that are profitable, have high credit ratings and have a low P/E ratio, and zero otherwise. Div_Ratio$_{it-1}$ is a ratio of the dividends over income before extraordinary items. TP_Ratio$_{it-1}$ is the sum of dividends and repurchases over income before extraordinary items. Repurchase$_{it-1}$ is an indicator that takes the value of one if a firm buys back shares and zero otherwise. The institutional ownership ratio is collected from Thomson Reuters 13F. Standard errors are clustered along firm and dividend declaration quarter dimensions. Quarter and industry dummy variables are included to control for trends in the data and unobservable industry attributes.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Cons_Div	**H$_2$**	**H$_3$**	**H$_4$**	**H$_5$**	**H$_6$**	**H$_7$**	**H$_8$**	**H$_{12}$**	**H$_{16}$**	**H$_{20}$**
INF$_{it-1}$	0.069***	0.079***	0.092***	0.119***	0.108***	0.097***	0.090***	0.081***	0.065***	0.044*	0.028
	(7.56)	(8.32)	(8.28)	(8.30)	(7.32)	(6.39)	(5.69)	(4.89)	(3.35)	(1.94)	(1.05)
ILLIQ$_{it-1}$	-0.054***	-0.073***	-0.085***	-0.117***	-0.103***	-0.083***	-0.067**	-0.054*	-0.045	-0.039	-0.061
	(-2.80)	(-4.08)	(-4.18)	(-4.55)	(-3.82)	(-2.98)	(-2.27)	(-1.71)	(-1.23)	(-0.91)	(-1.27)
MC$_{it-1}$	-0.105***	-0.144***	-0.190***	-0.277***	-0.271***	-0.260***	-0.254***	-0.253***	-0.269***	-0.301***	-0.362***
	(-6.21)	(-8.10)	(-8.74)	(-8.79)	(-8.27)	(-7.63)	(-7.12)	(-6.73)	(-6.06)	(-5.87)	(-5.94)
Assets Growth$_{it-1}$	-0.280***	-0.251***	-0.322***	-0.484***	-0.466***	-0.541***	-0.638***	-0.701***	-0.589***	-0.320*	-0.182
	(-2.89)	(-2.64)	(-3.30)	(-4.04)	(-3.82)	(-4.05)	(-4.33)	(-4.59)	(-3.45)	(-1.95)	(-1.00)
Tobin's q$_{it-1}$	-0.130***	-0.186***	-0.308***	-0.536***	-0.548***	-0.539***	-0.528***	-0.526***	-0.517***	-0.493***	-0.460***
	(-7.14)	(-9.29)	(-9.88)	(-8.46)	(-7.81)	(-7.16)	(-6.57)	(-6.13)	(-4.82)	(-4.04)	(-3.17)
Leverage$_{it-1}$	0.693***	0.780***	0.953***	1.214***	1.211***	1.190***	1.196***	1.177***	1.155***	1.016***	0.923**
	(5.52)	(6.17)	(6.07)	(5.54)	(5.38)	(5.10)	(4.89)	(4.58)	(3.75)	(2.70)	(1.98)
CashFlow$_{it-1}$	-2.304***	-1.781***	-0.849**	-1.111***	-1.161***	-1.490***	-1.332***	-1.496***	-1.664***	-1.568***	-1.384**
	(-3.27)	(-3.41)	(-2.20)	(-3.34)	(-3.39)	(-4.20)	(-3.61)	(-3.87)	(-3.63)	(-2.97)	(-2.15)
Tangibility$_{it-1}$	-0.114	-0.133	-0.159	-0.221	-0.229	-0.231	-0.244	-0.246	-0.296	-0.448	-0.610
	(-0.84)	(-0.97)	(-0.94)	(-0.94)	(-0.94)	(-0.92)	(-0.92)	(-0.88)	(-0.87)	(-1.11)	(-1.25)
Cash$_{it-1}$	0.091	0.118	0.364*	0.764***	0.781***	0.770**	0.789**	0.789**	0.855*	0.907*	0.751
	(0.58)	(0.71)	(1.73)	(2.58)	(2.58)	(2.46)	(2.38)	(2.24)	(1.96)	(1.71)	(1.13)
CashCow$_{it-1}$	-0.145**	-0.266***	-0.320***	-0.488***	-0.527***	-0.508***	-0.502***	-0.498***	-0.489***	-0.449**	-0.426*
	(-2.44)	(-4.31)	(-4.31)	(-4.47)	(-4.57)	(-4.26)	(-3.98)	(-3.72)	(-3.03)	(-2.39)	(-1.92)
IOR$_{it-1}$	0.060	0.057	0.186*	0.353**	0.406***	0.484***	0.552***	0.600***	0.788***	0.911***	1.009***
	(0.61)	(0.63)	(1.73)	(2.35)	(2.59)	(2.93)	(3.16)	(3.23)	(3.36)	(3.18)	(2.86)
Div_Ratio$_{it-1}$	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001*	-0.001*	-0.001*	-0.001***
	(0.93)	(-0.54)	(-0.45)	(-0.52)	(-0.19)	(-0.45)	(-1.57)	(-1.77)	(-1.82)	(-1.78)	(-4.05)
TP_Ratio$_{it-1}$	-1.586**	-1.876***	-2.504***	-3.380**	-4.924***	-6.126***	-7.832***	-7.460***	-8.509***	-12.832***	-14.979***
	(-2.38)	(-3.16)	(-3.39)	(-2.49)	(-2.87)	(-2.97)	(-3.22)	(-2.88)	(-2.73)	(-3.18)	(-2.92)
Repurchase$_{it-1}$	-0.014	-0.094***	-0.163***	-0.285***	-0.271***	-0.278***	-0.265***	-0.255***	-0.229***	-0.204***	-0.206**
	(-0.44)	(-3.32)	(-5.04)	(-6.39)	(-5.71)	(-5.59)	(-5.06)	(-4.65)	(-3.47)	(-2.72)	(-2.35)
Constant	1.961***	1.489***	1.318***	1.611***	1.386***	1.106***	0.851**	0.692*	0.107	-0.119	-0.644
	(9.99)	(7.10)	(5.42)	(5.02)	(4.16)	(3.16)	(2.30)	(1.77)	(0.21)	(-0.20)	(-0.63)
N	63,845	63,853	60,463	58,329	56,352	54,463	52,656	50,979	44,806	39,351	34,686
Pseudo R^2	0.031	0.049	0.079	0.142	0.139	0.135	0.131	0.128	0.124	0.125	0.131
Year & Industry Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

and zero otherwise. Next, we sum the number of times that H_4 is equal to one for all past quarters and divide by the number of quarters that the firm appears in the H_4 sample up to quarter t to form a H_4 hibernation ratio. We repeat the same procedure for other hibernation frequencies. To facilitate comparability, we estimate the same ratio (as a percentage) for dividend change events ($\Delta D \neq 0$) and call it Div_Chg. We run fixed-effect models where, for each regression, the dependent variable is the dividend change (Div_Chg), H_2, H_3, $\ldots$, or H_8, ratio. Quarter and firm fixed effects are included to control for trends, and standard errors are clustered by quarters and firms. The full set of controls is included to account for the heterogeneity of sample firms.

Table 2.11 summarises the results. Again, we see that a one-unit increase in information asymmetry relative to the mean in the last quarter is associated with a 0.18% increase in the H_4 ratio. Consistent with our previous results, the magnitude of the coefficient is highest for the H_4 ratio and decreases thereafter. The coefficient of information asymmetry is positive but insignificant for the dividend change ratio (Div_Chg). Taken together, information asymmetry is a significant predictor of whether firms adhere to a dividend hibernation policy in both the cross-section and time series.

Therefore, the results support the view that the information environment of dividend hibernating firms is different compared with firms that change their dividends. Consistent with signalling theories, dividend changers have less information asymmetry, while hibernating firms experience a wider information gap because they do not communicate the same information to the market. The information asymmetry index captures the adverse selection arising from the information asymmetry between corporate insiders and outsiders. A significant loading on the index indicates that hibernating firms have a wider information gap.

Table 2.11: Dividend hibernation ratio and information asymmetry. The dependent variables are the ratios of the number of quarters that firms report dividend changes (R_Div_Chg), constant dividends (R_Div_Cons) and dividend hibernation R_H$_t$ ($t \in \{4, 8, \ldots, 20\}$) over the total number of quarters that a firm appears in the sample up to that point. Time and firm fixed effects are included in the model to control for trends in the data and unobservable firm characteristics. Information asymmetry (INF) and illiquidity (ILLIQ) indexes are the first principal components of several adverse selection and illiquidity measures developed by the market microstructure literature. Standard errors are clustered by firm-quarter observations.

	(1) **R_Div_Chg**	(2) **R_Cons_Div**	(3) **R_H$_2$**	(4) **R_H$_3$**	(5) **R_H$_4$**	(6) **R_H$_5$**	(7) **R_H$_6$**	(8) **R_H$_7$**	(9) **R_H$_8$**	(10) **R_H$_{12}$**	(11) **R_H$_{16}$**	(12) **R_H$_{20}$**
INF$_{it}$	0.018	-0.015	0.027	0.110	0.178^{**}	0.170^{**}	0.169^{**}	0.158^{**}	0.145^{*}	0.126^{*}	0.098^{*}	0.086^{*}
	(0.32)	(-0.37)	(0.41)	(1.39)	(2.08)	(2.01)	(2.06)	(2.00)	(1.91)	(1.93)	(1.78)	(1.88)
ILLIQ$_{it}$	0.001	-0.113^{*}	-0.184^{*}	-0.221^{*}	-0.181	-0.174	-0.166	-0.174	-0.172	-0.161^{*}	-0.118^{*}	-0.085
	(0.01)	(-1.85)	(-1.91)	(-1.93)	(-1.47)	(-1.44)	(-1.43)	(-1.57)	(-1.63)	(-1.92)	(-1.81)	(-1.64)
MC$_{it}$	1.161^{***}	-0.802^{***}	-1.529^{***}	-2.047^{***}	-2.415^{***}	-2.161^{***}	-1.954^{***}	-1.816^{***}	-1.686^{***}	-1.104^{***}	-0.693^{***}	-0.378^{*}
	(5.40)	(-3.73)	(-4.63)	(-5.18)	(-5.64)	(-5.19)	(-4.84)	(-4.66)	(-4.48)	(-3.48)	(-2.65)	(-1.75)
Assets Growth$_{it}$	-0.205	-0.375	-0.506	-0.404	-0.295	-0.225	-0.086	0.164	0.386	0.840^{*}	0.842^{**}	0.768^{**}
	(-0.33)	(-1.07)	(-0.91)	(-0.63)	(-0.44)	(-0.34)	(-0.14)	(0.27)	(0.65)	(1.69)	(2.11)	(2.48)
Tobin's q$_{it}$	0.301^{**}	-0.847^{***}	-1.339^{***}	-1.433^{***}	-1.286^{***}	-1.137^{***}	-0.982^{***}	-0.833^{***}	-0.701^{***}	-0.450^{**}	-0.308^{*}	-0.213
	(2.09)	(-4.91)	(-5.10)	(-4.81)	(-4.20)	(-3.86)	(-3.51)	(-3.14)	(-2.78)	(-2.21)	(-1.86)	(-1.59)
Leverage$_{it}$	0.653	2.184^{**}	3.377^{**}	2.566	1.361	0.740	0.081	-0.548	-1.109	-2.306	-2.588^{**}	-2.438^{**}
	(0.52)	(2.32)	(2.33)	(1.53)	(0.76)	(0.42)	(0.05)	(-0.33)	(-0.69)	(-1.62)	(-2.11)	(-2.34)
CashFlow$_{it}$	2.203	-0.260	0.494	-0.709	-1.299	-1.625	-1.633	-1.796	-1.702	-1.027	-0.858	-0.961
	(1.15)	(-0.27)	(0.36)	(-0.48)	(-0.88)	(-1.15)	(-1.19)	(-1.39)	(-1.40)	(-1.01)	(-1.01)	(-1.37)
Tangibility$_{it}$	0.587	0.087	0.037	-0.688	-1.001	-1.645	-2.131	-2.705	-3.337	-4.048^{**}	-3.872^{**}	-3.360^{**}
	(0.28)	(0.07)	(0.02)	(-0.31)	(-0.41)	(-0.68)	(-0.91)	(-1.21)	(-1.55)	(-2.20)	(-2.49)	(-2.54)
Cash$_{it}$	1.807	-6.095^{***}	-9.793^{***}	-10.949^{***}	-10.311^{***}	-9.127^{***}	-7.904^{***}	-6.809^{***}	-5.788^{***}	-2.905^{*}	-1.286	-0.343
	(1.58)	(-4.70)	(-5.09)	(-5.07)	(-4.61)	(-4.19)	(-3.76)	(-3.38)	(-2.99)	(-1.79)	(-0.98)	(-0.34)
CashCow$_{it}$	0.122	-0.085	-0.120	-0.017	0.061	0.129	0.147	0.127	0.094	0.008	-0.062	-0.089
	(0.99)	(-0.72)	(-0.67)	(-0.09)	(0.28)	(0.62)	(0.73)	(0.64)	(0.49)	(0.05)	(-0.48)	(-0.82)
IOR$_{it}$	-1.028	2.676^{***}	4.872^{***}	5.591^{***}	5.676^{***}	5.504^{***}	5.162^{***}	4.735^{***}	4.380^{***}	2.998^{***}	2.161^{***}	1.608^{***}
	(-1.59)	(4.37)	(4.73)	(4.59)	(4.42)	(4.38)	(4.30)	(4.16)	(4.05)	(3.56)	(3.39)	(3.38)
Div_Ratio$_{it}$	-0.002	0.001	0.001	0.000	-0.001	-0.002	-0.004	-0.004^{**}	-0.005^{***}	-0.006^{***}	-0.006^{***}	-0.005^{***}
	(-0.60)	(0.40)	(0.23)	(0.01)	(-0.47)	(-0.82)	(-1.43)	(-1.99)	(-2.70)	(-4.00)	(-3.23)	(-2.74)
TP_Ratio$_{it}$	-2.657	-6.430^{***}	-9.537^{***}	-13.302^{***}	-16.805^{***}	-15.188^{***}	-13.549^{***}	-11.854^{***}	-10.750^{***}	-8.050^{***}	-5.205^{***}	-3.451^{**}
	(-1.12)	(-2.98)	(-2.92)	(-3.66)	(-4.30)	(-4.08)	(-3.88)	(-3.53)	(-3.36)	(-3.11)	(-2.63)	(-2.24)
Repurchase$_{it}$	-0.001	0.099	0.135	0.050	0.006	0.028	0.073	0.110	0.147	0.183	0.170	0.156^{*}
	(-0.00)	(0.96)	(0.81)	(0.26)	(0.03)	(0.14)	(0.39)	(0.62)	(0.87)	(1.36)	(1.62)	(1.83)
Constant	17.504^{***}	81.176^{***}	65.418^{***}	54.321^{***}	45.183^{***}	39.483^{***}	36.191^{***}	32.933^{***}	29.023^{***}	16.422^{***}	7.188^{***}	-0.519
	(8.50)	(59.53)	(30.62)	(21.08)	(16.06)	(14.49)	(13.66)	(12.91)	(11.83)	(7.97)	(4.22)	(-0.37)
N	10,939	67,822	67,822	67,822	67,822	67,822	67,822	67,822	67,822	67,822	67,822	67,822
R^2	0.930	0.793	0.753	0.788	0.815	0.804	0.797	0.791	0.786	0.766	0.742	0.712
Time & Firm Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
S.E. Clustered by Quarters & Firms	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

2.3.4 Changes after hibernation and information asymmetry

Dividend hibernation is followed by higher unexpected future earnings. Moreover, the hibernation periods coincide with higher information asymmetry between insiders and outsiders. Therefore, one expects that dividend changes after hibernation convey more information than a regular dividend change. That is, we expect each additional dollar of dividend change post-hibernation to be more informative, thus closing the information asymmetry gap more efficiently. To test this conjecture, we estimate the following regression:

$$\mathrm{INF}_{iq} = \beta_1 \mathrm{H}_{it} + \beta_2 \Delta\mathrm{D}_{iq} + \beta_3 \mathrm{H}_{it} \times \Delta\mathrm{D}_{iq} + \Sigma_j \beta_j \mathrm{Controls}_{iq-1} + \kappa_i + \tau_t + \epsilon_{iq} \tag{2.2}$$

where INF_{iq} is the quarterly information asymmetry index. H_t $(t \in \{2, 3, \ldots, 20\})$ is a dummy variable that takes the value of one if a firm ends its hibernation over the past two (H_2), three (H_3), four (H_4), five (H_5), six (H_6), seven (H_7), eight (H_8), twelve (H_{12}), sixteen (H_{16}) and twenty (H_{20}) quarters in the current quarter by changing its dividends, and zero if a firm changes its dividends but was not a hibernator in the last quarter. $\Delta\mathrm{D}_{iq}$ is the dividend change, calculated as the current quarter's dividend minus the dividend during the last quarter divided by the last quarter's dividend. $\mathrm{Controls}_{iq-1}$ is a set of lagged control variables included in addition to the illiquidity index (ILLIQ_{iq-1}). κ_i and τ_t are firm fixed effects and time fixed effects, respectively. ϵ_{iq} is the residual term.

When estimating Eq. 2.2, we cluster the standard errors by quarters and firms. The coefficient on H_t captures the difference between the information asymmetry indexes of the two groups of dividend changers defined by H_t dummies. This provides a robustness check of the finding in Table 2.9 that hibernating firms are more opaque (i.e. $\beta_1 > 0$). The more interesting observation relates to the effect of one additional dollar of dividend ($\Delta\mathrm{D}_{iq}$) used to signal private information to the public, thereby closing the information gap. This focus is consistent with the theories of costly signalling of dividends [Bhattacharya, 1979; John and Williams, 1985; Miller and Rock, 1985]. Therefore, we also interact the hibernation dummies with dividend changes to capture this effect (β_3). We repeat this test for firms that hibernate for different horizons. We include firm and time fixed effects to account for unobservables and time trends in the sample. We also control for dividend changes, the lagged liquidity index and other firm characteristics.

Table 2.12 tabulates the results ($H_2, H_3, \ldots, H_{20}$). Similar to our previous findings, the coefficients on the dummy variables indicate that hibernating firms are, on average, more opaque. There is a positive relationship between the length of hibernation and the information asymmetry index with an inverted U-shape function. Consistent with our hypothesis, the coefficient on the interaction term is negative and remains statistically significant (at 1%), regardless of the length of the hibernation period. The coefficients increase in magnitude and significance with the hibernation horizon up to the eighth quarter of hibernation, vanishing in significance thereafter. This suggests that once a hibernating firm changes its dividend payout policy, each additional dollar of dividend paid out is more effective in reducing the information gap compared with non-hibernating firms, making their dividends more informative.

