The Sensitivity of Cash Saving to the Cost of Capital*

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Abstract

We show that in the presence of a time-varying cost of capital (COC), firms save from external capital when the firm-specific COC is low to hedge against future underinvestment risks associated with a higher COC. This hedging motive drives the sensitivity of cash saving to the COC in both financially constrained and currently unconstrained firms. This sensitivity is especially pronounced among firms that face a higher COC when in need of external finance. Firms with high hedging motives issue excess capital to save cash when the COC is lower and use cash savings for future investment.

Key Words: Hedging, Precautionary motive, Market timing, Financial Constraint, Slack.

JEL Classification: G32; G35

1. Introduction

It is commonly assumed in corporate finance literature that financially constrained firms save from internal cash flows by comparing the marginal profitability of current and future investments, while the cash saving policies of unconstrained firms are indeterminate. In contrast, we document that both constrained and currently unconstrained firms save more from external capital than from internal cash flows. Additionally, firms use saved cash to make investments when facing a higher cost of capital (COC) (Bäuning et al., 2023). Since external capital is an important source of financing for investment, firms build cash reserves in a manner that lowers the *overall* COC—averaged over time—for their investment opportunities. We demonstrate that although raising external capital may be costly, firms save cash from external capital issuance when the COC is relatively low in order to use it when facing a higher COC for future investments and to mitigate the risk of underinvestment when the COC turns out to be high, thereby reducing the overall COC. We refer to this incentive as "hedging motive", which is most pronounced in firms that tend to face a higher COC when having greater external capital needs. Under uncertainty about COC and investment opportunities, this hedging motive drives the sensitivity of cash saving to the COC for *both* financially constrained and (currently) unconstrained firms.

We measure a firm's time-varying COC by its weighted average cost of capital (WACC) based on its debt to equity ratio and the costs of equity and debt. Our focus on WACC is driven by survey evidence showing that most firms base their decisions on WACC and regularly re-estimate their WACC in response to market dynamics (Zenner et al., 2014). The cost of equity (COE) is estimated by the implied required rate of return which is obtained by equating the stock price to the present value of future cash flow forecasts. This implied cost of capital (ICC) approach is used to estimate the COE since previous studies find that the ICC approach outperforms the CAPM and multi-factor models, in measuring the required rate of return both in time series and cross-sectional analyses (Frank and Shen, 2016; Hommel, Landier, and Thesmar, 2023). The cost of debt (COD) is estimated as the actual yield on the debt carried by the firm.[1] We then examine the impacts of the time-varying cost of capital, as well as the cross-sectional differences in firms' hedging needs, on their cash saving decisions.

We measure a firm's hedging motive as the time-series regression coefficient of the firm's external finance needs on the COC based on several standard proxies of external finance needs used in the literature.[2] A high value of the coefficient indicates that the firm faces a higher COC when it needs more external capital, i.e., a high hedging motive. Consistent with our hypothesis, we find that firms' cash saving from external capital is more sensitive to the COC when their hedging needs are greater; such firms issue significantly more external capital in excess of their current financial needs to save as cash when the COC is relatively low. We also show that future investment needs influence the sensitivity of cash saving to the COC, especially in firms with a strong hedging motive. These findings support our novel perspective that firms with high hedging motives save cash from external capital to hedge their future investments against a high COC.[3]

To address the endogeneity concern that cash saving may itself affect the COC or the relationship may be driven by other economic factors, we adopt two identification strategies. The first is to use the Regulation Fair Disclosure (Reg FD) in 2000 as a shock to the COC. The purpose of Reg FD

[1]Our approaches to estimate the COE and the COD have been widely used in the literature. Claus and Thomas (2001) and Fama and French (2002) use the ICC to measure the equity premium; Li, Ng, and Swaminathan (2013) and Lee, So, and Wang (2021) use the ICC to predict stock market return; and Burgstahler, Hail, and Leuz (2006), Botosan and Plumlee (2005), Hughes, Liu, and Liu (2009) Frank and Shen (2016), Xu (2020), and Byoun and Wu (2020) use the ICC to estimate the COE. The COD is estimated using the same measure applied in Frank and Shen (2016) and Xu (2020).