2.3.5 Changes after hibernation and the market reaction

Given that dividend changes are more informative for firms emerging from hibernation, and dividend hibernation brings about positive news with respect to future earnings, then the stock market should react more positively to dividend changes post-hibernation compared with dividend changes of non-hibernators. To test this, we run a series of OLS regressions in which we use the variation in dividend hibernation policy as an indicator to explain cumulative abnormal returns over several windows. Again, we include ΔD to control for the information conveyed to the market, as well as the size of the dividend change. An interaction term is included to investigate the market reaction to the magnitude of the dividend change and whether

Table 2.12: Dividend hibernation and the informativeness of dividend changes. The dependent variable is INF, the quarterly information asymmetry index. Cons_Div is set equal to one if a firm reports zero dividend changes for the past quarter but changes its dividends in the current quarter, and zero if a firm changes its dividends in the current quarter but did not report a constant dividend in the last quarter. H_t ($t \in \{4, 8, \ldots, 20\}$) is a dummy variable that takes the value of one if a firm hibernated for the past four (H_4), eight (H_8), twelve (H_{12}), sixteen (H_{16}) and twenty (H_{20}) quarters and ends its hibernation in the current quarter by changing its dividend, and zero if a firm changes its dividend and was not a hibernator in the last quarter. ΔD_{iq} is the dividend change, calculated as the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. The lagged control variables and the constant are included in the regression during estimation but are not reported for brevity. Time and firm fixed effects are included in the model to control for trends in the data and unobservable firm characteristics. Standard errors are clustered by firm-quarter observations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Con_Div	-0.238***										
	(-3.13)										
Con_Div × ΔD_q	-0.392***										
	(-2.94)										
H_2		-0.079									
		(-1.36)									
$H_2 \times \Delta D_q$		-0.429***									
		(-3.73)									
H_3			-0.059								
			(-1.32)								
$H_3 \times \Delta D_q$			-0.285***								
			(-2.80)								
H_4				0.221***							
				(3.62)							
$H_4 \times \Delta D_q$				-0.446***							
				(-3.87)							
H_5					0.247***						
					(3.57)						
$H_5 \times \Delta D_q$					-0.507***						
					(-4.25)						
H_6						0.217***					
						(3.05)					
$H_6 \times \Delta D_q$						-0.536***					
						(-4.19)					
H_7							0.169**				
							(2.25)				
$H_7 \times \Delta D_q$							-0.432***				
							(-3.32)				
H_8								0.105			
								(1.27)			
$H_8 \times \Delta D_q$								-0.305**			
								(-2.21)			
H_{12}									0.065		
									(0.57)		
$H_{12} \times \Delta D_q$									-0.148		
									(-0.95)		
H_{16}										-0.057	
										(-0.40)	
$H_{16} \times \Delta D_q$										0.015	
										(0.08)	
H_{20}											-0.083
											(-0.52)
$H_{20} \times \Delta D_q$											0.039
											(0.20)
ΔD_q	0.228*	0.203**	0.043	0.052	0.051	0.051	-0.010	-0.045	-0.124	-0.169**	-0.169*
	(1.75)	(2.25)	(0.50)	(0.62)	(0.59)	(0.65)	(-0.12)	(-0.51)	(-1.45)	(-1.99)	(-1.91)
N	10,410	9,872	9,467	9,044	8,786	8,566	8,291	7,933	7,046	6,245	5,559
R^2	0.606	0.604	0.605	0.605	0.607	0.609	0.608	0.612	0.615	0.619	0.626
Time & Firm Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
S.E. Clustered by Quarters & Firms	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

it differs across hibernating and non-hibernating firms. We apply dividend hibernation over different horizons to show that the effect is more pronounced among firms that hibernate for at least one year. Importantly, given that the market reaction to dividend increases and cuts is different in nature, we divide the sample accordingly and report the two sets of results separately, in Tables 2.13 and 2.14, respectively.

Table 2.13 reports the results of positive dividend changes (increases). Firms that increase their dividends after four and eight quarters of hibernation experience, on average, a 0.5% (t-stat = 2.41) and a 0.7% (t-stat = 2.76) higher cumulative abnormal return (over two-day event windows) compared with non-hibernating firms, respectively. The positive market reaction becomes insignificant for dividend changes after 12–20 quarters of hibernation. Therefore, the market welcomes the resolution of information asymmetry in the form of a dividend increase after at least one year of hibernation, but remains neutral to longer hibernation periods. This is consistent with our prior findings that there is an inverted U-shape relationship between the length of hibernation and our information asymmetry index. That is, the information asymmetry gap peaks at the fourth quarter of hibernation and decreases thereafter. Because our information asymmetry index is a market-implied measure, one can infer that market participants update their expectations once a firm passes a year of hibernation, that there is no information gap in the first place, and that they do not get surprised by subsequent dividend changes.

Conversely, Table 2.14 reports no significant differences between negative market reactions to dividend cuts among the two groups of firms. Unlike dividend increases, we observe that the coefficients on the hibernation dummies for dividend decreases remain insignificant. However, this should not be surprising, and likely results from the reduced statistical power associated with a much smaller sample. Specifically, there are only 347 observations to estimate market responses to dividend cuts and omissions for the H_8 category, compared with 9,797 observations for the positive dividend changes. If we extend the market reaction window to five days

Table 2.13: Dividend hibernation, positive dividend changes and the stock market reaction. The dependent variable is CAR[-2,+2], the cumulative abnormal return, relative to the value-weighted market return, within a two-day window before and after a dividend change event. H_t $(t \in \{2, \ldots, 20\})$ is a dummy variable that takes the value of one if a firm hibernated for the past two (H_2), three (H_3), four (H_4), five (H_5), six (H_6), seven (H_7), eight (H_8), twelve (H_{12}) and twenty (H_{20}) quarters and ends its hibernation in the current quarter by increasing its dividend, and zero if a firm increases its dividend and did not hibernate in the last quarter. ΔD_{iq} is the dividend change, calculated as the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. The lagged control variables and the constant are included in the regression during estimation but are not reported for brevity. Time and firm fixed effects are included in the model to control for trends in the data and unobservable firm characteristics. Standard errors are clustered by firm-quarter observations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Cons_Div	0.001										
	(0.58)										
Cons_Div× ΔD_q	-0.008										
	(-1.30)										
H_2		-0.003									
		(-1.57)									
$H_2\times \Delta D_q$		-0.005									
		(-0.98)									
H_3			-0.004*								
			(-1.80)								
$H_3\times \Delta D_q$			-0.002								
			(-0.34)								
H_4				0.005**							
				(2.41)							
$H_4\times \Delta D_q$				-0.012**							
				(-2.47)							
H_5					0.006***						
					(3.10)						
$H_5\times \Delta D_q$					-0.014***						
					(-2.77)						
H_6						0.006***					
						(2.74)					
$H_6\times \Delta D_q$						-0.016***					
						(-2.99)					
H_7							0.007***				
							(2.98)				
$H_7\times \Delta D_q$							-0.019***				
							(-3.98)				
H_8								0.007***			
								(2.76)			
$H_8\times \Delta D_q$								-0.017***			
								(-3.11)			
H_{12}									0.006		
									(1.69)		
$H_{12}\times \Delta D_q$									-0.009*		
									(-1.81)		
H_{16}										0.003	
										(0.75)	
$H_{16}\times \Delta D_q$										-0.013*	
										(-1.73)	
H_{20}											0.005
											(0.82)
$H_{20}\times \Delta D_q$											-0.020**
											(-2.05)
ΔD_q	0.016***	0.013**	0.011***	0.015***	0.013***	0.014***	0.014***	0.012***	0.010***	0.012***	0.012***
	(2.78)	(2.58)	(2.78)	(4.56)	(4.38)	(4.58)	(4.38)	(4.18)	(3.20)	(3.28)	(3.06)
N	12,989	12,290	11,747	11,218	10,878	10,574	10,214	9,797	8,693	7,702	6,891
R^2	0.187	0.188	0.185	0.188	0.181	0.183	0.180	0.188	0.184	0.178	0.178
Time & Firm Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
S.E. Clustered by Quarters & Firms	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm Characteristics Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

t statistics in parentheses

Table 2.14: Dividend hibernation, negative dividend changes and the stock market reaction. The dependent variable is CAR[-2,+2], the cumulative abnormal return, relative to the value-weighted market return, within a two-day window before and after a dividend change event. H_t $(t \in \{2, \ldots, 20\})$ is a dummy variable that takes the value of one if a firm hibernated for the past two (H_2), three (H_3), four (H_4), five (H_5), six (H_6), seven (H_7), eight (H_8), twelve (H_{12}) and twenty (H_{20}) quarters and ends its hibernation in the current quarter by cutting its dividend, and zero if a firm cuts its dividend and did not hibernate in the last quarter. ΔD_{iq} is the dividend change, calculated as the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. The lagged control variables and the constant are included in the regression during estimation but are not reported for brevity. Time and firm fixed effects are included in the model to control for trends in the data and unobservable firm characteristics. Standard errors are clustered by firm-quarter observations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Cons_Div	0.027										
	(0.73)										
Cons_Div × ΔD_q	0.150*										
	(1.80)										
H_2		0.053									
		(1.27)									
$H_2 \times \Delta D_q$		0.226**									
		(2.52)									
H_3			0.012								
			(0.22)								
$H_3 \times \Delta D_q$			0.053								
			(0.53)								
H_4				0.002							
				(0.04)							
$H_4 \times \Delta D_q$				0.055							
				(0.53)							
H_5					0.027						
					(0.41)						
$H_5 \times \Delta D_q$					0.132						
					(1.25)						
H_6						0.033					
						(0.44)					
$H_6 \times \Delta D_q$						0.126					
						(1.03)					
H_7							0.040				
							(0.48)				
$H_7 \times \Delta D_q$							0.133				
							(1.00)				
H_8								0.045			
								(0.50)			
$H_8 \times \Delta D_q$								0.129			
								(0.80)			
H_{12}									-0.065		
									(-0.79)		
$H_{12} \times \Delta D_q$									0.021		
									(0.15)		
H_{16}										0.154	
										(0.87)	
$H_{16} \times \Delta D_q$										0.270	
										(0.77)	
H_{20}											-0.050
											(-0.22)
$H_{20} \times \Delta D_q$											-0.273
											(-0.63)
ΔD_q	0.008	-0.004	0.051	0.065	0.061	0.034	0.027	0.024	0.053	-0.023	-0.036
	(0.20)	(-0.09)	(0.75)	(1.05)	(0.96)	(0.55)	(0.42)	(0.42)	(0.94)	(-0.36)	(-0.48)
N	551	512	476	437	418	385	359	347	290	252	215
R^2	0.620	0.634	0.619	0.618	0.631	0.632	0.627	0.629	0.659	0.732	0.835
Time & Firm Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
S.E. Clustered by Quarters & Firms	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm Characteristics Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

(Table 2.15), we observe that the market punishes (71.5% more negative market reaction) dividend cuts after 20 quarters of hibernation. The results suggest that investors penalise dividend cuts after a prolonged period of hibernation (12–20 quarters), with the stock price reduction being less severe for shorter-term hibernation (up to five quarters). Therefore, we observe that the market reaction to a dividend increase (decrease) by a hibernator is more positive (negative) than an increase (decrease) by a non-hibernating firm. Interestingly, we find that the coefficients on the interaction term are negative and significant (at 1%). That is, larger dividend changes for hibernating firms bear lower cumulative abnormal returns. This could be because of the non-linear market reactions to dividend changes previously documented by the literature [Fama and French, 2000; Grullon et al., 2005; Ham et al., 2020]. Closer scrutiny reveals that (in untabulated results) hibernating firms (H_8=1) experience larger mean (28.42%) and median (13.64%) dividend changes compared with the mean (18.39%) and median (10.71%) changes for non-hibernating (H_8=0) firms. This is also consistent with our finding that previously hibernating firms experience higher unexpected future earnings and therefore can afford to increase their dividends by a larger amount.

To confirm the robustness of our results, we substitute the original set of non-hibernators with non-hibernators that are matched to hibernators according to propensity scores based on the probability that a firm will change its dividends and re-run the previous tests. The results for dividend increases are reported in Table 2.16. Although we lose a substantial number of observations, thereby reducing the statistical power of our tests, the magnitude of the market reaction to dividend increases by hibernators becomes more pronounced. While a dividend increase after two and three quarters of hibernation results in a lower cumulative abnormal return (over a two-day event window) compared with non-hibernating firms (significant at 1%), firms that increase their dividends after four and eight quarters of hibernation experience, on average, a 0.7% (t-stat = 5.73) and a 1.1% (t-stat = 5.99) higher cumulative abnormal

Table 2.15: Dividend hibernation, negative dividend changes and the stock market reaction. The dependent variable is CAR[-5,+5], the cumulative abnormal return, relative to the value-weighted market return, within a five-day window before and after a dividend change event. H_t $(t \in \{2, \dots, 20\})$ is a dummy variable that takes the value of one if a firm hibernated for the past two (H_2), three (H_3), four (H_4), five (H_5), six (H_6), seven (H_7), eight (H_8), twelve (H_{12}) and twenty (H_{20}) quarters and ends its hibernation in the current quarter by decreasing its dividend, and zero if a firm decreases its dividend and did not hibernate in the last quarter. ΔD_{iq} is the dividend change, calculated as the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. The lagged control variables and the constant are included in the regression during estimation but are not reported for brevity. Time and firm fixed effects are included in the model to control for trends in the data and unobservable firm characteristics. Standard errors are clustered by firm-quarter observations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Con_Div	-0.018										
	(-0.45)										
Con_Div × ΔD_q	0.103										
	(1.18)										
H_2		0.001									
		(0.03)									
$H_2 \times \Delta D_q$		0.185^{**}									
		(2.17)									
H_3			-0.009								
			(-0.18)								
$H_3 \times \Delta D_q$			0.124								
			(1.44)								
H_4				-0.036							
				(-0.55)							
$H_4 \times \Delta D_q$				0.044							
				(0.40)							
H_5					-0.037						
					(-0.52)						
$H_5 \times \Delta D_q$					0.083						
					(0.77)						
H_6						0.044					
						(0.49)					
$H_6 \times \Delta D_q$						0.159					
						(1.18)					
H_7							-0.006				
							(-0.06)				
$H_7 \times \Delta D_q$							0.095				
							(0.65)				
H_8								-0.016			
								(-0.15)			
$H_8 \times \Delta D_q$								0.075			
								(0.43)			
H_{12}									-0.050		
									(-0.45)		
$H_{12} \times \Delta D_q$									0.141		
									(0.75)		
H_{16}										-0.176	
										(-0.81)	
$H_{16} \times \Delta D_q$										-0.162	
										(-0.41)	
H_{20}											-0.715^{**}
											(-2.20)
$H_{20} \times \Delta D_q$											-1.269^{**}
											(-2.43)
ΔD_q	0.051	0.046	0.076	0.105^{**}	0.114^{***}	0.080	0.087	0.092^{*}	0.122^{**}	0.082	0.018
	(1.24)	(1.06)	(1.64)	(2.47)	(2.67)	(1.55)	(1.51)	(1.80)	(2.04)	(0.98)	(0.19)
N	550	512	476	437	418	385	359	347	290	252	215
R^2	0.646	0.663	0.658	0.656	0.678	0.670	0.671	0.670	0.710	0.755	0.865
Time & Firm Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
S.E. Clustered by Quarters & Firms	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm Characteristics Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

return compared with the matched non-hibernating firms, respectively. Firms that hibernate for 12 consecutive quarters and then increase their dividends experience a 0.7% (t-stat = 5.40) higher cumulative abnormal return. In regard to dividend cuts after hibernation, the results (untabulated) are, again, largely insignificant. This is likely because of the limited size of the sample following the change in the matching procedure (a 48% drop in the number of observations from 2,593 to 1,366).

2.3.6 Dividend hibernation and investment opportunities

Why are hibernation periods followed by higher future unexpected earnings? Guttman et al. [2010] posit that dividend hibernation is a result of higher investment options and that periods of hibernation coincide with more investment. That is, the authors predict that superior investment options in hibernating firms translate into higher future profitability. Therefore, a priori, the positive association between hibernation and future unexpected earnings that we observe should be accompanied by higher current investment options.

Alternatively, Kaplan and Perez-Cavazos [2020] propose that investments serve as opportunity costs of dividend signalling. That is, firms with greater investment options save on costly signalling to finance their investments, while firms with lower investment options fund their dividends with their earnings. Hence, the information content of dividends on earnings is more pronounced in firms with relatively lower investment options. Given that the link between future unexpected earnings and hibernation is positive and robust, contrary to Guttman et al. [2010], Kaplan and Perez-Cavazos [2020] expect the link between hibernation and future unexpected earnings to be explained by lower investment options. To investigate the effect of investments on the relationship between dividend hibernation and future earnings,

Table 2.16: Dividend hibernation, positive dividend changes and the market reaction–matched sample analysis. The dependent variable is CAR[-2,+2], the cumulative abnormal return, relative to the value-weighted market return, within a two-day window before and after a dividend change event. Alt_H$_t$ ($t \in \{2, \ldots, 20\}$) is an alternative definition of hibernation where the dummy variable equals one if a firm reports fixed dividends in the current quarter as well as in the past one (Alt_H$_2$), two (Alt_H$_3$), three (Alt_H$_4$), four (Alt_H$_5$), five (Alt_H$_6$), six (Alt_H$_7$), seven (Alt_H$_8$), eleven (Alt_H$_{12}$) and nineteen (Alt_H$_{20}$) quarters and ends its hibernation in the current quarter by increasing its dividend, and zero if a matched firm increases its dividend and did not hibernate in the last quarter. ΔD_{iq} is the dividend change, calculated as the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. The lagged control variables and the constant are included in the regression during estimation but are not reported for brevity. Time and firm fixed effects are included in the model to control for trends in the data and unobservable firm characteristics. Standard errors are clustered by firm-quarter observations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Alt_H$_2$	-0.000									
	(-0.07)									
Alt_H$_2$× ΔD$_q$	0.001									
	(0.29)									
Alt_H$_3$		-0.005***								
		(-3.16)								
Alt_H$_3$× ΔD$_q$		0.002								
		(0.25)								
Alt_H$_4$			0.007***							
			(5.73)							
Alt_H$_4$× ΔD$_q$			-0.012*							
			(-1.87)							
Alt_H$_5$				0.007***						
				(4.42)						
Alt_H$_5$× ΔD$_q$				-0.006						
				(-0.73)						
Alt_H$_6$					0.007***					
					(4.85)					
Alt_H$_6$× ΔD$_q$					-0.009					
					(-1.33)					
Alt_H$_7$						0.008***				
						(5.19)				
Alt_H$_7$× ΔD$_q$						-0.011**				
						(-1.95)				
Alt_H$_8$							0.011***			
							(5.99)			
Alt_H$_8$× ΔD$_q$							-0.025***			
							(-3.15)			
Alt_H$_{12}$								0.007***		
								(5.40)		
Alt_H$_{12}$× ΔD$_q$								-0.021**		
								(-2.57)		
Alt_H$_{16}$									0.008**	
									(2.26)	
Alt_H$_{16}$× ΔD$_q$									-0.004	
									(-0.26)	
Alt_H$_{20}$										0.008*
										(1.71)
Alt_H$_{20}$× ΔD$_q$										-0.031
										(-1.47)
ΔD$_q$	0.013***	0.014**	0.021***	0.012*	0.014**	0.009	0.018***	0.010	0.006	0.030
	(2.94)	(2.04)	(3.28)	(1.68)	(2.41)	(1.55)	(3.19)	(1.10)	(0.40)	(1.47)
N	27,051	22,844	9,440	7,596	6,470	5,447	4,277	2,246	1,216	681
R^2	0.005	0.006	0.008	0.006	0.006	0.005	0.011	0.007	0.005	0.004

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

we test these competing theories by running the following regression:

$$\Delta \mathrm{E}_{iy+j} = \phi \mathrm{Inv\_Opp} + \beta_1 \mathrm{H}_{it} + \beta_2 \mathrm{H}_{iq} \times \mathrm{Inv\_Opp}_{iq} + \gamma_1 \Delta \mathrm{D}_{iq} + \gamma_2 \Delta \mathrm{D}_{iq} \times \mathrm{Inv\_Opp}_{iq} \\ + \delta \mathrm{E}_{iq-j} + \zeta \Delta \mathrm{E}_{iq-j} + \eta \mathrm{E}_{NL} + \theta \mathrm{CAR}_{[a,b]} + \Sigma_j \beta_j \mathrm{Controls}_{iq-1} + \kappa_i + \tau_t + \epsilon_{iy+j} \tag{2.3}$$

where $\Delta \mathrm{E}_{iy+j}$ is the difference between the sum of earnings for the four quarters j years ($j \in 1, 2, 3, 4, 5$) after the dividend announcement and the sum of earnings for the four quarters one year before the announcement, scaled by the market value of equity in the year before the announcement. Inv_Opp represents investment opportunities, proxied by Tobin's q (one plus the logarithm of the market value of equity plus the book value of total liabilities, scaled by total assets) as the most widely used measure of investment opportunities [Erickson and Whited, 2012]. H_t $(t \in \{4, 8, 12\})$ is a dummy variable that is equal to one if a firm reports zero dividend changes for four (H_4), eight (H_8) and twelve (H_{12}) quarters. $\Delta \mathrm{D}_{iq}$ is the dividend change, equal to the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. E_{iq-j} is the earnings level of firm i, j quarters prior to the dividend announcement, scaled by the market value of equity in the year before the announcement. $\Delta \mathrm{E}_{iq-j}$ is the difference between the earnings j quarters prior to the dividend announcement and earnings during the same quarter one year before the event window, scaled by the market value of equity in the year before the announcement. E_{NL} consists of six variables to control for non-linearity in Eq. 2.1. $\mathrm{CAR}_{[a,b]}$ $(a \in \{-20, -40, -60, -120, -240\}, b \in \{-2, -21, -41, -61, -121\})$ is a set of daily cumulative abnormal stock returns, indexed by the daily compounded return of the value-weighted market portfolio over the same period. $\mathrm{Controls}_{iq-1}$ is a set of firm characteristics including size, operating profitability, asset growth and accruals, as well as their interactions with the dividend change. Firm and time fixed effects are included in the regression to account for unobservable and time-invariant trends in the data.