[2]We use three proxies to capture firms' needs for external capital: external finance needs (Shyam-Sunder and Myers (1999), Frank and Goyal (2003), and Byoun (2008)), external finance dependence (Rajan and Zingales (1998)), and the revised KZ index (Baker et al. (2003)).

[3]Our results are also robust to alternative COC measures, adjustments for potential measurement errors, and different sample periods.

is to prevent public companies from selectively disclosing material nonpublic information to certain parties without simultaneously disclosing the information to the general public. Reg FD reduced the COC by leveling the information-playing field, especially among firms that are more prone to selective disclosure prior to the regulation (Chen et al., 2010).

To exploit the cross-sectional variation in the impact of Reg FD on the COC, we define treatment and control firms based on the market-to-book ratio and R&D ratio before Reg FD because previous studies show that firms with greater growth opportunities are more likely to disclose material information privately to selected investors (Gintschel and Markov (2004) and Hutton (2005)). Our results show that treatment firms experience significantly greater decline in the COC, especially COE, and exhibit increased cash saving from external capital after Reg FD relative to control firms. As a result of the lower COC following Reg FD, treatment firms issue more external capital in excess of their current financial needs and increase their cash savings more in the presence of future investment than control firms. Moreover, these treatment effects are only significant among firms with high hedging motives. We also verify that pre-existing divergent trends cannot explain our results and additional placebo tests suggest that our results are more likely to be driven by changes in the COC following Reg FD rather than by unobservable omitted factors such as investment opportunities. Additionally, the inclusion of firm fixed effects helps control for time-invariant unobserved factors that affect firms' cash saving decisions and year fixed effects control for economic conditions affecting all firms in a given year.

Secondly, we use the unified monetary policy shock measure developed by Bu, Rogers, and Wu (2021) to capture plausibly exogenous shocks to the COC. Treatment and control firms are defined based on the cross-sectional differences in exposure to monetary policy shocks. The exposure is measured by the monetary policy exposure (MPE) index developed by Ozdagli and Velikov (2020), which is constructed using observable firm characteristics that capture the effects of various monetary policy transmission mechanisms documented in the literature. We show that contractionary monetary policy shocks increase the COC significantly more for firms with more exposure to monetary policy shocks (treatment firms) than for those with less exposure (control firms). Moreover, following the increased COC stemming from monetary policy shocks, treatment firms with high hedging motives save significantly less from external capital relative to those with less hedging motives. Furthermore, the negative effects of contractionary monetary policy shocks on external capital issuance in excess of their current financial needs and cash saving for future investment are particularly pronounced among treatment firms with high hedging motives. These results provide further evidence that firms with high hedging motives are particularly sensitive to COC shocks.

We also find that financially constrained and (currently) unconstrained firms *both* save more in response to a low COC. These are interesting results because in an important contribution, Almeida et al. (2004) model and show empirically that financially constrained firms save from internal cash flows to mitigate underinvestment due to financial constraints. Our findings suggest that firms save not only from internal cash flows to mitigate the effect of financial constraints, but also from external capital in order to hedge against higher financing costs for future investments. Thus, in the presence of a time-varying COC, *both* constrained and unconstrained firms are affected by the hedging motive.

Finally, the hedging motive explains the sensitivity of cash saving to the COC independently from market timing or precautionary motives. The market timing motive suggests that firms save from equity issuance proceeds to take advantage of overvalued stock (Kim and Weisbach (2008) and Bates et al. (2009)). Market timing of equity issuances is not necessarily motivated by future investments as pointed out by Bolton et al. (2013). The purpose of precautionary saving is to insulate firms from external finance by saving from internal cash flows (Keynes, 1936), especially for financially constrained firms. Our evidence reiterates the conclusions of DeAngelo, DeAngelo, and Stulz (2010) and Dittmar, Duchin, and Harford (2019) that neither market timing nor the precautionary motive alone can fully explain firms' cash saving behavior.

2. Related Literature

The literature has offered several explanations for firms' cash holdings, including macroeconomic conditions (Graham and Leary (2018)), agency conflicts (Jensen (1986), Dittmar et al. (2003); Dittmar and Mahrt-Smith (2007), Harford et al. (2008), and Nikoloo and Whited (2014)), tax considerations (Foley et al. (2007), Harford et al. (2017), and Faulkender et al. (2019)), product market competition (Fresard (2010)), diversification (Duchin (2010)), refinancing risk (Harford et al. (2014)), and leverage (DeAngelo et al. (2021)). While most studies focus on the level of cash holdings, we focus on explaining firms' cash saving behavior (changes in cash). Our study contributes to the literature by demonstrating the importance of the hedging motive for corporate cash saving from external capital in the presence of time-varying COC.

Kim and Weisbach (2008) suggest that firms' saving from equity issuance reflect the market timing motive to take advantage of overvalued stocks, while McLean (2011) finds that equity proceeds are an important source of cash saving for the precautionary motive. We propose a hedging motive for cash saving from external capital where firms consider both the time-variation in COC and future financing needs for investments when making current cash saving and external financing decisions. This hedging motive might help explain the finding of DeAngelo et al. (2010) that most firms with attractive market timing opportunities fail to issue stocks and that many mature firms without apparent financial difficulties and hence with low precautionary motive issue equity to save.

Our study is also related to Azar, Kagy, and Schmalz (2016) who suggest that the cost of carry for cash holdings, which depends on the risk-free interest rate, is an important factor explaining the trend in corporate cash holdings over time. However, Gao, Whited, and Zhang (2021) find a hump-shaped relationship between cash holdings and interest rates. They suggest that firms' precautionary cash demand is non-monotonically correlated with interest rates and that interest rates are unlikely to explain the recent rise in corporate cash holdings.[4] Morck et al. (1990) and Baker et al. (2003) suggest that the COC is the key channel through which financial markets affect corporate decisions. To the best of our knowledge, our study is the first to employ the time-varying firm-level COC, which reflects movements in stock prices and interest rates, to provide direct evidence for the impact of the time-varying COC on cash saving from external capital.[5]

Recently, Huang and Ritter (2020) and Denis and McKeon (2021) show that firms' debt and equity financing decisions are driven by the expected cash needs rather than by the volatility of cash flows as suggested by the precautionary motive. These firms' financing decisions are consistent with our hedging motive in that firms save from external financing for future external financing needs. Dittmar et al. (2019) maintain that the existing theories fail to explain most within-firm variation in cash savings. Our study shows that the variation in cash savings is sensitive to the within-firm variation of the COC.

We also extend the literature on the effects of financial constraints on cash savings. Almeida et al. (2004) suggest that the cash flow sensitivity of cash captures the effect of financial constraints. Riddick and Whited (2009) challenge this interpretation by showing that financially constrained

[4]Unlike Azar, Kagy, and Schmalz (2016), who estimate a weighted regression with the sum of each firm's total assets as weights, Gao, Whited, and Zhang (2021) estimate an unweighted regression that includes a squared interest rate term to account for the hump-shaped relationship between cash and the interest rate.

[5]Myers (1984) suggests that if information asymmetry disappears from time to time, then firms may issue equity to accumulate financial slack (cash and reserved borrowing power) before it reappears. However, he adds the following footnote: "this observation is probably not much practical help, however, because we lack an objective proxy for changes in the degree of asymmetry" (p. 590). We extend his intuition by considering theoretically and empirically the time-varying COC which reflects the variations in market frictions including asymmetric information.

firms' cash savings and cash flows can be negatively related because firms reduce cash to increase investment after receiving positive cash flow shocks. The continuous-time model developed in Bolton et al. (2013) demonstrates that financially constrained firms respond to fluctuations in financing conditions such as the probability of a crisis by adjusting cash, payout, and investment decisions for a precautionary motive, and by timing equity markets even without immediate funding needs when firms have low cash holdings. We propose that constrained and (presently) unconstrained firms trade off between not only current and future investments but also the current and future costs of capital in accessing external capital so as to hedge against higher financing costs for future investments. Acharya, Almeida, and Campello (2007) show that financially constrained firms' preference for cash saving from internal funds over preserving debt capacity depends on their need to hedge investment opportunities against income shortfalls. Our hedging motive is distinct from theirs because we consider cash saving from external capital (especially equity) in response to the COC.

Finally, Eisfeldt and Muir (2016) find a positive correlation between aggregate external financing and savings waves. We focus on firm-level analyses to explain cash saving from external capital driven by the hedging motive. Our cross-sectional evidence that firms with high hedging motives save cash from external capital when the COC is lower not only validates the premise of Eisfeldt and Muir (2016), but also identifies the underlying mechanism for such firm behavior, viz. optimizing the COC over time and reducing the risk of underinvestment when the COC turns out to be high.