The coefficient on the interaction term between the hibernation dummies and investment opportunities (β_2) provides a test of the competing hypotheses. Guttman et al. [2010] predict a positive and significant coefficient on the interaction term, because hibernating firms have greater investment options. In contrast, finding a negative and significant coefficient is consistent with Kaplan and Perez-Cavazos [2020], whereby investments entail opportunity costs of dividend signalling. For robustness, following Kaplan and Perez-Cavazos [2020], we also explore two alternative measures of investment opportunities. First, the authors argue that companies with current dividends that are high are likely to have less of their valuation derived from future dividend (and therefore firm) growth. Hence, dividend yields can proxy for investment options. Second, firms tend to hold more cash to readily increase their liquidity in an effort to finance their investment options. Hence, more (less) cash holdings can correspond to higher (lower) investment options.

Table 2.17 summarises the results. Panel A reports the results of applying Tobin's q. For brevity, we only report the coefficients on the hibernation dummies H_4, H_8, H_{12}, H_{16} and H_{20}, as well as their interactions with Tobin's q. Consistent with our previous findings, the hibernating dummies remain positive and significant (at 1%). Compared with a non-hibernator, a firm that hibernates its dividends for the past eight quarters experiences a 1.0% and 2.8% increase in future unexpected earnings in the first and second years following the dividend announcement, respectively. The coefficient estimates for H_8 persistently increase over time. At the five-year mark, a hibernator reports future unexpected earnings that are 5.5% (significant at 1%) higher compared with its non-hibernating match. It is worth mentioning that our estimation strategy is more stringent compared with Eq. 2.1 because it includes more controls as well as firm and time fixed effects. Yet, we find that the hibernation dummies become more statistically and economically significant.

The coefficients on the interaction terms between the hibernation dummies and Tobin's q are mostly negative but insignificant. Panel B reports the results of apply-

Table 2.17: Dividend hibernation and investment opportunities. The table reports the moderating effect of investment opportunities on the relationship between dividend hibernation and future unexpected earnings. H_t $(t \in \{4, 8, 12, 16, 20\})$ is a dummy variable equal to one if a firm reports fixed dividends for four (H_4), eight (H_8), twelve (H_{12}), sixteen (H_{16}) and twenty (H_{20}) quarters, and zero otherwise. ΔD_{iq} is the dividend change, calculated as the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. Tobin's q is the market value of equity plus the book value of total liabilities, scaled by total assets. Cash is cash and cash equivalents, scaled by total assets. Dividend yield is the quarterly dividend for the last quarter divided by the share price the month before the dividend announcement. Standard errors are clustered by firm-quarter observations. The constants and all controls are included in the regression during estimation but are not reported for brevity.

Panel A: The Moderating Effect of Investment Opportunities (Tobin's q)

	ΔE_{y+1}					ΔE_{y+2}					ΔE_{y+3}					ΔE_{y+4}					ΔE_{y+5}				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
H_4	0.006					0.023***					0.032***					0.040***					0.049***				
	(1.53)					(3.63)					(3.57)					(3.42)					(3.88)				
$H_4\times$Tobin_q	0.002					-0.005					-0.006					-0.009					-0.014**				
	(0.74)					(-1.61)					(-1.46)					(-1.46)					(-2.39)				
H_8		0.010**					0.028***					0.040***					0.049***					0.055***			
		(2.07)					(3.44)					(3.47)					(3.71)					(4.14)			
$H_8\times$Tobin_q		0.002					-0.005					-0.007					-0.009					-0.014**			
		(1.27)					(-1.45)					(-1.43)					(-1.42)					(-2.40)			
H_{12}			0.007					0.030**					0.039***					0.043***					0.050***		
			(1.08)					(2.59)					(3.01)					(3.10)					(3.69)		
$H_{12}\times$Tobin_q			0.004*					-0.005					-0.005					-0.006					-0.010		
			(1.72)					(-1.21)					(-1.09)					(-1.17)					(-1.49)		
H_{16}				0.009					0.025**					0.027**					0.044***					0.048***	
				(0.99)					(2.17)					(1.99)					(3.07)					(2.86)	
$H_{16}\times$Tobin_q				0.004					-0.002					0.000					-0.008					-0.007	
				(1.18)					(-0.51)					(0.06)					(-1.05)					(-0.85)	
H_{20}					-0.001					0.018*					0.034**					0.052***					0.051**
					(-0.16)					(1.85)					(2.51)					(2.79)					(2.25)
$H_{20}\times$Tobin_q					0.007**					-0.003					-0.007					-0.016					-0.011
					(2.00)					(-0.63)					(-0.96)					(-1.60)					(-0.93)
N	102,363	95,577	83,624	73,447	64,674	93,316	87,064	76,176	66,959	59,079	85,022	79,215	69,391	61,131	54,057	77,418	72,080	63,273	55,892	49,457	70,582	65,728	57,847	51,142	45,337
R^2	0.299	0.331	0.348	0.372	0.390	0.321	0.355	0.400	0.429	0.494	0.333	0.362	0.398	0.457	0.556	0.382	0.399	0.443	0.560	0.661	0.438	0.447	0.561	0.656	0.663

Panel B: The Moderating Effect of Investment Opportunities (cash holdings)

	ΔE_{y+1}					ΔE_{y+2}					ΔE_{y+3}					ΔE_{y+4}					ΔE_{y+5}				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
H_4	0.006***					0.016***					0.024***					0.030***					0.036***				
	(2.73)					(4.74)					(6.46)					(5.00)					(5.22)				
H_4 $\times$Cash	0.023					0.040					0.044					0.059					0.036				
	(0.95)					(0.83)					(0.63)					(0.53)					(0.39)				
H_8		0.010***					0.019***					0.028***					0.036***					0.039***			
		(3.70)					(4.26)					(5.10)					(5.09)					(4.33)			
$H_8\times$Cash		0.028					0.061					0.083					0.083					0.068			
		(0.80)					(0.81)					(0.73)					(0.65)					(0.62)			
H_{12}			0.009**					0.020***					0.026***					0.031***					0.039***		
			(2.56)					(3.11)					(3.69)					(3.93)					(4.36)		
H_{12} $\times$Cash			0.037					0.081					0.126					0.103					0.056		
			(0.65)					(0.66)					(0.80)					(0.69)					(0.53)		
H_{16}				0.007					0.017**					0.021***					0.033***					0.039***	
				(1.61)					(2.49)					(2.81)					(3.91)					(3.73)	
$H_{16}\times$Cash				0.079					0.081					0.098					0.048					0.041	
				(0.88)					(0.65)					(0.65)					(0.41)					(0.47)	
H_{20}					0.008*					0.019***					0.032***					0.039***					0.042***
					(1.87)					(3.41)					(4.37)					(4.08)					(3.23)
$H_{20}\times$Cash					-0.001					-0.061					-0.062					-0.069					-0.014
					(-0.05)					(-1.42)					(-1.14)					(-1.20)					(-0.25)
N	10,2833	96,026	84,045	73,842	65,032	93,760	87,490	76,576	67,331	59,420	85,450	79,625	69,775	61,491	54,383	77,823	72,467	63,634	56,229	49,767	70,969	66,096	58,189	51,462	45,630
R^2	0.299	0.331	0.348	0.371	0.390	0.319	0.354	0.398	0.427	0.493	0.331	0.360	0.396	0.455	0.555	0.380	0.396	0.440	0.558	0.659	0.433	0.443	0.557	0.653	0.660

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Panel C: The Moderating Effect of Investment Opportunities (dividend yield)

	ΔE_{y+1}					ΔE_{y+2}					ΔE_{y+3}					ΔE_{y+4}					ΔE_{y+5}				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
H_4	0.010**					0.024***					0.033***					0.049***					0.054***				
	(2.50)					(3.36)					(3.27)					(3.39)					(4.07)				
H_4×Div_Yield	-0.002					-0.006					-0.005					-0.014					-0.016				
	(-0.61)					(-1.04)					(-0.73)					(-1.30)					(-1.27)				
H_8		0.015***					0.031***					0.040***					0.059***					0.061***			
		(3.02)					(3.31)					(2.92)					(3.80)					(4.14)			
H_8×Div_Yield		-0.003					-0.007					-0.005					-0.017					-0.018			
		(-0.79)					(-1.18)					(-0.61)					(-1.55)					(-1.47)			
H_{12}			0.018**					0.034***					0.043***					0.060***					0.071***		
			(2.40)					(2.63)					(2.86)					(3.81)					(5.39)		
H_{12}×Div_Yield			-0.006					-0.010					-0.009					-0.026**					-0.037***		
			(-1.29)					(-1.45)					(-1.03)					(-2.45)					(-3.43)		
H_{16}				0.018					0.027*					0.045**					0.053***					0.058***	
				(1.39)					(1.70)					(2.50)					(3.38)					(3.71)	
H_{16}×Div_Yield				-0.005					-0.005					-0.021					-0.023*					-0.023*	
				(-0.50)					(-0.43)					(-1.62)					(-1.91)					(-1.79)	
H_{20}					0.011					0.016**					0.033***					0.041***					0.055***
					(1.55)					(2.24)					(3.39)					(3.41)					(3.51)
H_{20}×Div_Yield					-0.004					-0.003					-0.008					-0.012					-0.022*
					(-0.54)					(-0.45)					(-0.97)					(-1.08)					(-1.80)
N	102,825	96,019	84,038	73,838	65,029	93,751	87,482	76,570	67,327	59,417	85,441	79,617	69,769	61,487	54,380	77,819	72,464	63,631	56,228	49,766	70,965	66,093	58,186	51,461	45,629
R^2	0.299	0.331	0.348	0.371	0.390	0.319	0.354	0.398	0.427	0.493	0.331	0.360	0.395	0.455	0.554	0.379	0.396	0.440	0.558	0.659	0.433	0.443	0.558	0.654	0.661

Panel D: The Moderating Effect of Investment Opportunities (Tobin's q, cash holdings and dividend yield)

	ΔE_{y+1}					ΔE_{y+2}					ΔE_{y+3}					ΔE_{y+4}					ΔE_{y+5}				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
H_4	0.009*					0.028***					0.033**					0.051**					0.062**				
	(1.77)					(2.93)					(2.04)					(2.23)					(2.46)				
$H_4\times$Tobin_q	0.000					-0.008*					-0.009					-0.014					-0.019**				
	(0.05)					(-1.87)					(-1.38)					(-1.61)					(-2.14)				
$H_4\times$Cash	0.023					0.019					-0.025					-0.059					-0.031				
	(0.93)					(0.40)					(-0.38)					(-0.56)					(-0.36)				
$H_4\times$Div_Yield	-0.003					-0.003					0.000					-0.014*					-0.021**				
	(-0.71)					(-0.58)					(0.02)					(-1.77)					(-1.99)				
H_8		0.013**					0.033***					0.039**					0.060***					0.067***			
		(2.04)					(2.78)					(2.13)					(2.64)					(2.90)			
$H_8\times$Tobin_q		0.001					-0.009*					-0.012					-0.016					-0.020**			
		(0.30)					(-1.68)					(-1.42)					(-1.63)					(-2.29)			
$H_8\times$Cash		0.026					0.044					0.016					-0.022					-0.021			
		(0.73)					(0.60)					(0.16)					(-0.18)					(-0.21)			
$H_8\times$Div_Yield		-0.004					-0.006					-0.001					-0.016*					-0.018*			
		(-0.94)					(-0.94)					(-0.11)					(-1.94)					(-1.95)			
H_{12}			0.013					0.038**					0.041**					0.061***					0.081***		
			(1.45)					(2.48)					(2.35)					(3.03)					(4.24)		
$H_{12}\times$Tobin_Q			0.001					-0.011					-0.012					-0.015					-0.019**		
			(0.39)					(-1.35)					(-1.22)					(-1.46)					(-1.98)		
$H_{12}\times$Cash			0.033					0.066					0.045					0.005					-0.004		
			(0.60)					(0.56)					(0.31)					(0.04)					(-0.04)		
$H_{12}\times$Div_Yield			-0.007					-0.004					-0.001					-0.011*					-0.014**		
			(-1.52)					(-0.65)					(-0.20)					(-1.66)					(-2.54)		
H_{16}				0.012					0.028					0.046**					0.068***					0.070***	
				(0.76)					(1.48)					(2.24)					(3.10)					(2.79)	
$H_{16}\times$Tobin_q				-0.001					-0.007					-0.009					-0.016					-0.014	
				(-0.10)					(-0.77)					(-0.79)					(-1.40)					(-1.25)	
$H_{16}\times$Cash				0.070					0.051					0.018					-0.028					-0.032	
				(0.79)					(0.42)					(0.13)					(-0.24)					(-0.35)	
$H_{16}\times$Div_Yield				-0.005					0.001					-0.014					-0.007					0.004	
				(-0.54)					(0.11)					(-1.10)					(-0.55)					(0.29)	
H_{20}					0.002					0.025*					0.049**					0.072***					0.078**
					(0.17)					(1.95)					(2.46)					(2.79)					(2.43)
$H_{20}\times$Tobin_q					0.007					-0.002					-0.008					-0.018					-0.017
					(1.65)					(-0.30)					(-0.84)					(-1.53)					(-1.25)
$H_{20}\times$Cash					-0.015					-0.087*					-0.124**					-0.122*					-0.073
					(-0.42)					(-1.70)					(-1.98)					(-1.77)					(-1.07)
$H_{20}\times$Div_Yield					-0.003					0.002					-0.006					-0.001					0.002
					(-0.40)					(0.26)					(-0.55)					(-0.10)					(0.12)
N	102,356	95,571	83,618	73,444	64,672	93,308	87,057	76,171	66,956	59,077	85,014	79,208	69,386	61,128	54,055	77,414	72,077	63,270	55,891	49,456	70,578	65,725	57,844	51,141	45,336
R^2	0.299	0.331	0.349	0.372	0.390	0.321	0.356	0.401	0.429	0.495	0.333	0.363	0.399	0.458	0.557	0.383	0.400	0.444	0.561	0.662	0.438	0.448	0.562	0.657	0.664

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

ing cash holdings as the measure of investment opportunities. Again, coefficients on the hibernation dummies remain positive and statistically significant. The coefficients capturing the interaction between the hibernation dummies and the cash-to-asset ratios are positive but insignificant. Therefore, contrary to Kaplan and Perez-Cavazos [2020], we find that hibernating firms with lower investment options do not necessarily experience higher future unexpected earnings.

Panel C employs the dividend yield as a measure of investment opportunities (higher dividend yield indicating greater investment options). Again, the coefficients on the hibernation dummies remain positive and significant. The signs of the interaction terms between the hibernation dummies and the dividend yields are negative. Here, the coefficients on the interaction terms are weakly significant for H_{12} and H_{16} four and five years after the dividend announcement. Specifically, a one-standard-deviation increase in the dividend yield reduces the unexpected future-earnings-to-asset ratio for a hibernating firm in five years by 0.3% (significant at 1%) relative to a non-hibernator. Hence, the results indicate that when we apply the dividend yield as a measure of investment options, we observe some evidence of investments acting as opportunity costs of dividends in hibernating firms.

Panel D incorporates all measures of investment opportunities (Tobin's q, cash holdings and the dividend yield). Again, the hibernation dummies remain positively significant and the effect becomes more pronounced. For example, a H_8 firm experiences a 1.3%, 3.3%, 3.9%, 6.0% and 6.7% increase in unexpected earnings in the first, second, third, fourth and fifth years after the dividend announcement, respectively. The coefficients on the interaction terms maintain signs that are consistent with Kaplan and Perez-Cavazos [2020]. Specifically, we observe a negative sign for Tobin's q, a positive sign for cash holdings and a negative sign for the dividend yield. However, except for the unexpected earnings (in the fourth and fifth years), the results lack statistical significance.

Taken together, contrary to Kaplan and Perez-Cavazos [2020], we do not find a difference between hibernators and non-hibernators in terms of their growth options. Although the signs of the coefficients are consistent with Kaplan and Perez-Cavazos [2020], the lack of statistical significance prevents us from drawing further conclusions. The results also do not support the assertion of Guttman et al. [2010] that hibernating firms should have higher investment options.