3. Hedging Motive Hypotheses

We start with a basic example that illustrates the essential elements of our theory. Specifically, we examine the optimal cash-saving policy of a firm that anticipates growth opportunities in the future and faces a time-varying cost of capital. Suppose the firm has \$100 in pledgable cash flows at date 2 and an investment opportunity of size \$50 at date 1, which yields a return of 21% between date 1 and date 2. If the COC at date 1, denoted as δ_1, exceeds 21%, then the firm will not find it profitable to invest at that time unless it possesses cash; otherwise, the project would yield a positive net present value (NPV).

Let us then consider a firm whose COC does exceed 21% at date 1. This situation characterizes a "hedging motive" firm. To make the investment profitable at date 1, the firm can issue external capital against date 2 cash flows at date 0 and save cash. We denote the cost of capital at date 0 for raising two-period capital, i.e., for repayment at date 2, as δ_0. In other words, to raise \$1 at date 0, the firm needs to repay external financiers $(1+\delta_0)^2$ at date 2. If δ_0 satisfies the condition $(1+\delta_0)^2 < 1.21$ (equivalently $\delta_0 < 10\%$), then it is optimal for the firm to issue external capital at date 0 and save as cash for investment needs at date 1.

To capture the firm's hedging motive more generally, we introduce a parameter γ which characterizes a positive coincidence of investment needs and a high COC. Firms at date 1 are distributed based on the value of γ, where $\delta_1 = \bar{\delta}_1(1+\gamma)$ and $\bar{\delta}_1$ is a constant determining the overall level of COC at date 1. Intuitively, a firm with a high γ has a higher COC for its investment at $t = 1$. Specifically, a firm will issue external capital at date 0 and save cash for investment at date 1 if and only if $(1+\delta_0)^2 < 1 + \bar{\delta}_1(1+\gamma)$. Define $\gamma^* \equiv [(1+\delta_0)^2 - (1+\bar{\delta}_1)]/\bar{\delta}_1$. If $\gamma \leq \gamma*$, then the firm has no hedging motive. If $\gamma > \gamma*$, then the firm does have a hedging motive.

As this simple example shows, hedging motive firm issues external capital at date 0 and saves cash even though it is not financially constrained, that is, it is able to pledge adequate cash flows from date 2 in order to fully finance the investment at date 1. In Appendix A, we generalize this example to allow for an uncertain investment opportunity at date 1 as well as a time-varying cost of capital, and formalize γ as the correlation between investment needs and the cost of capital. The model also shows that both constrained and (presently) unconstrained firms save by issuing external capital when γ, the hedging motive, is high. Specifically, we derive the following hypotheses:

Hypothesis 1a Both constrained and unconstrained firms save more from external finance when the COC is relatively low.

Hypothesis 1b Firms with high hedging motives will save more from external finance when the COC is relatively low.

Hypothesis 1c Firms with high hedging motives will issue more excess external capital when the COC is relatively low.

Hypothesis 1d Firms with high hedging motives have a higher cash saving sensitivity to the COC when they expect more future investment.

4. Data and Variables

4.1 Sample

Our initial sample includes all U.S. firms from the annual Compustat files for the 1981–2019 period. We require that firms have asset value greater than $5 million and positive values for equity, cash holdings and net sales. Financial firms (SIC codes 6000-6799) and regulated utilities (SIC codes 4900-4999) are excluded from the sample. Stock price information is obtained from the Center for Research in Security Prices (CRSP). Observations with missing net income and stock price are excluded. We obtain analysts' earnings and growth forecasts from the Institutional Brokers Estimate System (I/B/E/S). We require non-missing data for the prior year's book value, earnings, and dividends. When explicit forecasts are unavailable, we obtain forecasts by applying the long-term growth rate to the prior year's earnings forecast.

4.2 Cost of Capital

It is challenging to estimate individual firms' cost of capital because the COE and the COD are not directly observable. In light of the findings of Frank and Shen (2016) and Hommel, Landier, and Thesmar (2023), we measure the COE using the implied cost of capital (ICC) approach, which estimates the required rate of return implied by market prices.[6] Specifically, the ICC is the discount rate that equates a stock's present value of expected cash flows to its current price. According to the discounted cash flow model, the stock price of a firm at time t is given by

$$P_t = \sum_{k=1}^{\infty} \frac{E_t(FE_{t+k})}{(1 + ICC_t)^k}, \tag{1}$$

where P_t is the market value of the stock at time t, $E_t(FE_{t+k})$ is the expected free cash flow to equity at time $t + k$, and ICC_t is the implied cost of equity capital.

To estimate the cost of equity, we use three models based on analyst forecasts proposed by Gebhardt, Lee, and Swaminathan (2001), Claus and Thomas (2001), and Li, Ng, and Swaminathan (2013) and one residual income model developed by Li and Mohanram (2014). The consensus analyst forecasts from the I/B/E/S are used to predict future earnings per share. Given that firms are required to file their financial statements within 90 days of the fiscal year end, we estimate the COE using the earliest forecasts available after three months of the prior fiscal year end. As these models rely on analyst forecasts to estimate future free cash flow to equity, the estimated ICC is only available for firms with both analyst coverage and positive earnings forecasts. To circumvent this

[6] Frank and Shen (2016) show that the ICC can better reflect the time-varying required return on capital than the CAPM as a proxy for the cost of capital. Hommel et al. (2023) show that expected returns models, including various versions of the CAPM and the multi-factor model, perform poorly in measuring the discount rate, whereas the ICC performs much better.

disadvantage, we also use the approach developed in Li and Mohanram (2014) to forecast future earnings from cross-sectional residual income models. Since this approach does not use analyst forecasts, it helps mitigate the concerns about potential biases in analyst forecasts (Hoberg and Philips (2010)) and allows us to include firms with no analyst coverage and negative earnings. The specific estimation procedures are provided in Appendix D. The reported results in the tables to follow are based on the Gebhardt, Lee, and Swaminathan (2001) approach. The results are robust to the alternative COE estimation methods (see Appendix E3).

We estimate the COC as follows:

$$COC_{i,t} = \frac{Debt_{i,t}}{MVA_{i,t}} COD_{i,t}(1 - TaxRate) + (1 - \frac{Debt_{i,t}}{MVA_{i,t}})COE_{i,t}, \tag{2}$$

where $COC_{i,t}$ is the weighted average cost of capital of firm i in year t. $\frac{Debt_{it}}{MVA_{it}}$ is the market leverage ratio. $COD_{i,t}$ is the cost of debt of firm i in year t proxied by the actual yield on the debt carried by the firm as used in Frank and Shen (2016).[7] The COC of each firm is estimated for each year.

4.2.1 Hedging Motive Measures

We measure the hedging motive at firm level by the time series regression coefficient of its external capital needs on its COC.[8] We follow Shyam-Sunder and Myers (1999), Frank and Goyal (2003), and Byoun (2008) to capture firms' needs for external capital as follows:

$$ExNeeds = (Div + Acq + Inv - ICF1)/TA, \tag{3}$$

where Div is the cash dividend; Acq is acquisitions; Inv is net investments; $ICF1$ is income before extraordinary (ibc) items plus depreciation and amortization (dpc) and TA is total assets at the beginning of the period. We regress annual external capital needs of individual firm on its COC

[7] Since we are interested in variation in the COD over time and firms do not issue bonds every year, using the yields of new bond issue as a proxy for the COD is not suitable for our analysis.

[8] The hedging motive measured by the regression coefficient is consistent with γ in our theoretical framework. In an earlier version of the paper, we also measure the hedging motive based on the correlation coefficient between the COC and external capital needs. The results are similar.

over the sample period. Based on the estimated coefficient which is our hedging motive measure, we define firms in the top 30 percent as "high hedging motive firms" and those in the bottom 30 percent as "low hedging motive firms,"removing the middle 40 percent. We also use two alternative measures of hedging motives for robustness check (reported in Appendix Table E3 Panel D).

5. Empirical Analysis

5.1 Univariate Analysis

The summary statistics of the firm characteristic variables and the COC are reported in Panel A of Table 1. The average cash holding is 12.72% of total assets and the cash saving rate is approximately 1.57% of total assets. The average COC is 10.11%, with an average COE of 12.2% and an average COD of 6.78%.[9] Panel B shows the decomposition of the standard deviation of the COC across firms and over time. As expected, the COD exhibits less variation than the COE across firms and over time. The COE varies much more over time than across firms. In Panel C, we compare standard deviation of the COE, COD, and COC over time between high and low hedging motive firms. The COC of firms with high hedging motives fluctuate more over time than that of firms with low hedging motive.