There is a possible explanation for these findings. According to Guttman et al. [2010], the strategic pooling of dividends in the form of hibernation mitigates the underinvestment problem, resulting in higher future profitability. However, the investment first-best decision by the manager is not observable to outsiders ex ante. Another possibility is to observe the outcome of the investment made by hibernating firms. If hibernation alleviates the underinvestment problem, we expect to observe that hibernating firms invest more efficiently. We employ three measures of investment efficiency to study this assertion. Following Hou et al. [2019], we define one profitability dummy and two operational efficiency dummies. ROA is our profitability metric and is defined as income before extraordinary items (Compustat annual item IB), scaled by total assets at the beginning of the year (item AT). We set a dummy variable (Froa) equal to one if a firm's ROA is positive and zero otherwise. Further, we apply two operational efficiency indicators. First, we consider the yearly changes in the gross margin ratio (dmargin), where the ratio is measured as the gross margin (Compustat annual item SALE minus item COGS), scaled by sales (item SALE). Improvements in the gross margin ratio signal a rise in the price of the firm's product, a reduction in inventory costs or a potential improvement in factor costs [Hou et al., 2019]. A dummy variable (Fdmargin) takes the value of one when the change in the gross margin ratio is positive and zero otherwise. Second, we measure the yearly changes in the asset turnover ratio (dato), where the ratio is calculated as the total sales, scaled by the total assets at the beginning of the year. An increase in the asset turnover ratio signals an improvement in productivity from the asset base [Hou et al., 2019]. Hence, Fdato takes the value of one if a firm experiences a positive change in the asset turnover ratio and zero otherwise. We acknowledge that these ex post measures are ad hoc and are not intended to represent first-best choices made by the manager. However, they provide an overview of the possible relationship between the investment options of the firm and hibernation.

Last, we repeat the prior estimation procedure with a full set of investment option measures by including the three investment efficiency dummies as well as their interactions with the hibernation dummies. We also include the interaction terms between the three measures and the dividend changes but do not report these results for brevity. Table 2.18 summarises the results. The hibernation dummies remain positively significant, but the introduction of the new variables reduces their levels of significance. The coefficients of the interaction terms between the profitability indicator (Froa) and the hibernation dummy are insignificant. This is not surprising because we also control for the operating profitability of the firm. However, the interaction terms between the hibernation dummies and the two operating efficiency indicators (Fdmargin and Fdato) load positively at traditional levels of significance. Specifically, H_4 firms that experience positive changes in their gross margin experience a 0.8%, 0.8%, 0.5% and 0.7% increase in unexpected earnings in the first, second, third and fourth years after the dividend announcement. The same type of firms with positive changes in their asset turnover ratios experience a 1.5%, 1.0%, 1.0% and 0.7% increase in unexpected earnings in the first, second, third and fourth years after the dividend announcement. The results are qualitatively the same for H_8 firms. For longer hibernation horizons, the interaction terms between Fdmargin and the hibernation dummies remain positive but insignificant. The same interactions with respect to Fdato are positively significant throughout. Therefore, we can conclude that hibernating firms exhibit higher operating efficiencies. This is consistent with the assertion of Guttman et al. [2010] that strategically pooling dividends mitigates the underinvestment problem, leading to higher future unexpected earnings.

Table 2.18: Dividend hibernation and investment efficiencies. The table reports the moderating effect of investment efficiencies on the relationship between dividend hibernation and future unexpected earnings. H_t ($t \in \{4, 8, 12, 16, 20\}$) is a dummy variable equal to one if a firm reports fixed dividends for four (H_4), eight (H_8), twelve (H_{12}), sixteen (H_{16}) and twenty (H_{20}) quarters, and zero otherwise. ΔD_{iq} is the dividend change, calculated as the current quarter's dividend minus the last quarter's dividend divided by the last quarter's dividend. Tobin's q is the market value of equity plus the book value of total liabilities, scaled by total assets. Cash is cash and cash equivalents, scaled by total assets. Dividend yield is the quarterly dividend for the last quarter divided by the share price at the end of the month before the dividend announcement. Froa is a dummy variable that takes the value of one if a firm's ROA is positive, and zero otherwise. Fdmargin is a dummy variable that takes the value of one in cases of positive yearly changes in the gross margin ratio, and zero otherwise. The gross margin ratio is measured as the gross margin, scaled by sales. Fdato takes the value of one if a firm experiences positive yearly changes in the asset turnover ratio, and zero otherwise. The asset turnover ratio is measured as total sales, scaled by total assets at the beginning of the calendar year. Standard errors are clustered by firm-quarter observations. The constants and all controls are included in the regression but are not reported for brevity.

	ΔE_{y+1}			ΔE_{y+2}			ΔE_{y+3}			ΔE_{y+4}			ΔE_{y+5}		
	H_4	H_8	H_{12}	H_4	H_8	H_{12}	H_4	H_8	H_{12}	H_4	H_8	H_{12}	H_4	H_8	H_{12}
H_t	0.017*	0.014	0.006*	0.032**	0.035*	0.042	0.038*	0.041*	0.030	0.048*	0.056**	0.044*	0.066***	0.066***	0.066***
	(1.79)	(1.31)	(1.69)	(2.27)	(1.80)	(1.55)	(1.92)	(1.74)	(1.39)	(1.95)	(2.20)	(1.95)	(2.63)	(2.79)	(3.22)
$H_t \times$Froa	-0.014*	-0.004	-0.002	-0.005	-0.002	-0.003	-0.007	-0.001	0.010	0.000	0.004	0.014	-0.004	0.002	0.014
	(-1.74)	(-0.66)	(-0.19)	(-0.52)	(-0.17)	(-0.20)	(-0.75)	(-0.09)	(0.96)	(0.02)	(0.33)	(1.19)	(-0.49)	(0.14)	(1.01)
$H_t \times$Fdmargin	0.008***	0.009***	0.006*	0.008***	0.010***	0.006	0.005**	0.007**	0.010***	0.007**	0.009**	0.012**	0.004	0.007*	0.007*
	(3.76)	(3.61)	(1.69)	(3.13)	(2.80)	(1.61)	(2.23)	(2.30)	(3.09)	(2.27)	(2.16)	(2.31)	(1.41)	(1.75)	(1.70)
$H_t \times$Fdto	0.015***	0.013***	0.012***	0.010***	0.009***	0.007**	0.010***	0.004	0.006	0.007**	0.005	0.009**	0.002	0.001	0.005
	(6.48)	(5.40)	(4.24)	(3.67)	(2.92)	(2.11)	(3.61)	(1.29)	(1.59)	(2.47)	(1.38)	(1.98)	(0.66)	(0.13)	(1.24)
$H_t \times$Tobin_q	0.000	0.001	0.001	-0.008*	-0.009*	-0.011	-0.009	-0.012	-0.012	-0.014	-0.016*	-0.015	-0.019**	-0.020**	-0.019**
	(0.06)	(0.21)	(0.32)	(-1.87)	(-1.72)	(-1.39)	(-1.39)	(-1.46)	(-1.26)	(-1.63)	(-1.67)	(-1.51)	(-2.12)	(-2.31)	(-2.00)
$H_t \times$Cash	0.022	0.025	0.033	0.019	0.044	0.066	-0.024	0.016	0.045	-0.058	-0.022	0.005	-0.029	-0.021	-0.003
	(0.89)	(0.70)	(0.59)	(0.41)	(0.60)	(0.56)	(-0.38)	(0.15)	(0.31)	(-0.55)	(-0.18)	(0.04)	(-0.34)	(-0.21)	(-0.03)
$H_t \times$Div_Yield	-0.003	-0.004	-0.006	-0.003	-0.005	-0.004	0.000	-0.001	-0.001	-0.014*	-0.016*	-0.011	-0.021**	-0.018*	-0.014**
	(-0.63)	(-0.85)	(-1.41)	(-0.52)	(-0.90)	(-0.59)	(0.06)	(-0.09)	(-0.15)	(-1.76)	(-1.92)	(-1.61)	(-1.99)	(-1.96)	(-2.52)
N	102,356	95,571	83,618	93,308	87,057	76,171	85,014	79,208	69,386	77,414	72,077	63,270	70,578	65,725	57,844
R^2	0.302	0.334	0.351	0.322	0.357	0.402	0.334	0.363	0.399	0.383	0.400	0.444	0.439	0.448	0.562

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

2.4 Conclusion

According to the signalling theories of payout policy, dividends serve as a costly signal to communicate a corporate insider's private information of earnings or investments to the less-informed outsider. Numerous studies test signalling theories by relating dividend changes to unexpected future earnings to determine whether they carry information content. In this paper, we ask a different question: If dividend changes transmit information held by insiders, does a constant payout policy also provide an information signal? To answer this question, we define dividend hibernation as a dividend policy in which firms keep their dividends fixed for two consecutive periods or more. Then, we provide evidence that dividend hibernation does not necessarily mean a no-information state. We relate dividend hibernation to unexpected future earnings and document that firms that hibernate for the past eight quarters experience higher unexpected earnings up to five years after the constant dividend announcement compared with non-hibernators. The effect is persistent and does not attenuate over time in our sample. Further, we apply several adverse selection measures to construct an information asymmetry index and show that dividend hibernation is associated with higher information asymmetry that increases over longer periods of hibernation, indicating an increasing information gap between insiders and outsiders. Combined with the higher (unexpected) future earnings, this result yields credence to the signalling theory of dividend smoothing introduced by Guttman et al. [2010]. Although our results do not support hibernating firms having higher investment options, we provide some evidence that strategically pooling dividends mitigates the underinvestment problem, resulting in higher future profitability.

This study contributes to the payout policy literature on several fronts. First, given that firms frequently hold their dividends fixed for consecutive periods, a large proportion of the universe is typically excluded from empirical studies. This paper sheds light on the strategic implications of this prevalent dividend policy. Second, we directly investigate the existence of an information gap between corporate insiders and outsiders, which is a necessary condition for signalling theories. Last, we provide support for the signalling theory of dividend smoothing developed in Guttman et al. [2010] by showing that a fixed dividend policy is associated with higher adverse selection, both in the cross-section and the time series.

Chapter 3

Estimating Permanent Earnings Surprise

3.1 Introduction

In this paper, we use the theoretical work of Lambrecht and Myers [2012, henceforth LM] to provide an estimate of the unexpected changes in permanent earnings for individual firms. We relate lagged stock market returns of firms to their changes in dividends. LM develop a dynamic agency model to explain the smooth dividends phenomenon documented by Lintner [1956]. In doing so, they present the first theoretical model linking payout to permanent earnings. Although several empirical works attempt to relate permanent earnings to payout at the aggregate level [e.g. Marsh and Merton, 1987; Garrett and Priestley, 2000], the current work is the first to provide an estimate of unexpected permanent earnings for individual firms.

Instead of past changes in earnings, we relate past stock market returns to changes in dividends. More specifically, we use a distributed lag model in which the changes in dividends are regressed against lagged stock market returns. Then, we sum all coefficients to arrive at an estimate of unexpected changes in permanent earnings. LM argue that in an efficient market, unanticipated changes in market value will reveal unanticipated changes in permanent income. Therefore, the lagged stock market responses to changes in dividends provides an estimate for unanticipated changes in permanent earnings. Previous studies use past changes in earnings to infer information about permanent earnings. They assume that earnings follow a random walk with drift, and shocks to earnings are purely permanent in nature [Ali and Zarowin, 1992]. Our procedure does not entail such a presumption for the earnings series. In effect, our model relies on two basic assumptions: first, that changes in stock market capitalisation (returns) are proportional to changes in permanent earnings; and two, that changes in permanent earnings drive changes in dividends. Marsh and Merton [1987] and Garrett and Priestley [2000] show that the first assumption holds, at the minimum, at the aggregate level. Skinner [2008] and Guay and Harford [2000] document that dividends are largely paid out of permanent earnings, providing support for the second assumption.

The novelty of our approach is twofold. First, we estimate unexpected changes in permanent earnings for individual firms in our sample on a quarterly basis. Previous literature mainly focuses on aggregate permanent earnings on a yearly basis. Second, our measure of unexpected changes in permanent earnings is time-varying. That is, for each firm in our sample, we regress changes in dividends on a distributed lag model of stock market returns over past quarters. This model is then rolled over the past 20 quarters to provide a time-varying estimate of unanticipated permanent earnings.

We use changes in dividends, not changes in total payout, to estimate changes in permanent earnings because prior literature extensively shows that dividends are paid out of permanent earnings [e.g. DeAngelo et al., 2009; Skinner, 2008; Guay and Harford, 2000; Fama and Babiak, 1968]. It is also well documented that dividends are used to distribute permanent earnings while being less responsive to transitory earnings.

One of the shortcomings of our strategy is the complications arising from the information content of dividends. In particular, if there is information asymmetry between managers and outsiders, then managers have superior information about permanent income relative to investors. In this case, stock prices do not anticipate changes in payouts; rather, they react to them. To address this concern, we develop an information asymmetry index and control for the information content of dividends in our empirical model.

Our information asymmetry index relies on market-implied measures of information asymmetry developed by the market microstructure literature. We employ several measures of information asymmetry to form a unique index. With this index, we are able to control for the information content of dividends. In this way, the reaction of the stock market to changes in dividends is less driven by the manager's private knowledge of earnings and is more likely to reflect changes in permanent earnings.

Whether dividend changes signal changes in permanent earnings is subject to a lively debate. Survey evidence of Lintner [1956] and Brav et al. [2005] document that managers do not raise dividends unless future earnings can sustain the new dividend levels. Several empirical works show that dividend changes regularly occur after persistent changes in past earnings. For example, Benartzi et al. [1997] show that dividend changes predict current and past changes in earnings, and Koch and Sun [2004] find that dividend changes signal the persistence of past earnings changes. Further, Guay and Harford [2000] document that dividends are paid out of relatively more permanent earnings, while share repurchases are used to distribute more transitory earnings. Consistent with this notion, Fama and French [1998] and Skinner and Soltes [2011] find that firms with higher and more persistent earnings have higher levels of dividends. Therefore, prior literature suggests a positive relationship between dividend changes and current or past earnings.[1]

Earnings are comprised of permanent and transitory components. Transitory shocks only affect immediate cash flow while remaining uninformative about future profitability. Short-term changes in demand, unexpected increases in receivable turnover, sudden breakdowns in machinery or supply chain disruptions are frequent

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[1] The evidence on the relationship between dividend changes and future unexpected earnings is rather mixed. See DeAngelo et al. [2009] for a comprehensive review of the literature on this subject.

examples of transitory shocks. By contrast, permanent shocks to earnings affect both the immediate and future cash flows of the firm. Modernization of the labor force in a labor-intensive industry or radical changes in productivity are considered as permanent shocks to earnings with long-lasting effects. Therefore, estimating permanent earnings is of singular importance.

Permanent earnings are, however, unobservable. A large and growing body of literature strives to provide estimates of permanent and transitory earnings. Garrett and Priestley [2000],Schwartz and Smith [2000], and Mirantes et al. [2015] apply Kalman filter techniques to estimate the unobservable parameters of earnings. Lee and Rui [2007] and Chang et al. [2014] use the Beveridge and Nelson [1981] filter to decompose cash flows into permanent and transitory components. In this study, we employ lagged stock returns and their responses to dividend changes to infer permanent earnings for individual firms.

We show that, consistent with the prediction put forth by LM, lagged returns are positively and significantly related to changes in dividends. Although the size of the loadings on the lagged stock market returns attenuate through time, they remain economically significant. We document that average (lagged) stock market response to dividend changes amounts to 2% of market capitalization. That is, in response to dividend changes, the stock market adjusts firms value by 2% of the market capitalization.

After applying our estimation procedure, we end up with a time-varying measure of permanent earnings surprise for individual firms in our sample. We show that at the aggregate level, our measure of permanent earning shocks co-varies with the state of the economy. In particular, we show that our measure follows episodes of recession over the past five decades. For example, we show that during the global financial crisis (2008-2009), the average firm in our sample experiences permanent earnings shocks as large as 2% of its market capitalization. Our measure varies across firms and industries. We further document that the sensitivity of dividend changes to permanent earnings surprise is 82%, meaning that firms distribute 82% of their permanent earnings shocks through dividends. Our estimate for the sensitivity of dividend changes to permanent earnings is much higher than that reported by Garrett and Priestley [2000], 16%. We argue that our estimated sensitivity is closer to previous theoretical and empirical studies in the field.

3.2 Data

Our sample includes all quarterly ordinary dividend declarations (distribution code 1232) over 1970–2019 from CRSP. To be included in the sample, firms must have dividend declarations for each quarter over the past 180 days. We retain non-financial firms[2] that are listed on the NYSE, AMEX and Nasdaq exchanges and focus on ordinary common stocks (share code 10 or 11). Further, we drop observations for which stock splits occur in the same dividend declaration quarter to avoid conflating the effect of splits on dividend changes and earnings (564 firm-quarter observations). If the earnings announcement coincides with a dividend declaration, we treat such earnings as the previous quarter's earnings (741 incidents). Last, we only keep observations with one quarterly dividend declaration (14,722 firm-quarter observations deleted). Stock bid-ask data, return data and other variables necessary to estimate the information asymmetry measures are sourced from CRSP. The number of analysts following sample firms is from IBES. Earnings and accounting data are from the CRSP/Compustat merged database. All variables are winsorised at the top (bottom) 1%.

3.2.1 Summary statistics

Table 3.1 reports the summary statistics of our full sample. The average value of the natural logarithm of one plus dividend changes equals 0.706. This means that the average dividend change ($d_t/dt - 1$) equals \$919,107 (US dollars). The distribution

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[2] We exclude financial firms by removing those with a four-digit SIC code beginning with six.

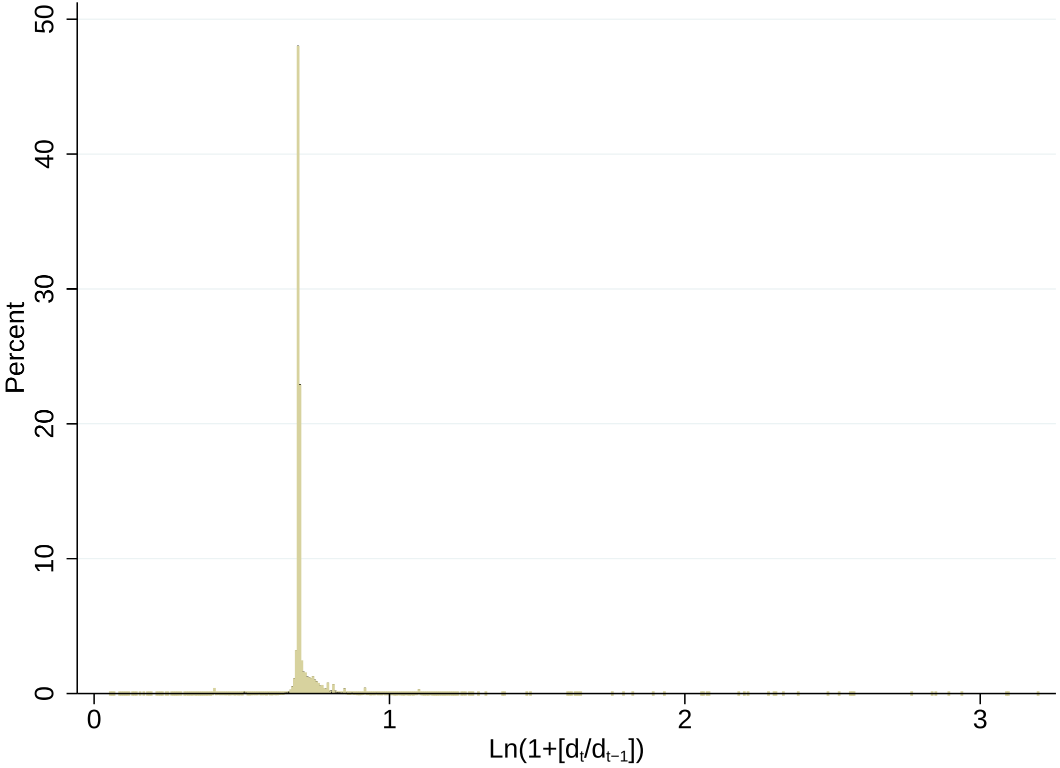
of our measure of dividend changes is heavily concentrated at the median value (0.693). Figure 3.1 illustrates the distribution of the changes in dividends. It is consistent with prior literature [Lintner, 1956; Fama and Babiak, 1968; Skinner, 2008] that finds firms keep their dividends unchanged for consecutive periods. We also find that around 47% of sample firms hold their dividends fixed for two consecutive quarters. That is, dividend changes become one ($d_t/d_{t-1} = 1$), making the natural logarithm equal to 0.693.

Table 3.1: Summary statistics. The table presents summary statistics of the sample of dividend-paying firms for 1970–2019. $Ln(1 + [dt/d_{t-1}])$ is the natural logarithm of one plus current dividends, divided by dividends in the previous quarter. Dividends are cash dividends for common shares (divamt), multiplied by the number of shares outstanding (cshoq). ΔEarnings is changes in earnings divided by total assets in the previous quarter. $\text{Cret}_{it}^{[k,j]}$ $(k \in \{-2, -21, -41, -61, -121, -240\}, j \in \{-20, -40, -60, -120, -240, -360\})$ is a set of cumulative (daily) stock returns. InfI and IlliqI are information asymmetry and illiquidity indexes, respectively. MC is the natural logarithm of the market capitalisation of the firms.

	N	Mean	SD	P25	Median	P75
$Ln(1 + [dt/d_{t-1}])$	200,368	0.706	0.073	0.693	0.693	0.697
ΔEarnings	187,432	0.004	0.056	-0.007	0.004	0.015
Cret[-2,-20]	198,878	0.011	0.095	-0.041	0.007	0.058
Cret[-21,-40]	198,566	0.010	0.094	-0.041	0.006	0.057
Cret[-41,-60]	198,265	0.013	0.095	-0.039	0.009	0.061
Cret[-61,-120]	197,248	0.035	0.167	-0.060	0.026	0.120
Cret[-121,-240]	195,084	0.074	0.251	-0.072	0.052	0.188
Cret[-241,-360]	192,774	0.080	0.257	-0.069	0.057	0.195
InfI	128,923	-0.002	1.921	-1.393	-0.356	1.065
IlliqI	171,203	-0.000	1.474	-0.910	0.020	0.875
MC	200,324	6.199	2.124	4.630	6.158	7.659
Leverage	173,957	0.254	0.167	0.130	0.251	0.362
Tobin_Q	184,628	1.501	1.003	0.957	1.202	1.694
Cash/TA_{t-1}	178,741	0.089	0.121	0.016	0.045	0.115
Capx/TA_{t-1}	127,387	0.017	0.024	0.006	0.012	0.021
Cf/TA_{t-1}	110,500	0.028	0.041	0.010	0.025	0.043
PPE/TA_{t-1}	146,500	0.721	0.451	0.421	0.676	1.004
Institutional Ownership Ratio	188,348	0.378	0.320	0.010	0.361	0.642

Average changes in the earnings-to-asset ratio are 0.4%. The average compound (daily) rate of return for the sample over -2 to -20 days from the dividend announcement day is 1.1%. The average compound (daily) rate of return increases monotonically with the length of the estimation window and reaches 8% when -241 to -360 days from the dividend announcement. The table shows the information asymmetry and illiquidity indexes along with several variables describing characteristics of sample firms. DeAngelo et al. [2009] review the prior literature and conclude that positive (negative) stock market reactions to increases (decreases) in dividends are extensively documented by prior studies. Given that dividend cuts or omissions and their negative market reactions are rare (only 2% of the sample), we expect to observe average positive reactions in the cumulative returns.

Figure 3.1: Empirical distribution of dividend changes. $Ln(1 + [dt/d_{t-1}])$ is the natural logarithm of one plus current dividends, divided by dividends in the previous quarter. Dividends are cash dividends for common shares (divamt), multiplied by the number of shares outstanding (cshoq).



3.3 Method and results

LM argues that the relationship between permanent earnings and total payout is governed by the following regression:

$$\mathrm{p}_t = \alpha_t + \beta \sum_{j=0}^{\infty} \mathrm{Y}_{t-j} \tag{3.1}$$

where p_t represents total payout, α_t is the constant term and Y is the unobserved permanent earnings.

While permanent earnings are unobservable, prior empirical works [e.g. Marsh and Merton, 1987; Garrett and Priestley, 2000] show that lagged stock prices capture information about expected permanent earnings. LM argues that stock market capitalisation is proportional to permanent income. They further assert that in an efficient market, unanticipated changes in market value will reveal unanticipated changes in permanent income. Therefore, we estimate unexpected changes in permanent earnings by substituting Y with distributed lags on past stock market returns. In addition, prior literature extensively shows that permanent earnings are used to pay dividends, and that transitory earnings are less responsive to dividends. Therefore, we estimate the unexpected changes in permanent earnings by adhering to a two-step procedure. First, we estimate the sensitivities (coefficients) of lagged stock market return to changes in dividends by estimating the following regression:

$$\Delta \mathrm{d}_{it} = a_{it} + b \sum \mathrm{Cret}_{it}^{[k,j]} \tag{3.2}$$

where $\Delta \mathrm{d}_t$ represents changes in dividends, and a_{it} is the constant term. $\mathrm{Cret}_{it}^{[k,j]}$ $(k \in \{-2, -21, -41, -61, -121, -240\}, j \in \{-20, -40, -60, -120, -240, -360\})$ is a set of cumulative (daily) stock returns. Dividends are cash dividends per share (divamt), multiplied by the number of shares outstanding (cshoq). The dependent variable is the natural logarithm of the current period dividends divided by lagged dividends.

We run (3.2) for the whole sample to observe the overall effect of lagged stock market returns on dividend changes and report the results. We find that the lagged stock market returns show a large and significant relationship with changes in permanent earnings. However, to estimate the coefficients on lagged stock market returns for individual firms, we estimate (3.2) for individual firms on a rolling window basis. That is, for each firm i, we estimate the regression over 20-quarter rolling windows. This allows us to estimate the coefficients on $\mathrm{Cret}_{it}^{[k,j]}$, which we then use in the following equation to arrive at an estimate of permanent earnings surprises for individual firms.

$$\widehat{\Delta \mathrm{Y}}_{it} = \widehat{b} \sum \mathrm{Cret}_{it}^{[k,j]} \tag{3.3}$$

We multiply realised values for $\mathrm{Cret}_{it}^{[k,j]}$ by their estimated coefficients ($\widehat{b}$) to estimate time-varying values for unexpected changes in permanent earnings ($\widehat{\Delta \mathrm{Y}}$).

3.3.1 Results

First, we estimate (3.2) for the whole sample and report the results in Table 3.2. Evidently, all coefficients on lagged stock market returns are positive and economically significant. We document that lagged stock market responses to dividend changes amounts to 2% of the market capitalisation, on average. The rate of response attenuates over time but remains significant. This is consistent with the theoretical prediction of LM, who predict that stock market returns provide a good proxy for unexpected changes in permanent earnings. Expectedly, changes in the earnings-to-asset ratio positively and significantly relate to changes in dividends. Our control variables that account for firm characteristics are well in line with our prior. Larger firms that spend more on CAPEX with more tangible assets experience larger changes in dividends. Further, firms with a larger proportion of institutional ownership report larger changes in dividends. However, more levered firms report lower changes in dividends. These results are in line with the notion that more mature firms change dividends more often and payout more [DeAngelo et al., 2009].

Table 3.2: The stock market return reactions to changes in dividends. The dependent variable is $Ln(1+[dt/d_{t-1}])$, which is the natural logarithm of one plus current dividends, divided by dividends in the previous quarter. Dividends are cash dividends for commons shares (divamt), multiplied by the number of shares outstanding (cshoq). $\text{Cret}_{it}^{[k,j]}$ $(k \in \{-2,-21,-41,-61,-121,-240\}, j \in \{-20,-40,-60,-120,-240,-360\})$ is a set of cumulative (daily) stock returns. ΔEarnings is changes in earnings divided by total assets in the previous quarter.

	$Ln(1+[d_t/d_{t-1}])$			
	(1)	(2)	(3)	(4)
Cret[-2,-20]	0.033***	0.025***	0.029***	0.024***
	(19.54)	(8.22)	(9.22)	(7.67)
Cret[-21,-40]	0.033***	0.031***	0.032***	0.028***
	(19.27)	(10.00)	(9.78)	(5.41)
Cret[-41,-60]	0.033***	0.030***	0.029***	0.023***
	(19.60)	(9.72)	(8.99)	(5.42)
Cret[-61,-120]	0.027***	0.021***	0.020***	0.015***
	(27.60)	(11.49)	(9.93)	(4.64)
Cret[-121,-240]	0.021***	0.014***	0.014***	0.010***
	(32.28)	(11.50)	(10.53)	(7.28)
Cret[-241,-360]	0.015***	0.010***	0.012***	0.009***
	(24.62)	(8.50)	(9.61)	(5.90)
ΔEarnings		0.038***	0.034***	0.031***
		(7.67)	(6.86)	(4.73)
MC		0.001***	0.001***	0.007***
		(5.43)	(3.82)	(5.67)
Leverage		-0.009***	-0.008***	-0.019***
		(-4.54)	(-4.04)	(-4.37)
Tobin_Q		0.002***	0.002***	-0.000
		(4.71)	(5.54)	(-0.19)
Cash/TA$_{t-1}$		0.013***	0.011***	0.027***
		(4.76)	(3.73)	(3.59)
CAPX/TA$_{t-1}$		0.103***	0.099***	0.073***
		(6.15)	(5.89)	(5.47)
CF/TA$_{t-1}$		0.002	0.000	-0.009
		(0.23)	(0.02)	(-0.72)
PPE/TA$_{t-1}$		0.000	0.001	0.014**
		(0.41)	(0.92)	(2.49)
Institutional Ownership Ratio		0.003***	0.003**	0.018***
		(2.60)	(2.30)	(5.16)
Constant	0.700***	0.689***	0.695***	0.649***
	(3832.74)	(512.96)	(9.38)	(64.13)
Observations	192726	70911	70911	70825
R^2	0.017	0.016	0.037	0.075
Firm characteristic controls	NO	YES	YES	YES
Time fixed effects	NO	NO	YES	YES
Firm fixed effects	NO	NO	NO	YES
Firm characteristic controls	NO	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Next, we estimate time-varying changes in unexpected permanent earnings for individual firms. In doing so, we estimate (3.2) on a 20-quarter rolling basis.[3] We then collect coefficients on cumulative returns. Last, we multiply estimated coefficients by realised values of lagged cumulative returns to arrive at a time-varying measure of surprises in permanent earnings.

To verify the economic credibility of our measure, for each quarter we plot cross-sectional averages of unexpected changes in permanent earnings over the period 1970–2019 in Figure 3.2. This provides us with aggregate unexpected changes in permanent earnings in a time series format. We superimpose the shaded areas, which represent the National Bureau of Economic Research (NBER) recession periods. As the figure shows, periods of recession coincide with periods of significant declines in average unexpected changes in permanent earnings. Therefore, our measure keeps track of economic episodes at the aggregate level.

Our measure also varies cross-sectionally. We present the univariate statistics of permanent earnings shocks ($\widehat{\Delta Y}$) and industry averages in Figure 3.3. The mean (median) shock to permanent earnings is 0.15% (0.04%), with a standard deviation of 3.59%. Almost 25% of the sample have a $\widehat{\Delta Y}$ below -0.92%, while 75% of the sample have a $\widehat{\Delta Y}$ below 1.18%. We further calculate average unexpected changes in permanent earnings for the Fama–French 30 industry categories and plot the results in Figure 3.3. We observe that our measure varies cross-sectionally. The Automobile and Truck sector experiences a quarterly 0.45% shock to permanent earnings, which is the largest positive shock during our sample period, followed by Steel Works (0.34%) and Electrical Equipment (0.32%). Printing and Publication experience a -0.01% shock to permanent earnings, which is the largest negative shock to a given industry, followed by Petroleum and Natural Gas (-0.01%) and Apparel (0.01%). The negative shocks to the Printing and Publication and Petroleum and Gas industries are expected because the consumption shifted from paper-based products to paperless, and from fossil fu-

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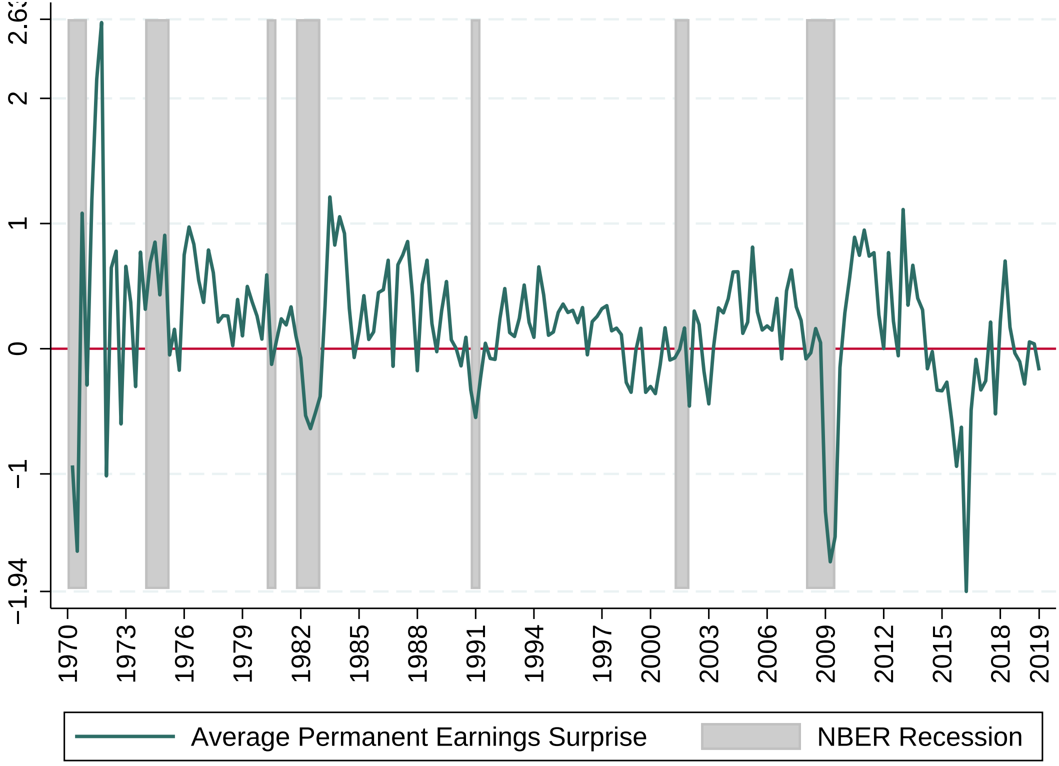
[3] Since we require at least 20 quarters of data to estimate our measure, we start the sample from 1965 to have estimates starting from 1970.

Figure 3.2: Time series evolution of the permanent earnings surprise. This graph shows the cross-sectional averages of unexpected changes in permanent earnings $(\widehat{\Delta Y})$ for the period 1970–2019. The numbers are in percentages. For each quarter, we calculate average values for unexpected changes in permanent earnings and plot them across the time series.

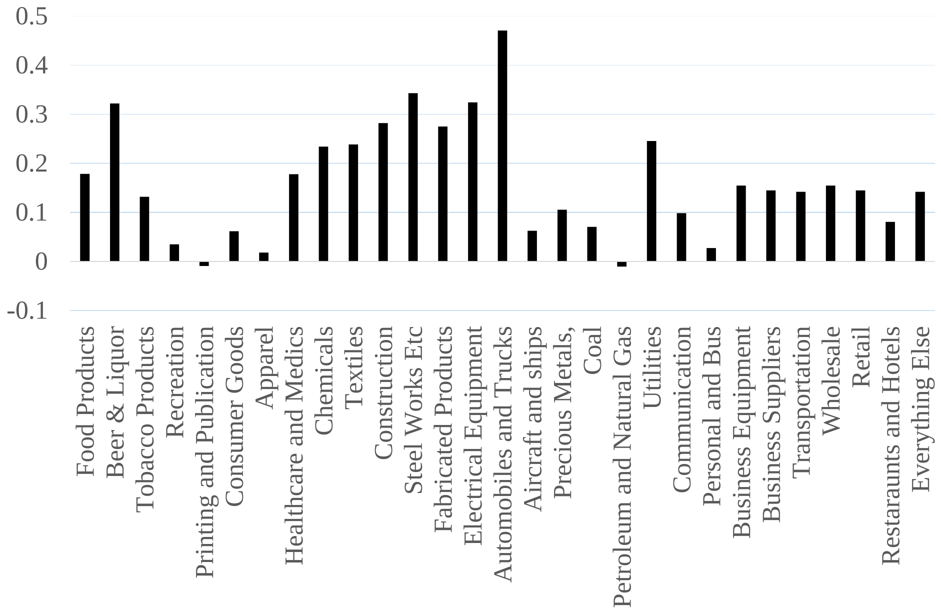


els to more environmentally friendly sources of energy. The small positive shock to Apparel is also expected given the forceful completion in this sector. The largest positive shocks to Automobile and Steel industries are expected because these industries are protected from fierce completion by tariffs. The large positive shocks to Electronic Equipment is in line with the high-tech revolution over the past two decades.

As discussed earlier, prior literature finds that dividends are usually paid out of the permanent component of cash flow (earnings). For example, Garrett and Priestley [2000] estimate permanent earnings and find that only 16% of permanent earnings are distributed as dividends. We run the following regression to find how much of

Figure 3.3: Unexpected changes in permanent earnings and Fama–French 30 industry categorisation. We use the Fama–French 30 industry categorisation to group firms into categories. For each industry, we calculate average values of unexpected changes in permanent earnings ($\widehat{\Delta Y}$) and plot.

variable	N	Mean	SD	P25	Median	P75
$\widehat{\Delta Y}$ (%)	77,210	0.148	3.588	-0.921	0.035	1.176



the unexpected changes in permanent earnings are distributed as dividends:

$$\Delta \mathrm{d}_{it} = a_{it} + b\widehat{\Delta Y}_{it} + c_i + y_t + \Sigma_{it} \tag{3.4}$$

where $\Delta \mathrm{d}_t$ is the natural logarithm of the current period dividends divided by lagged dividends. Dividends are cash dividends per share (divamt), multiplied by the number of shares outstanding (cshoq). a_{it} is the constant term, $\widehat{\Delta Y}_{it}$ is the unexpected changes in permanent earnings. c_i represents firm fixed effects and y_t accounts for time trends in the sample data. Σ_{it} represents an array of observable firm characteristics.