Figure 1 plots cash holdings as percentage of total assets and the annual average COC for all sample firms over the sample period. The inverse relationship suggests that firms increase (decrease) cash when the COC is low (high). To examine how the variation in the COC relates to corporate cash saving, we obtain a firm's COC minus its historical average for firms with a minimum of 3 years of data. Panel A of Figure 2 plots cash saving across deciles of the deviation of COC from

[9] The estimated COE is comparable to the estimates in the literature. For example, Pastor et al. (2008) report that the firm-level equal-weighted implied risk premia, measured by ICC minus yield on 10-year government bond, for US firms in 1981-2002 are 4.57%.

the historical average for the sample period 1981-2019 and the subsample periods 1981-1999 and 2000-2019. The downward-sloping graphs indicate that firms save more when the COC is lower relative to the historical average. Panel B presents cash saving across deciles of the deviation of COC from the historical average separately for high and low hedging motive firms. The figure shows that cash saving of high hedging motive firms is particularly sensitive to the variation in the COC. The sensitivity of cash saving to the variation in the COC is weaker for firms with low hedging motives.

To examine whether firms' cash saving is related to future investment, Figure 3 plots the current year cash saving across future investment (subsequent two-year average) deciles. The figure shows that firms with greater future investment save more cash in the current year, which is consistent with the hedging motive view that firms save cash for future investments.

5.2 Cost of Capital and Cash Saving

To test our intermediate hypothesis that firms build cash savings from external capital, we first evaluate the relative importance of external capital to internal cash flows by estimating the following regression:

$$\Delta Cash_{it} = \lambda_0 + \lambda_1 ExCapital_{it} + \lambda_2 ICF_{it} + \lambda_3 X_{it-1} + f_i + \eta_t + \varepsilon_{it} \quad (4)$$

where $\Delta Cash_{it}$ is the change in cash and equivalents of firm i in year t; ICF_{it} is internal cash flow; and $ExCapital_{it}$ is the sum of net debt and equity issuance. Each variable is divided by total assets at the beginning of the period. X_{it-1} is a vector of control variables and f_i denotes firm fixed effects. η_t represents year fixed effects which control for the macroeconomic effects. Following Opler et al. (1999) and Bates et al. (2009), we include the following control variables: M/B_{it-1}, the market-to-book asset ratio that controls for investment opportunities; $Cash_{it-1}$, the lagged cash-to-asset ratio; Vol_{it}, cash flow volatility; $Leverage_{it-1}$, and the leverage ratio;[10] $Size_{it-1}$, the logarithm of total assets; NWC_{it}, net working capital excluding cash and equivalents divided by total assets at $t-1$; $CapEx_{it}$, capital expenditures divided by total assets at $t-1$; $Acquisitions_{it}$, acquisitions divided by total assets at $t-1$; and $Dividend_{it}$, cash dividend divided by total assets at $t-1$. We winsorize all variables at the 2 and 98 percentiles to mitigate the effects of outliers.

We first estimate the model without firm and year fixed effects. As shown in Panel A of Table E1 Column 1. the coefficient estimate of external capital ($ExCapital$) is 0.5385 and significant, whereas that of internal cash flows (ICF) is 0.4566 and significant. Column 5 shows that the standardized beta coefficient of external capital is much larger than that of internal cash flow (0.7702 versus 0.3718), indicating that external capital is a major source of firms' cash saving. As equity and debt are the two main sources of external capital, we further investigate their relative importance for firms' cash saving. Panel B of Table E1 shows that the coefficient estimate of net equity issues ($EIssue$) is 0.451 and significant, with an adjusted R^2 of 15.74%. The coefficient estimate of debt issues ($DIssue$) is a mere 0.0828, and the adjusted R^2 is 0.7%.[11] The estimated coefficient of internal cash flows (ICF) is 0.277 and statistically significant, with an adjusted R^2 of 4.31%. Overall, external equity is the most important source of cash saving.