Table 3.3 reports the results. In Column (4), where all controls are included, the estimated loading on $\widehat{\Delta Y}_{it}$ is 0.817 (significant at 1%). That is, almost 81.7% of the permanent earnings surprise is used to finance dividend changes. Therefore, we verify our prior finding that dividend changes are more sensitive to permanent earnings.

3.3.2 Information asymmetry complication

Complications arising from the information content of dividends makes our strategy in estimating unexpected changes in permanent earnings less straightforward. In particular, in the presence of information asymmetry between corporate insiders and outsiders, where insiders have superior information about permanent income relative to investors, stock prices do not anticipate changes in payouts; rather, they react to them. To address this concern, we develop an information asymmetry index and control for the information content of dividends in our model.

3.3.3 Index construction

We use seven measures of adverse selection developed by microstructure research to generate our information asymmetry index (InfI_{it}). We use daily and monthly variables. Our daily measures include the daily total stock return volatility, the percent quoted spread introduced by George et al. [1991], the average effective bid-ask spread, and two other measures of bid-ask spread proposed by Abdi and Ranaldo [2017] and Corwin and Schultz [2012]. Our monthly measures of adverse selection include analyst forecast dispersion, scaled by the mean monthly price, following Garfinkel [2009]. All of these variables are then used to construct our information asymmetry index for each firm *i* at quarter *t*.

Jiang et al. [2017] show that there is a positive and economically significant association between liquidity and payout policy. More specifically, they report that a one-standard-deviation increase in stock liquidity is about 11.82% of the mean dividend payout. Although our measure of adverse selection may be related to liquidity,

Table 3.3: Changes in dividends and unexpected changes in permanent earnings. The dependent variable is $Ln(1+[dt/d_{t-1}])$, which is the natural logarithm of one plus current dividends, divided by dividends in the previous quarter. Dividends are cash dividends for common shares (divamt), multiplied by the number of shares outstanding (cshoq). $\text{Cret}_{it}^{[k,j]}$ ($k \in \{-2,-21,-41,-61,-121,-240\}, j \in \{-20,-40,-60,-120,-240,-360\}$) is a set of cumulative (daily) stock returns. $\widehat{\Delta Y}$ is our estimate of permanent earnings surprises. ΔEarnings is changes in earnings divided by total assets in the previous quarter.

	$Ln(1+[d_t/d_{t-1}])$			
	(1)	(2)	(3)	(4)
$\widehat{\Delta Y}$	0.821***	0.777***	0.772***	0.817***
	(133.85)	(83.76)	(83.51)	(6.28)
Cret[-2,-20]	0.009***	0.006	0.011***	0.007
	(3.77)	(1.50)	(2.76)	(1.03)
Cret[-21,-40]	0.012***	0.008**	0.011**	0.007**
	(4.87)	(2.11)	(2.57)	(2.33)
Cret[-41,-60]	0.011***	0.010***	0.010**	0.005
	(4.41)	(2.73)	(2.41)	(1.05)
Cret[-61,-120]	0.010***	0.008***	0.007***	0.003
	(6.76)	(3.47)	(2.98)	(1.16)
Cret[-121,-240]	0.007***	0.002	0.002	-0.000
	(7.49)	(1.16)	(1.24)	(-0.24)
Cret[-241,-360]	0.006***	0.002*	0.005***	0.003
	(6.74)	(1.67)	(3.26)	(1.50)
ΔEarnings		0.019***	0.021***	0.019**
		(3.19)	(3.47)	(2.38)
MC		0.001***	0.001***	0.004**
		(3.96)	(2.99)	(2.18)
Leverage		-0.010***	-0.009***	-0.017***
		(-4.13)	(-3.96)	(-3.85)
Tobin_Q		0.003***	0.003***	0.003
		(6.40)	(6.88)	(1.39)
Cash/TA_{t-1}		0.009**	0.006*	0.011
		(2.50)	(1.69)	(0.93)
CAPX/TA_{t-1}		0.100***	0.098***	0.085**
		(4.54)	(4.39)	(2.71)
CF/TA_{t-1}		0.003	0.000	-0.011
		(0.27)	(0.01)	(-0.81)
PPE/TA_{t-1}		-0.000	-0.000	0.006*
		(-0.49)	(-0.24)	(1.82)
Institutional Ownership Ratio		0.000	-0.002	0.004
		(0.10)	(-1.24)	(0.81)
Constant	0.700***	0.692***	0.697***	0.665***
	(2802.84)	(418.06)	(11.02)	(47.83)
Observations	77210	37376	37376	37298
R^2	0.201	0.171	0.186	0.236
Firm characteristic controls	NO	YES	YES	YES
Time fixed effects	NO	NO	YES	YES
Firm fixed effects	NO	NO	NO	YES
S.E Clusterd by Firm & Quarter	NO	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

it is unlikely that it captures all dimensions of liquidity. Thus, we use several measures of liquidity to construct our illiquidity index (IlliqI), which includes the illiquidity ratio of Amihud [2002], *minus* the Amivest liquidity ratio [Hasbrouck, 2009], the zero-return proportion measure estimated following Lesmond et al. [1999], and for each firm *i*, *minus* the number of analysts following the sample firm.

After estimating the constituent of each index, for each firm *i* during each quarter *t*, we use principal component analysis to estimate the common component of the cross-sectional variation of the two index constituents. This way, we have two separate indexes, one representing adverse selection and the other representing illiquidity. In paticular, for each quarter, we estimate the first principal components of the correlation matrix of the firm-level standardised measures of adverse selection and illiquidity. The first principal components of the adverse selection and illiquidity proxies explain, on average, more than 60% and 50% of the total cross-sectional sample variance, respectively. Therefore, we set the information asymmetry (InfI_{it}) and illiquidity (IlliqI_{it}) indexes equal to the first principal components of the asymmetric information and illiquidity variables, respectively. The two indexes enable us to investigate the information and liquidity environments of firms for each quarter before and after the dividend declaration window.

After constructing our two indexes, we re-estimate (3.2) and (3.4), controlling for information asymmetry and illiquidity. We estimate the following regressions:

$$\Delta \mathrm{d}_{it} = \alpha_{it} + \beta \sum \mathrm{Cret}_{it}^{[k,j]} + \gamma InfI_{it} + \delta IlliqI_{it} \tag{3.5}$$

$$\Delta \mathrm{d}_{it} = \alpha_{it} + \beta \widehat{\Delta \mathrm{Y}}_{it} + \gamma InfI_{it} + \delta IlliqI_{it} c_i + y_t + \Sigma_{it} \tag{3.6}$$

where InfI and IlliqI are information asymmetry and illiquidity indexes, respectively.

Tables 3.4 and 3.5 report the results of applying models (3.5) and (3.6), respectively. When we add information asymmetry and illiquidity indexes, the results remain largely consistent. The InfI index remains negatively significant through both models. The higher values for the information asymmetry index indicate more information asymmetry. Therefore, it is not surprising that we find that InfI is negatively and significantly associated with dividend changes. This result implies a firm with higher information asymmetry tends to pay smaller dividends, which is different from a lower chance to change dividends. Also, dividend signalling theories assert that more changes in dividends convey more information to the market, reducing the information gap by a greater amount. The Illiquidity index remains insignificant through both models.

Table 3.4: The stock market return reactions to changes in dividends, controlling for information asymmetry and illiquidity. The dependent variable is $Ln(1 + [dt/d_{t-1}])$, which is the natural logarithm of one plus current dividends, divided by dividends in the previous quarter. Dividends are cash dividends for common shares (divamt), multiplied by the number of shares outstanding (cshoq). $\text{Cret}_{it}^{[k,j]}$ $(k \in \{-2, -21, -41, -61, -121, -240\}, j \in \{-20, -40, -60, -120, -240, -360\})$ is a set of cumulative (daily) stock returns. ΔEarnings is changes in earnings divided by total assets in the previous quarter. InfI and IlliqI are information asymmetry and illiquidity indexes, respectively.

	$Ln(1 + [d_t/d_{t-1}])$			
	(1)	(2)	(3)	(4)
Cret[-2,-20]	0.031^{***}	0.025^{***}	0.029^{***}	0.025^{***}
	(14.97)	(6.96)	(7.67)	(7.26)
Cret[-21,-40]	0.030^{***}	0.032^{***}	0.032^{***}	0.027^{***}
	(14.09)	(8.45)	(8.05)	(5.23)
CCret[-41,-60]	0.034^{***}	0.032^{***}	0.030^{***}	0.023^{***}
	(16.05)	(8.68)	(7.78)	(4.64)
Cret[-61,-120]	0.026^{***}	0.023^{***}	0.022^{***}	0.016^{***}
	(21.33)	(10.56)	(8.90)	(5.39)
Cret[-121,-240]	0.021^{***}	0.015^{***}	0.015^{***}	0.010^{***}
	(26.30)	(9.87)	(9.43)	(5.82)
Cret[-241,-360]	0.015^{***}	0.010^{***}	0.013^{***}	0.009^{***}
	(19.62)	(7.29)	(8.18)	(4.31)
InfI	-0.000^{***}	-0.001^{***}	-0.001^{***}	-0.001^{**}
	(-3.31)	(-3.24)	(-3.28)	(-2.46)
IlliqI	-0.001^{***}	0.001^{**}	0.000	0.001
	(-4.81)	(2.11)	(0.72)	(1.04)
ΔEarnings		0.034^{***}	0.030^{***}	0.027^{***}
		(5.80)	(5.04)	(3.68)
MC		0.001^{***}	0.000	0.008^{***}
		(2.72)	(0.84)	(5.05)
Leverage		-0.012^{***}	-0.011^{***}	-0.018^{***}
		(-5.27)	(-4.60)	(-3.84)
Tobin_Q		0.001^{***}	0.002^{***}	-0.000
		(2.94)	(3.72)	(-0.36)
Cash/TA_{t-1}		0.019^{***}	0.016^{***}	0.034^{***}
		(5.31)	(4.45)	(4.83)
CAPX/TA_{t-1}		0.126^{***}	0.119^{***}	0.081^{***}
		(6.21)	(5.87)	(3.26)
CF/TA_{t-1}		-0.002	-0.003	-0.016
		(-0.23)	(-0.33)	(-1.09)
PPE/TA_{t-1}		0.001	0.001	0.017^{**}
		(1.02)	(1.46)	(2.31)
Institutional Ownership Ratio		0.004^{**}	0.004^{**}	0.019^{***}
		(2.57)	(1.99)	(4.24)
Constant	0.701^{***}	0.689^{***}	0.696^{***}	0.640^{***}
	(3025.90)	(277.47)	(9.15)	(51.31)
Observations	125366	50677	50677	50573
R^2	0.017	0.017	0.037	0.081
Firm characteristic controls	NO	YES	YES	YES
Time fixed effects	NO	NO	YES	YES
Firm fixed effects	NO	NO	NO	YES
S.E Clusterd by Firm & Quarter	NO	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 3.5: Changes in dividends and unexpected changes in permanent earnings, controlling for information asymmetry and illiquidity. The dependent variable is $Ln(1+[dt/d_{t-1}])$, which is the natural logarithm of one plus current dividends, divided by dividends in the previous quarter. Dividends are cash dividends for common shares (divamt), multiplied by the number of shares outstanding (cshoq). $\text{Cret}_{it}^{[k,j]}$ $(k \in \{-2,-21,-41,-61,-121,-240\}, j \in \{-20,-40,-60,-120,-240,-360\})$ is a set of cumulative (daily) stock returns. $\widehat{\Delta Y}$ is our estimate of permanent earnings surprises. ΔEarnings is changes in earnings divided by total assets in the previous quarter. InfI and IlliqI are information asymmetry and illiquidity indexes, respectively.

	$Ln(1+[d_t/d_{t-1}])$			
	(1)	(2)	(3)	(4)
$\widehat{\Delta Y}$	0.801***	0.768***	0.765***	0.813***
	(107.62)	(73.15)	(72.87)	(6.63)
Cret[-2,-20]	0.010***	0.008*	0.013***	0.008
	(3.32)	(1.79)	(2.78)	(1.33)
Cret[-21,-40]	0.008***	0.006	0.008	0.003
	(2.68)	(1.29)	(1.57)	(0.86)
Cret[-41,-60]	0.016***	0.012***	0.011**	0.005
	(5.11)	(2.60)	(2.31)	(1.10)
Cret[-61,-120]	0.011***	0.011***	0.010***	0.005*
	(6.56)	(4.15)	(3.48)	(1.81)
Cret[-121,-240]	0.008***	0.003*	0.004**	0.001
	(7.03)	(1.85)	(2.11)	(0.24)
Cret[-241,-360]	0.006***	0.003*	0.005**	0.002
	(5.72)	(1.70)	(2.48)	(0.59)
InfI	-0.001***	-0.001***	-0.001***	-0.001**
	(-5.70)	(-3.75)	(-3.71)	(-2.29)
IlliqI	-0.000*	0.000	-0.000	-0.000
	(-1.94)	(0.92)	(-0.93)	(-0.38)
ΔEarnings		0.013*	0.015**	0.013*
		(1.89)	(2.08)	(1.82)
MC		0.000	-0.001	0.004**
		(0.57)	(-1.29)	(2.14)
Leverage		-0.009***	-0.008***	-0.011**
		(-3.23)	(-2.93)	(-2.45)
Tobin_Q		0.002***	0.003***	0.002
		(5.07)	(5.45)	(1.26)
Cash/TA_{t-1}		0.018***	0.015***	0.025**
		(4.14)	(3.50)	(2.72)
CAPX/TA_{t-1}		0.128***	0.123***	0.084*
		(4.84)	(4.59)	(1.92)
CF/TA_{t-1}		-0.007	-0.009	-0.021
		(-0.57)	(-0.73)	(-1.41)
PPE/TA_{t-1}		-0.001	-0.000	0.009**
		(-0.59)	(-0.39)	(2.19)
Institutional Ownership Ratio		0.001	-0.002	0.006
		(0.41)	(-0.95)	(1.09)
Constant	0.700***	0.695***	0.700***	0.656***
	(2161.70)	(246.37)	(11.10)	(51.64)
Observations	52454	27397	27397	27310
R^2	0.195	0.178	0.191	0.243
Firm characteristic controls	NO	YES	YES	YES
Time fixed effects	NO	NO	YES	YES
Firm fixed effects	NO	NO	NO	YES
S.E Clusterd by Firm & Quarter	NO	YES	YES	YES

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

3.4 Conclusion

We estimate unexpected changes in permanent earnings from lagged stock market return responses to changes in dividends for individual firms. We employ the theoretical framework outlined in Lambrecht and Myers [2012], who relate unexpected changes in market capitalisation to unexpected changes in permanent earnings. Further, we show that our estimate is positively correlated with economic states at the aggregate level. Our study makes two main contributions. First, we estimate the unexpected changes in permanent earnings for individual firms on a quarterly basis. Prior literature is mainly focused on estimating aggregate permanent earnings on a yearly basis. Second, we provide a time-varying estimate of permanent earnings surprises. Thus, our measure is closer to the actual unexpected changes in permanent earnings, which are also time-varying in nature.

Future work could investigate the relationship between the estimated earnings surprise and analyst forecasts. Does our estimate follow analyst forecasts of earnings? Moreover, since unexpected changes in permanent earnings are correlated with technological shocks, one could investigate how permanent earning shocks relate to technological shocks at the industry level.

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Chapter 1 - Appendix

Appendix A. The theoretical model

To motivate our empirical investigation, we apply a simple adjustment to the benchmark model of Kaplan and Zingales [1997, henceforth, KZ] by assuming that dividends are a costly source of internal funds. KZ assume that firms have access to internal cash flow (W) that is retained after paying out dividends. They further assume that firms have costly access to outside funding, which is captured by a cost wedge between the internal and external funds (k). We provide two simple examples to explain why dividends and their smoothing matters. First, adding back dividends (D) to retained cash flow (W) results in internal cash flow (C). Assume a cross-section of two firms (A and B) with identical external cost functions, where $C^A = C^B$ and $k^A = k^B > 0$ are fixed. Further, assume that nature randomly selects A as a dividend payer and B as a non-payer. This causes $W^A < W^B$ (because $W = C - D$), implying that A has less available funding to satisfy its investment needs. Faced with the same investment outlay, A is now more likely to become financially constrained relative to B. But, we started with the assumption that $k^A = k^B$, suggesting the same level of constraint for the two firms. Second, suppose there is another dividend-paying firm, C. Firms A and C are both dividend payers, where $D^A = D^C$, but A smooths its dividends more than C. If there is a negative shock to cash flow such that $C^A = C^C = 0$ and $k^A = k^C > 0$, then $W^A < W^C$ because $D^A > D^C$ over time. That is, firm A becomes comparatively more constrained because of a lack of flexible payout when internal cash flows shrink. The extended KZ model allows us to elaborate on the effect of costly dividends on cash flow allocation within firms.

We define a simple one-period model where a firm chooses the level of investment (I) to maximise profits. Production function $f(.)$ takes I and delivers a return on investment $f(I)$, where $f' > 0$ and $f'' < 0$. There are two ways in which firms can finance their investment needs, either through internal funds ($W = C - D$), where C is internally generated cash flow and D is dividends paid out, or with external funds (E). To maintain comparability with KZ, we also assume that the opportunity cost of internal funds equals the cost of capital that equals one. Raising external funds is costly, mainly as a result of management overconfidence, risk aversion, and information or agency problems, which induce a deadweight cost. The cost function of external funds is represented by $C^e(E,k)$. In the model, we do not consider the choice between debt or equity finance for simplicity. It is assumed that $C^e(.)$ is rising in k–that is, that the cost of raising external funds increases with the amount that is raised.

Market frictions that cause dividend smoothing are varied, from agency and information problems to rent-seeking activities by managers[4]. We proxy for the additional cost associated with smooth dividends via the function $C^d(D,\ell)$, where ℓ is a measure of the firm's wedge between the retention and distribution costs of funds. The extant literature documents that the absolute size of the market reaction to dividend cuts is proportional to the size of the cut, where omission bears the maximum punishment [Pettit, 1972; DeAngelo and DeAngelo, 1990]. Therefore, it is plausible to assume that C^d is increasing in ℓ. That is, the cost of a dividend cut monotonically increases with the amount of the cut.

Formally, a given firm chooses I to maximize profits as follows:

$$\max f(I) - C^e(E,k) - C^d(D,l) - I, \quad s.t.\ I = C - D + E \tag{1}$$

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[4] For example, see Kumar [1988]; Kumar and Lee [2001]; Guttman et al. [2010]; Leary and Michaely [2011]; Lambrecht and Myers [2012]; Wu [2017].

We assume that both cost functions, $C^e(.)$ and $C^d(.)$, are convex in E and ℓ, respectively[5]. Then, the first-best investment policy is achieved by taking the first-order condition of (1) and equating it to zero. That is, we have:

$$f_1(I) = 1 + C_1^e(I - C + D, k) - C_1^d(C + E - I, \ell) \tag{2}$$

where $f_1()$ is the first derivative of f with respect to I, and $C_1^e(0)$ and $C_1^d(0)$ are the partial derivatives of C^e and C^d with respect to their first arguments. The relationship in (2) is interesting in that, even if a firm is not financially constrained, its first-best investment decision is affected if the firm goes along with cutting dividends. Evidently, a firm with unconditional access to outside finance would not contemplate cutting dividends. Still, this relationship shows one of the upsides of having the cost of a dividend cut as a separate stand-alone term in the model. By implicit differentiation of (2), the relationship between the available internal finance and investment is immediate:

$$\frac{dI}{dC} = \frac{C_{11}^e + C_{11}^d}{C_{11}^e + C_{11}^d - f_{11}} \tag{3}$$

where the convexity of C^e and C^d assures that (3) is positive. Rewriting (3), we have:

$$\frac{dI}{dC} = 1 + \frac{f_{11}}{C_{11}^e + C_{11}^d - f_{11}} \tag{4}$$

In a perfect capital market where firms have access to abundant external funds without additional costs, $C^e(.) = 0$, and thus $C_{11}^e = 0$. In such a world, the cost associated with a dividend cut is irrelevant, ($C^d(.) = 0$, and thus $C_{11}^d = 0$). Because $f_{11} < 0$, (4) collapses to zero, and investments become insensitive to internal cash flow. However, in an imperfect market, (4) is different from zero, making invest-

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[5] As noted by KZ, the convexity of $C^e(.)$ in E might not be warranted. However, we concede to this to maintain comparability with the benchmark model. Convexity of $C^d(.)$ in ℓ is less of a concern because prior research [e.g. DeAngelo and DeAngelo, 1990] shows that the cost of cutting dividends increases with the size of the dividend cut, and the maximum cost is incurred when dividends are fully omitted.

ments positively associated with cash flow. In the extreme case, investment–cash flow sensitivity rises to unity.

The argument is that because $C^d_{11} > 0$, the costs associated with a dividend cut increase investment–cash flow sensitivity. If a firm does not pay dividends at all, then the costs associated with altering dividends are effectively zero, reducing investment–cash flow sensitivity. As shown, dividends introduce friction into the cash flow allocation of the firm, which affects the sensitivity of investments to cash flow.

Following KZ, by implicit differentiation of (2), it is possible to derive the sensitivity of investment to the wedge between the cost of internal and external financing (k) as follows:

$$\frac{dI}{dk} = \frac{-C^e_{12}}{C^e_{11} - f_{11}} \tag{5}$$

Consistent with KZ, dI/dk is negative if $C^e_{12} > 0$ (i.e. the marginal cost of raising external finance is increasing in k), which means that there is a negative association between the cost wedge of internal and external finance and the level of investment.

By the same token, we derive the sensitivity of investment to the wedge between the cost of retention and distribution of funds (ℓ). Again, by implicit differentiation of (2), we have:

$$\frac{dI}{d\ell} = \frac{C^d_{12}}{C^d_{11} - f_{11}} \tag{6}$$

which is positive if the marginal cost of a dividend cut is increasing in ℓ (i.e. $C^d_{12} > 0$).

There are two immediate implications. First, dividend smoothing increases investment–cash flow sensitivity. Second, the friction arising from smoothing is positively associated with investment–cash flow sensitivity. We test these two theoretical predictions empirically.

As put forward by KZ, the results outlined above do not necessarily imply financial constraints. We need to satisfy the monotonicity condition by showing that either d^2I/dC^2 is negative or $d^2I/dCd\ell$ is positive. Applying implicit differentiation to (3), we obtain:

$$\frac{d^2 I}{dC^2} = \frac{f_{111}[C^e_{11} + C^d_{11}]^2 - f^2_{11}[C^e_{111} + C^d_{111}]}{(C^e_{11} + C^d_{11} - f_{11})^3} \tag{7}$$

Assuming that $f^2_{11} > 0$ and $[C^e_{11} + C^d_{11}] > 0$, we can rewrite (7) as:

$$\frac{d^2 I}{dC^2} = \left[\frac{f_{111}}{f^2_{11}} - \frac{[C^e_{111} + C^d_{111}]}{[C^e_{11} + C^d_{11}]^2}\right] \frac{f^2_{11}[C^e_{11} + C^d_{11}]^2}{(C^e_{11} + C^d_{11} - f_{11})^3} \tag{8}$$

Evidently, the second term is always positive; therefore, to ensure that $d^2 I/dC^2 < 0$ is always satisfied, we need to show that $[f_{111}/f^2_{11} - [C^e_{111} + C^d_{111}]/[C^e_{11} + C^d_{11}]^2]$ is negative. Consistent with KZ, we acknowledge that this condition may be violated. Consider a case where both $C^e(.)$ and $C^d(.)$ are quadratic. Then, one can arbitrarily find numerous production functions with $f_{111} > 0$ that violate the condition numerous times. Nevertheless, it is important to note that because we require both cost functions to be the same and $[C^e_{111} + C^d_{111}] \geq C^e_{111}$ for any dividend-paying firm, then the violation of the $d^2 I/dC^2 < 0$ condition in (8) is more restrictive than that reported by KZ, which only includes C^e_{111}. It is possible to derive $d^2 I/dCd\ell$ by implicit differentiation of (3) as:

$$\frac{d^2 I}{dCd\ell} = \frac{f_{11}C^d_{12}[C^d_{111} - C^e_{111}] + f_{111}[C^d_{12}C^d_{11} + C^d_{12}C^e_{11}] - f_{11}C^d_{112}[C^e_{11} + C^d_{11} + f_{11}]}{(C^e_{11} + C^d_{11} - f_{11})^3} \tag{9}$$

Satisfying the monotonicity condition is non-trivial. To show that $d^2 I/dCd\ell$ is positive (assuming that $C^e_{11}, C^d_{11}, C^d_{12} > 0$), one of the most restrictive options is to show that $C^d_{112} > 0$, $C^e_{11} + C^d_{11} + f_{11} > 0$, $f_{111} > 0$ and $C^e_{111} > C^d_{111}$ are jointly satisfied. Showing that $C^d_{112} > 0$ is not problematic because it is reasonable to assume that firms with a higher cost of dividend adjustment are more sensitive to dividend adjustments (especially in regard to a dividend cut). However, at the optimal level of investment, the dividend cost function must be less curved than the external fund cost function ($C^e_{111} > C^d_{111}$) to ensure monotonicity. Moreover, the trade-offs between the second and third derivatives of the cost function and the second and third derivatives of the production function cannot be resolved theoretically.

Bond and Söderbom [2013] assure monotonicity in (8) once they condition on marginal (Tobin's) q. We aim to control for marginal q by applying an orthogonal decomposition, which isolates the transitory cash flow and thus provides us with an estimation that is independent of the growth options of the firm. Therefore, we let the empirical tests determine the relationship of (8) and (9) after controlling for marginal q via a cash flow decomposition.

Table A.1: Financial constraints (HP index), total payout smoothing (SOA_{t-1}^{Tpay}) and the allocation of cash flow. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. A firm is categorised as more (less) financially constrained if its HP index falls into the top (bottom) 40%. The table reports the allocation of internally generated cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Tpay is cash dividends plus share buybacks, CR is cash reserve, ND is net debt issuance and NQ^{Adj} is net equity issuance adjusted for share buybacks. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. The SOA_{t-1}^{Tpay} is the lagged speed of adjustment of total payouts, estimated by the method described in Leary and Michaely [2011]. All variables are demeaned to account for unobservable heterogeneity that might affect the results (firm fixed effects). Control variables, year dummy variables and the constants are included in the model during estimation but are suppressed in the output for brevity.

	CF Series					Permanent CF Series					Transitory CF Series				
	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}
More Financially Constrained Firms															
CF	0.308^{***}	0.113^{***}	0.284^{***}	-0.296^{***}	0.001										
	(13.11)	(9.55)	(16.42)	(-13.42)	(0.28)										
$\text{SOA}_{t-1}^{\text{Tpay}}$	0.010^{**}	-0.002	-0.005	-0.001	0.003^{***}	0.008	-0.003	-0.004	-0.001	0.003^{***}	0.009^{*}	-0.002	-0.005	0.000	0.003^{***}
	(1.96)	(-0.96)	(-1.43)	(-0.17)	(3.10)	(1.64)	(-1.22)	(-0.99)	(-0.23)	(2.78)	(1.85)	(-0.62)	(-1.25)	(0.03)	(3.16)
CF × $\text{SOA}_{t-1}^{\text{Tpay}}$	-0.100	-0.083	-0.018	-0.198^{**}	-0.003										
	(-0.97)	(-1.59)	(-0.24)	(-2.05)	(-0.14)										
CF_Permnt						0.424^{***}	0.344^{***}	0.024	-0.229^{***}	0.022^{**}					
						(7.60)	(12.62)	(0.57)	(-4.36)	(2.10)					
CF_Permnt × $\text{SOA}_{t-1}^{\text{Tpay}}$						-0.074	0.137	-0.312^{**}	-0.200	-0.049					
						(-0.36)	(1.37)	(-2.01)	(-1.04)	(-1.30)					
CF_Transit											0.288^{***}	0.062^{***}	0.336^{***}	-0.310^{***}	-0.004
											(11.19)	(4.74)	(17.94)	(-12.88)	(-0.80)
CF_Transit × $\text{SOA}_{t-1}^{\text{Tpay}}$											-0.075	-0.143^{**}	0.034	-0.199^{*}	0.016
											(-0.61)	(-2.27)	(0.38)	(-1.73)	(0.68)
N			2006					2006					2006		
R^2	0.146	0.281	0.142	0.157	0.054	0.116	0.299	0.046	0.109	0.057	0.131	0.258	0.156	0.150	0.054
Less Financially Constrained Firms															
CF	0.291^{***}	0.098^{***}	0.249^{***}	-0.356^{***}	-0.007										
	(10.77)	(7.05)	(14.79)	(-13.58)	(-1.07)										
$\text{SOA}_{t-1}^{\text{Tpay}}$	0.008	-0.004	-0.002	-0.001	0.003^{**}	0.008	-0.005	-0.001	-0.001	0.003^{*}	0.007	-0.003	-0.002	-0.001	0.003^{**}
	(1.18)	(-1.14)	(-0.51)	(-0.19)	(1.97)	(1.14)	(-1.38)	(-0.17)	(-0.10)	(1.92)	(1.07)	(-0.97)	(-0.42)	(-0.17)	(2.01)
CF × $\text{SOA}_{t-1}^{\text{Tpay}}$	-0.108	-0.040	0.027	-0.110	-0.011										
	(-0.80)	(-0.56)	(0.31)	(-0.83)	(-0.35)										
CF_Permnt						0.266^{***}	0.295^{***}	0.108^{***}	-0.334^{***}	0.004					
						(4.35)	(9.60)	(2.76)	(-5.60)	(0.29)					
CF_Permnt × $\text{SOA}_{t-1}^{\text{Tpay}}$						0.314	-0.173	-0.006	0.202	-0.066					
						(1.07)	(-1.18)	(-0.03)	(0.71)	(-0.99)					
CF_Transit											0.298^{***}	0.047^{***}	0.285^{***}	-0.360^{***}	-0.010
											(9.80)	(3.02)	(15.13)	(-12.21)	(-1.36)
CF_Transit × $\text{SOA}_{t-1}^{\text{Tpay}}$											-0.243	0.016	0.028	-0.205	0.006
											(-1.54)	(0.20)	(0.29)	(-1.34)	(0.16)
N			1993					1993					1993		
R^2	0.170	0.174	0.133	0.157	0.068	0.148	0.190	0.051	0.116	0.068	0.165	0.158	0.137	0.148	0.069

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.2: Financial constraints (HP index), total payout smoothing (Rel-Vol$_{t-1}^{Tpay}$) and the allocation of cash flow. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1987–2018 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. A firm is categorised as more (less) financially constrained if its HP index falls into the top (bottom) 40%. The table reports the allocation of internally generated cash flow (CF), as well as its permanent (CF_Permnt) and transitory (CF_Transit) components. Inv is investment, Tpay is cash dividends plus share buybacks, CR is cash reserve, ND is net debt issuance and NQ^{Adj} is net equity issuance adjusted for share buybacks. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. CF is decomposed by applying the Butterworth filter. The Rel-Vol$_{t-1}^{Tpay}$ is the lagged relative volatility of total payouts, estimated by the method described in Leary and Michaely [2011]. All variables are demeaned to account for unobservable heterogeneity that might affect the results (firm fixed effects). Control variables, year dummy variables and the constants are included in the model during estimation but are suppressed in the output for brevity.

	CF Series					**Permanent CF Series**					**Transitory CF Series**				
	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}	Inv	Tpay	CR	ND	NQ^{Adj}
More Financially Constrained Firms															
CF	0.299^{***}	0.126^{***}	0.280^{***}	-0.298^{***}	0.002										
	(15.90)	(12.51)	(20.27)	(-16.81)	(0.58)										
Rel-Vol$_{t-1}^{\text{Tpay}}$	0.000	-0.000^{*}	-0.000^{*}	-0.000	-0.000	0.000^{*}	-0.000	-0.000^{**}	-0.000	-0.000	0.000	-0.000^{**}	-0.000^{**}	-0.000	-0.000
	(1.48)	(-1.85)	(-1.93)	(-0.83)	(-0.75)	(1.65)	(-1.63)	(-2.21)	(-0.73)	(-0.82)	(1.64)	(-2.03)	(-1.99)	(-0.80)	(-0.79)
CF × Rel-Vol$_{t-1}^{\text{Tpay}}$	-0.000	0.000	-0.000	-0.000^{*}	0.000										
	(-1.30)	(0.49)	(-0.57)	(-1.67)	(0.55)										
CF_Permnt						0.403^{***}	0.369^{***}	0.041	-0.205^{***}	0.018^{*}					
						(8.87)	(15.55)	(1.20)	(-4.75)	(1.90)					
CF_Permnt × Rel-Vol$_{t-1}^{\text{Tpay}}$						-0.000	-0.000	-0.000	-0.000	-0.000					
						(-1.44)	(-0.09)	(-0.22)	(-1.62)	(-0.57)					
CF_Transit											0.279^{***}	0.073^{***}	0.329^{***}	-0.317^{***}	-0.001
											(13.51)	(6.51)	(21.91)	(-16.30)	(-0.26)
CF_Transit × Rel-Vol$_{t-1}^{\text{Tpay}}$											-0.000	-0.000	-0.000	-0.000	0.000
											(-0.71)	(-0.18)	(-0.14)	(-1.21)	(1.09)
N			3006					3006					3006		
R^2	0.125	0.291	0.144	0.134	0.037	0.095	0.308	0.046	0.082	0.038	0.110	0.266	0.157	0.127	0.037
Less Financially Constrained Firms															
CF	0.339^{***}	0.090^{***}	0.241^{***}	-0.319^{***}	-0.011^{**}										
	(15.38)	(7.83)	(17.54)	(-14.89)	(-2.03)										
Rel-Vol$_{t-1}^{\text{Tpay}}$	-0.000	-0.000	-0.000	-0.000	0.000	0.000	-0.000	-0.000^{*}	0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
	(-0.08)	(-0.17)	(-1.01)	(-0.85)	(0.12)	(1.48)	(-0.45)	(-1.69)	(0.22)	(-0.17)	(0.42)	(-0.10)	(-1.10)	(-0.31)	(-0.03)
CF × Rel-Vol$_{t-1}^{\text{Tpay}}$	-0.000	0.000	-0.000	-0.000	0.000										
	(-1.08)	(0.19)	(-0.19)	(-1.18)	(0.22)										
CF_Permnt						0.295^{***}	0.250^{***}	0.085^{***}	-0.367^{***}	-0.002					
						(5.86)	(9.74)	(2.67)	(-7.52)	(-0.18)					
CF_Permnt × Rel-Vol$_{t-1}^{\text{Tpay}}$						0.000	-0.000	-0.000	-0.000	0.000					
						(0.31)	(-1.11)	(-0.40)	(-0.57)	(0.18)					
CF_Transit											0.352^{***}	0.051^{***}	0.276^{***}	-0.308^{***}	-0.013^{**}
											(14.39)	(3.94)	(18.20)	(-12.94)	(-2.19)
CF_Transit × Rel-Vol$_{t-1}^{\text{Tpay}}$											-0.000	0.000	-0.000	-0.000	0.000
											(-0.75)	(0.54)	(-0.25)	(-0.65)	(0.07)
N			2984					2984					2984		
R^2	0.169	0.177	0.116	0.136	0.059	0.136	0.185	0.037	0.105	0.057	0.162	0.165	0.121	0.124	0.059

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Appendix B. An alternative estimation strategy

In estimating the two measures of dividend smoothing, we impose several restrictions that reduce the overall number of observations, skewing our results towards firms that survive through the sample period. In this section, we devise an alternative empirical strategy that directly estimates the SOA and target payout ratios, thereby adding robustness to our main results.

The cash flow identity holds in the level, and thus should hold in changes. Hence, we have:

$$\Delta \mathrm{Inv}_t + \Delta \mathrm{CR}_t + \Delta \mathrm{Div}_t - \Delta \mathrm{ND}_t - \Delta \mathrm{NQ}_t = \Delta \mathrm{CF}_t \tag{10}$$

where $\Delta \mathrm{CF}_t$ is the change in the internally generated cash flow, $\Delta \mathrm{ND}_t$ is the change in net debt issuance and $\Delta \mathrm{NQ}_t$ is the change in net equity issuance. The changes in the uses of funds variables include changes in investment ($\Delta \mathrm{Inv}_t$), changes in cash reserves ($\Delta \mathrm{CR}_t$) and changes in cash dividends ($\Delta \mathrm{Div}_t$).

Prior literature reviewed in this study provides grounds to argue that changes in dividends are not strictly endogenous and, more often than not, are treated as given. In addition, the cash flow variable (and its changes) is assumed to be exogenously determined because it is a realisation of a firm's past investments and current consumer behaviour [Gatchev et al., 2010]. Hence, we could rewrite the abovementioned equation as follows:

$$\Delta \mathrm{Inv}_t + \Delta \mathrm{CR}_t - \Delta \mathrm{ND}_t - \Delta \mathrm{NQ}_t = \Delta \mathrm{CF}_t - \Delta \mathrm{Div}_t \tag{11}$$

According to (11), each dollar change in the uses of funds ($\Delta \mathrm{Inv}_t + \Delta \mathrm{CR}_t$) that is not financed through changes in financing activities ($\Delta \mathrm{ND}_t + \Delta \mathrm{NQ}_t$) is financed by changes in retained cash flow ($\Delta \mathrm{CF}_t - \Delta \mathrm{Div}_t$). To investigate the effect of dividend smoothing on the allocation of the changes in internally generated cash flow, it is sufficient to substitute $\Delta \mathrm{Div}_t$ with the distributed lag model of changes in dividends

[Lintner, 1956] as described below:

$$\Delta \mathrm{Div}_t = \beta_0 + \gamma(\mathrm{Div}^* - \mathrm{Div}_{t-1}) + \eta_t \tag{12}$$

where $\Delta\mathrm{Div}_t$ is the change in dividends, β_0 is the intercept, $\gamma < 1$ is the Speed-of-Adjustment (SOA) of dividends, and Div^* is the target dividend (defined as Target $\times$ E_t, where Target is the target dividend payout ratio and E_t are the realized earnings). Substituting for $\Delta\mathrm{Div}_t$ in (12) yields:

$$\Delta \mathrm{Inv}_t + \Delta \mathrm{CR}_t - \Delta \mathrm{ND}_t - \Delta \mathrm{NQ}_t = \alpha + \Delta \mathrm{CF}_t - \tau \mathrm{E}_t + \gamma \mathrm{Div}_{t-1} + \epsilon_t \tag{13}$$

where $\alpha = -\beta_0$, $\tau = \gamma \times \text{Target}$, and $\epsilon_t = -\eta_t$.