To test our primary hypothesis concerning the impact of the COC on firms' cash saving from external capital, we include the COC and its interaction with external capital ($ExCapital$) in

[10]Previous studies show that firms with more volatile cash flows tend to hold more cash (Bates et al. (2009) and McLean (2011)). The inclusion of cash flow volatility as an independent variable helps control for the effect of the precautionary motive of cash saving. We include leverage to control for the potential effects of capital structure. Although firms may hedge by altering their capital structure, this change will only enable firms to optimize debt and equity and cannot neutralize the common component of the COE and COD.

[11]Although firms save 45 cents from every dollar of equity capital raised and approximately 8 cents from every dollar of debt issued, firms may issue debt more frequently. Following Denis and McKeon (2021), we define equity issuance and debt issuance if the annual issuance is more than 3% of lagged total assets. The average frequency of equity issuance and debt issuance is 11.85% and 28.78%, respectively, indicating a higher frequency of debt issuance. For firms that issue equity or debt, the average equity issues and debt issues scaled by lagged total assets are 17.75% and 14.71%, respectively.

equation (4). The estimation results are reported in Table 2. For brevity, we do not report the estimates of control variables. The negative and significant coefficient estimates of the COC suggest that firms save more when the COC is low. The economic magnitude of the impact is also significant. A one percent decrease in the COC is associated with an approximately 2.19% increase in cash saving. The negative and significant coefficient estimates of the interaction term between the COC and external capital ($ExCapital \times COC$) indicate that firms save significantly more from external capital when the COC is lower.

We next examine the relative importance of the COE and COD for firms' cash saving by including the interaction terms between the COE (COD) and net equity issuance proceeds (net debt issuance proceeds) in our regression model. As shown in Table 2 Column 2, both the coefficient estimates of COE and COD are negative and significant, indicating that firms save less when the cost of equity or the cost of debt increases. However, the coefficient estimate of $Eissue \times COE$ is negative and significant, whereas the coefficient estimate of $Dissue \times COD$ is insignificant. These results suggest that firms' cash saving from external capital is more sensitive to the COE than the COD.

5.3 Financial Constraints

The precautionary motive suggests that financially constrained firms can avoid external financing by saving cash from internal cash flows (Almeida et al. (2004) and Bates et al. (2009)). Acharya et al. (2007) suggests that financially constrained firms save cash to hedge against income shortfalls. Given the importance of financial constraints in firms' cash saving decisions, we investigate whether financial constraints explain the sensitivity of cash saving to the COC. Our hypothesis is that both financially constrained and presently unconstrained firms save when the COC is low to hedge against higher future COC (hypothesis 1a). To test this prediction, we follow previous studies to use credit ratings and the HP index (Hadlock and Pierce (2010)) to define financially constrained and unconstrained firms.[12] Financially constrained (unconstrained) firms are defined as firms without (with) credit ratings or firms in the top (bottom) 30 percent of the HP index.

The results presented in Table 3 show that the coefficients on the COC are all negative and significant, indicating that both financially constrained and unconstrained firms save more when the COC is relatively low. The coefficients of $ExCapital$ and ICF indicate that both constrained and unconstrained firms save more from external capital than from internal cash flows. The estimated coefficients of $ExCapital \times COC$ are also negative and statistically as well as economically significant for both constrained and unconstrained firms. When $ExCapital \times COC$ decreases by one standard deviation, the cash saving of financially unconstrained (constrained) firms based on the HP index increases by 7.49% (10.73%). These results are consistent with hypothesis 1a and suggest that the time-varying COC is an important consideration for cash saving decisions of *both* constrained and unconstrained firms.

5.4 Hedging Motive

Next, we test the hedging motive hypothesis that firms with a high correlation between their COC and external financing needs (high hedging motive) have greater incentives to raise external capital and save cash at a relatively low COC. As noted in Figure 2 Panel B, firms with high hedging motives save more cash when their COC is lower relative to its historical mean, whereas such a downward-sloping relationship is much weaker for firms with low hedging motives. We formally test below the hedging motive hypotheses 1b, 1c, and 1d.

[12] Another financial constraint measure is that developed by Hoberg and Maksimovic (2015), which identifies constrained firms based on textual analysis of firms' annual reports. Since this measure is only available for 1997-2015, we do not use it as one of the main measures of financial constraints.