Equation (13) suggests that in a world where dividends are determined according to the Lintner [1956] model and firms are subject to budgetary constraints, the SOA (γ) has a positive association with the changes in the uses of funds ($\Delta\mathrm{Inv}_t + \Delta\mathrm{CR}_t$), while simultaneously having a negative relationship with the changes in the sources of funds ($\Delta\mathrm{ND}_t + \Delta\mathrm{NQ}_t$). That is, more smooth dividends (lower SOA) should translate into less (yearly) changes in investment and cash and more (yearly) changes in net debt issuance and net equity issuance. It should be noted that the lagged dividend (Div_{t-1}) is determined in the previous period, and thus is strictly exogenous to the cash flow identity in the current period. However, it still imposes a constraint on the changes in the current allocation by limiting available changes in cash flow from operation. If firms choose to smooth less (more), then the restriction on available cash flow is reduced (increased) and firms have more (less) discretion in modifying their response to transitory shocks to cash flow.

In substituting Lintner's model into the changes in cash flow equation, we make two implicit assumptions that require further elaboration. The original Lintner [1956] model assumes that firms pay dividends out of earnings. However, this is unobservable to us. We employ this version of the model acknowledging that Fama and Babiak

[1968] assert its validity in comparison to alternative models. We also assume that firms smooth cash dividends, whereas previous studies use dividends paid to ordinary (common) shares. In non-tabulated results, we use common dividends (Compustat data item "DVC") instead of cash dividends and confirm that the results remain qualitatively the same.

Equation (13) forms a system of equations where four dependent variables are determined by the same set of independent variables. Given all of these specifications, in the baseline model, each component pertaining to the changes in the cash flow identity delineated in (13) is regressed on the changes in cash flow ($\Delta\mathrm{CF}_{it}$), realised earnings (E_{it}) and lagged dividends (Div_{it-1}). A vector of control variables (V) is added to control for observed heterogeneity among firms, while year dummies (y) are embedded into the regressions to partially fix time effects. Because we apply the differences in variables, the firm fixed effect (the unobservable time-invariant effect) is partially taken care of. Hence, our empirical regression model is written as follows:

$$\Delta\mathrm{Inv}_{it} = \alpha^{\Delta\mathrm{Inv}} + \beta_1^{\Delta\mathrm{Inv}}\Delta\mathrm{CF}_{it} + \beta_2^{\Delta\mathrm{Inv}}\mathrm{E}_{it} + \beta_3^{\Delta\mathrm{Inv}}\mathrm{Div}_{it-1} + \beta_4^{\Delta\mathrm{Inv}}\mathrm{V}_{it-1} + y_t + \varepsilon_{it}^{\Delta\mathrm{Inv}} \tag{14}$$

$$\Delta\mathrm{CR}_{it} = \alpha^{\Delta CR} + \beta_1^{\Delta CR}\Delta\mathrm{CF}_{it} + \beta_2^{\Delta CR}\mathrm{E}_{it} + \beta_3^{\Delta CR}\mathrm{Div}_{it-1} + \beta_4^{\Delta CR}\mathrm{V}_{it-1} + y_t + \varepsilon_{it}^{\Delta CR} \tag{15}$$

$$\Delta\mathrm{ND}_{it} = \alpha^{\Delta ND} + \beta_1^{\Delta ND}\Delta\mathrm{CF}_{it} + \beta_2^{\Delta ND}\mathrm{E}_{it} + \beta_3^{\Delta ND}\mathrm{Div}_{it-1} + \beta_4^{\Delta ND}\mathrm{V}_{it-1} + y_t + \varepsilon_{it}^{\Delta ND} \tag{16}$$

$$\Delta\mathrm{NQ}_{it} = \alpha^{\Delta NQ} + \beta_1^{\Delta NQ}\Delta\mathrm{CF}_{it} + \beta_2^{\Delta NQ}\mathrm{E}_{it} + \beta_3^{\Delta NQ}\mathrm{Div}_{it-1} + \beta_4^{\Delta NQ}\mathrm{V}_{it-1} + y_t + \varepsilon_{it}^{\Delta NQ} \tag{17}$$

For a given firm i at time t, the changes in the sources of funds must equate to the changes in the uses of funds (the accounting identity). It follows that the coefficients of ΔCF (β_1) in Equations (14)–(17) must add up to unity. The sum of the coefficients on realised earnings (β_2) should add up to $\tau = \gamma \times$ Target, and the sum of all coefficients on lagged dividends (β_3) should add up to the SOA (γ). Last, V_{t-1} variables are exogenously predetermined with respect to ΔCF_t. Therefore, the coefficients on all of these variables (β_4) must add up to zero. Hence, we have the following constraints:

$$\beta_1^{\Delta Inv} + \beta_1^{\Delta CR} - \beta_1^{\Delta ND} - \beta_1^{\Delta NQ} = 1 \tag{18}$$

$$\beta_2^{\Delta Inv} + \beta_2^{\Delta CR} - \beta_2^{\Delta ND} - \beta_2^{\Delta NQ} = \tau \tag{19}$$

$$\beta_3^{\Delta Inv} + \beta_3^{\Delta CR} - \beta_3^{\Delta ND} - \beta_3^{\Delta NQ} = \gamma \tag{20}$$

$$\beta_4^{\Delta Inv} + \beta_4^{\Delta CR} - \beta_4^{\Delta ND} - \beta_4^{\Delta NQ} = 0 \tag{21}$$

Table B.1 reports the results of estimating the abovementioned system of equations in a sample of dividend-paying firms for changes in cash flow (ΔCF), changes in transitory cash flow (ΔCF_Transit) and changes in permanent cash flow (ΔCF_Permnt). The sum of the lagged dividend coefficients (β_3) is 0.188 (-0.531 + 0.125 + 0.540 + 0.054). This shows that, in our sample of dividend-paying firms, it takes approximately 3.33 years to close half the gap between the target dividend payout and lagged dividends. Except for the regression pertaining to the changes in net equity issuance (ΔND), SOA loads significantly on all other cash flow variables. As verified in our study, SOA significantly affects investments and net debt issuance. The estimated SOA in a transitory cash flow setting is around 0.147, which is 22% lower than the SOA estimated for total cash flow. This is another indication that the SOA is only partially responsive to transitory cash flow and firms are less agile in adjusting their dividends once exposed to cash flow shocks. As expected, the target dividend payout ratio in a total cash flow setting is 19.15%, whereas the target payout ratio for the permanent and transitory components is 20.97% and 15.65%, respectively. This is consistent with the observation that firms pay dividends mostly out of the permanent component of cash flow.

The positive relationship between the estimated SOA and the target payout ratio among firms with varying degrees of financial constraint is evident from the results reported in Table B.2. The estimated SOA for firms that are categorised as more financially constrained (according to the WW index) is around 0.27 in a transitory cash flow setting. This is 238% more than the SOA for less constrained firms. Firms that are more constrained adjust half the gap between the target and the current dividends faster by 5.97 years compared with those that are less constrained.

Table B.1: . Alternative estimation strategy–allocation of changes in cash flow and dividend smoothing. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1988–2018 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. The table reports the allocation of the changes in internally generated cash flow (ΔCF), as well as its permanent (ΔCF_Permnt) and transitory (ΔCF_Transit) components. ΔInv is the change in investment, ΔCR is the change in the cash reserve, ΔND is the change in net debt issuance and ΔNQ is the change in net equity issuance. Flow-of-funds data in Compustat are used to calibrate cash flow variables according to Chang et al. [2014]. ΔCF is decomposed by applying the Butterworth filter. γ is the loading on the lagged dividends, and τ is $\gamma \times$ Target Dividend Payout Ratio. The sum of all coefficients on lagged dividends (γ) should add up to the SOA. Control variables and year dummies are included in the model during estimation but are suppressed in the output for brevity.

	CF Series				**Permanent CF Series**				**Transitory CF Series**			
	ΔInv	ΔCR	ΔND	ΔNQ	ΔInv	ΔCR	ΔND	ΔNQ	ΔInv	ΔCR	ΔND	ΔNQ
ΔCF	0.436***	0.393***	-0.141***	-0.030***								
	(28.10)	(41.13)	(-9.44)	(-3.35)								
γ	-0.531***	0.125***	-0.540***	-0.054	-0.402***	0.085*	-0.334***	-0.045	-0.464***	0.107**	-0.480***	-0.024
	(-5.41)	(2.61)	(-6.22)	(-1.22)	(-3.93)	(1.65)	(-3.76)	(-1.01)	(-4.84)	(2.25)	(-5.63)	(-0.54)
τ	0.118***	-0.034**	0.062**	0.058***								
	(4.21)	(-2.38)	(2.47)	(4.42)								
ΔCF_Permnt					0.522***	0.350***	-0.047	-0.081*				
					(6.08)	(6.40)	(-0.57)	(-1.67)				
τ_Permnt					-0.298***	-0.033	-0.353***	0.035*				
					(-6.90)	(-1.44)	(-9.16)	(1.73)				
ΔCF_Transit									0.421***	0.394***	-0.158***	-0.027***
									(26.72)	(40.44)	(-10.46)	(-3.01)
τ_Transit									0.355***	-0.011	0.302***	0.065***
									(9.95)	(-0.64)	(9.56)	(4.05)
Constant	0.016	-0.009	0.008	0.000	0.031***	-0.010*	0.026**	0.001	0.017	-0.012**	0.010	0.003
	(1.43)	(-1.51)	(0.81)	(0.03)	(2.73)	(-1.73)	(2.55)	(0.22)	(1.55)	(-2.17)	(1.04)	(0.50)
N	13543				13543				13543			
R^2	0.084	0.110	0.073	0.027	0.054	0.013	0.074	0.025	0.088	0.108	0.078	0.026

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Table B.2: . Alternative estimation strategy–speed of adjustment and the target dividend payout ratio. The sample includes US industrial firms at the intersection of the annual Compustat file and the CRSP tapes during 1988–2018 with at least 10 years of non-missing records for cash flow variables. Firms must pay dividends for at least 10 years to be included in our sample. A firm is categorised as more (less) financially constrained if its HP (WW) index falls into the top (bottom) 40%. The table reports the estimated SOA and target dividend payout ratio according to (4) for total cash flow (ΔCF), as well as its permanent (ΔCF_Permnt) and transitory (ΔCF_Transit) components. ΔCF is decomposed by applying the Butterworth filter.

	ΔCF	ΔCF_Permnt	ΔCF_Transit
SOA	0.188	0.062	0.147
Target Dividend Ratio	19.15%	20.97%	15.65%
	HP Index		
	More Financially Constrained Firms		
SOA	0.193	0.137	0.167
Target Dividend Ratio	14.51%	48.91%	7.78%
	Less Financially Constrained Firms		
SOA	0.176	0.001	0.098
Target Dividend Ratio	14.77%	-	5.10%
	WW Index		
	More Financially Constrained Firms		
SOA	0.328	0.291	0.267
Target Dividend Ratio	8.54%	27.49%	1.12%
	Less Financially Constrained Firms		
SOA	0.124	-	0.081
Target Dividend Ratio	24.19%	-	27.16%

Appendix C. The Global Financial Crisis, extreme smoothing and investment

To provide a more direct estimate of the effect of dividend smoothing and to provide additional robustness to our findings, we condition on the GFC as a market-wide (exogenous) credit supply shock. Given that firms hit by this supply-side credit shock become more constrained, altering the dividend stream could provide internal funds to neutralise the shock and avoid adjusting the investments. However, we observe that 87 firms in our sample hold their DPS unchanged from 2007 to 2009. That is, these firms continue paying smooth dividends despite the contraction in outside finance. Firms with extreme dividend smoothing (dividend stickiness) become our treated firms. The control firms (619 firms) are those that did not pay dividends during 2007–2009. Note that both the treated and control firms are engaged in a variant of smoothing. The difference is that the latter does not pay dividends and has more flexibility in responding to external shocks, while the former is committed to a fixed stream of dividends.

We follow the firm matching strategy of Barber and Lyon [1997] where, for each year, we match a dividend-paying firm with a non-dividend-paying firm based on the Fama–French 12 industry classification,[6] firm size (lagged ln(Assets)) and lagged market-to-book (proxy for growth opportunities). In addition, we control for lagged leverage and lagged asset tangibility to account for the same set of controls discussed earlier. The Abadie–Imbens matching estimator [Abadie and Imbens, 2006] is applied to produce only one match for each treated firm (dividend payer) from a population of non-treated firms (non-dividend payers). Treated firms are exactly matched along industry classification, while the (Mahalanobis) distance between the treated and the matched observations with respect to their covariates (lagged size, lagged market-to-book, lagged leverage and lagged asset tangibility) is minimised and corrected for

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[6] Available at `http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_49_ind_port.html`

bias in the procedure with heteroskedasticity-consistent standard errors.

Table C.1 reports the investment-to-asset ratio with respect to the Average Treatment Effect on the Treated (ATET). Firms that keep their DPS fixed through the GFC decrease their investment-to-asset ratio by 2.9% compared with firms that do not pay dividends. The results are less likely to be driven by investment options because we match the two subsamples of firms along the market-to-book ratio dimension, as well as an additional list of control variables. This verifies our finding that dividend smoothing materially affects investment when the firm is more financially constrained while maintaining smooth dividends.

Table C.1: . The matched sample results for sticky dividend firms. The table reports the investment-to-asset ratio for the Average Treatment Effect on the Treated (ATET) firms. Treated firms–those that hold their DPS unchanged from 2007 to 2009–are matched with firms that did not pay dividends for the period 2007–2009. Treated firms are matched according to the Fama–French 12 industry classification, firm size (lagged ln(Assets)), lagged market-to-book ratio, lagged leverage (total debt divided by total assets) and lagged asset tangibility (net PPE over total assets). Treated firms are exactly matched along industry classification, while the (Mahalanobis) distance between the treated and the matched observations with respect to their covariates (lagged size, lagged market-to-book, lagged leverage and lagged asset tangibility) is minimised and corrected for bias in the procedure with heteroskedasticity-consistent standard errors.

	Investment-to-Asset Ratio (ATET)
Sticky vs Non-sticky	-0.029**
	(-2.22)
AI Robust Std. Err.	0.013
N	706
N-Sticky	87
N-Non-Dividend Payers	619

t statistics in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Appendix D. Sample construction and variable definitions

Table D.1: . **Sample construction.** The table reports the applied data filters and the number of observations deleted under each filter to determine the final sample size.

Sample Filters	# of Observations
Compustat industrial annual files merged with the CRSP tapes for 1987-2018	145,476
Excluding firms with less than two years of data	(4,047)
Imposing the cash flow identity data requirements	(58,352)
Requiring at least ten years of non-missing cash flow data	(33,386)
The finak sample	**49,691**
Observations employed in the baseline regression after accounting for lagged controls (Table 3)	46,136
The Final Sample after imposing at least ten years of non-missing dividend history	35,550
Observations employed in the baseline regression after accounting for lagged controls (Table 4)	33,190
3,071 unique firms	
1,542 firms each year (on average)	

Variable definitions

ROA (return on assets): Income before extraordinary items (item 18) plus total interest and related expense (item 15) plus deferred taxes (item 126) over total assets (item 6).

Earnings volatility: The standard deviation of the ratio of EBITDA (item 13) to total assets over the prior ten years.

Sales growth: The annual percentage change in sales: $\text{Sales}_{it}/\text{Sales}_{it-1} - 1$ (item 117).

Leverage: The sum of short-term (item 34) and long-term (item 9) debt divided by total assets.

Asset tangibility: Net property, plant and equipment (item 8), scaled by total assets.

Dividends per share (DPS): Common dividends per share (item 26).

Earnings per share (EPS): Earnings per share (basic), excluding extraordinary items (item 58).

Payout ratio: Common dividends (item 21) divided by net income (item 18).

Dividend yield: DPS divided by the year-end share price (item 24).

Firm age: The number of years since the firm first appeared in the Compustat database.

Firm size: The natural log of book assets in constant 2010 dollar terms.

Market-to-book ratio (MB): The market value of equity (product of items 24 and 25) plus the book value of assets (item 6) minus the book value of equity, all divided by the book value of assets.

Book value of equity: Book assets minus book liabilities (item 181) minus preferred stock plus deferred taxes (item 35).

Preferred stock: The liquidation value of preferred stock (item 10) if not missing. Otherwise, the redemption value (item 56) if not missing. Otherwise, the carrying value (item 130).

Non-dividend payers: Firms that have not paid dividends (item 21 is zero) for at least 10 years during the sample period.

Dividend payers: Firms that have paid dividends (item 21 is non-zero) for at least 10 years during the sample period.

Net repurchases: Following Fama and French [2001], it is measured as the increase in common treasury stock if treasury stock is not zero or missing. If treasury stock is zero in the current and prior quarter, we measure repurchases as the difference between stock purchases and stock issuances from the statement of cash flows. If either of these amounts is negative, repurchases are set to zero.

HP index: Defined as -0.737Size + 0.043Size^2 - 0.040Age, where Size is defined as firm size and Age is defined as firm age.

WW index: Defined as -0.091 [(ib + dp)/at] - 0.062A* + 0.021[dltt/at] - 0.044 [log(at)] + 0.102[average industry sales growth, estimated separately for 49 Fama-French industry portfolios and each year] - 0.035 [sales growth]. In the original formula, A* is defined as an indicator set to one if dvc + dvp is positive and zero otherwise. We set this equal to one since we only consider dividend-paying firms.

Cash flow variables

Inv: Defined as capital expenditure (capx) + increase in investment (ivch) + acquisition (aqc) - sale of PPE (sppe) - sale of investment (siv) - change in short-term investment (ivstch) - other investing activities (ivaco).

Div: Defined as cash dividends (dv).

CR: Defined as cash and cash equivalents increase/decrease (chech).

ND: Defined as long-term debt issuance (dltis) - long-term debt reduction (dltr) + changes in current debt (dlcch).

NQ: Defined as sale of common and preferred stock (sstk) - purchase of common and preferred stock (prstkc).

Δ***WC:*** Defined as negative change in accounts receivable (recch) - change in inventory (invch) - change in accounts payable (apalch) - accrued income taxes (txach) - other changes in assets and liabilities (aoloch) - other financing activities (fiao).

CF: Defined as income before extra items (ibc) + extra items & discontinued operations (xidoc) + depreciation & amortization (dpc) + deferred taxes (txdc) + equity in net loss (esubc) + gains in sale of PPE & investment (sppiv) + other funds from operations (fopo) + exchange rate effect (exre) - ΔWC.

Tpay: Defined as dividends common/ordinary (dvc) plus purchase of common and preferred stock (prstkc).

NQ^{Adj}***:*** Defined as sale of common and preferred stock (sstk).