5.4.1 Hedging Motive and Cash Saving

To test hypothesis 1b that firms with high hedging motives save more from external capital when the COC is relatively low, we examine whether the sensitivity of cash saving to the COC is more pronounced among firms with high hedging motives. We divide the sample into high and low hedging motive firms based on the hedging motive measure and report the results in Panel A of Table 4. The coefficient estimate of the interaction term between external finance and the COC ($ExCapital \times COC$) is significant and negative only among high hedging motive firms, indicating that firms with greater hedging motives save more from external capital when the COC is relatively low. Moreover, the difference in the coefficients of $ExCapital \times COC$ between high and low hedging motive firms is statistically significant (p-value of 0).[13]

5.4.2 Hedging Motive and Excess Capital Issuance

According to hypothesis 1c, firms with greater hedging motives issue excess capital when the COC is relatively low. To test this prediction, we define *excess capital issuance* as net external capital issues minus financial deficit, which represents the portion of external capital saved as cash. We regress excess capital issuance on the COC while controlling for firm characteristics, firm fixed effects and year fixed effects. As shown in Panel B of Table 4, the coefficient estimate of the COC is negative and significant only for firms with high hedging motives, which suggests that high hedging motive firms issue more external capital in excess of current financial needs when the COC is lower. The results are thus consistent with hypothesis 1c.

[13] We test the difference in the coefficients between high and low hedging motive firms by interacting a dummy variable, which equals one for high hedging motive firms and zero otherwise, with all variables including fixed effects in the regression.

5.4.3 Future Investment and Cash Savings

To test hypothesis 1d that firms with high hedging motives save cash from external capital to fund future investments, we estimate the following regression:

$$\Delta Cash_{it} = \alpha_0 + \alpha_1 FInvestment_{it} + \alpha_2 COC_{it} + \alpha_3 FInvestment_{it} \times COC_{it} + \alpha_4 ICF_{it}$$

$$+ \alpha_5 X_{it-1} + f_i + \eta_t + \varepsilon_{it} \tag{5}$$

where $FInvestment_{it}$ is the future investment at time t of firm i, defined as the average of investment scaled by lagged total assets in the subsequent two years.[14] The same set of control variables in equation (4) and ICF are included to control for the effects of other factors on cash saving. We estimate equation (5) separately for firms with high and low hedging motives. Since the incentive to save cash from external capital for future expected investment will be greater when facing a relatively low COC, we expect α_3 to have a negative sign, especially for firms with high hedging motives. Table 4 Panel C reports the results for high and low hedging motive firms. The coefficient estimate of the interaction term between future investment and COC ($FInvestment \times COC$) is negative and significant only for high hedging motive firms, which is consistent with hypothesis 1d.

6. Shocks to the COC

An endogeneity concern may arise if firms' cash saving affects their COC or if other confounding factors drive the observed relationship. To ease this concern, we exploit two plausibly exogenous events that affect firms' COC to examine whether high hedging motive firms' cash saving from external capital is particularly sensitive to the COC.

[14] Realized future investment will of course be positively correlated with managers' ex-ante expected investment. The use of realized future investment for expected investment is, however, consistent with the use of future stock returns for expected stock returns in previous studies (Baker et al. (2003) and DeAngelo et al. (2010)).

6.1 Regulation Fair Disclosure (Reg FD)

In the first quasi-experiment, we use Reg FD as a shock to the COC and investigate whether firms experiencing a greater reduction in their COC during the post-Reg FD period save more from external capital than firms experiencing a smaller reduction in their COC. Reg FD, which was implemented on October 23, 2000, prohibits the selective disclosure of material information to a subset of market participants, such as analysts and institutional investors, without simultaneously disclosing such information to the public. The Securities and Exchange Commission (SEC) believed that Reg FD would encourage investor participation in capital markets by curtailing the practice of selective information disclosure, thereby lowering the COC. Such reduction in the COC caused by Reg FD is considered exogenous to individual firm fundamentals (Chen et al. (2010)).

Prior studies suggest that the effects of selective disclosure before Reg FD is more pronounced for firms with high market-to-book ratio, since these firms face greater growth opportunities and are more difficult to value and more likely to disclose material information privately to selected investors (Gintschel and Markov (2004), and Hutton (2005)). Accordingly, we use the M/B ratio to classify firms into treatment and control groups. Specifically, treatment and control firms are defined as the top and bottom 30% ranked by the M/B ratio in 1999, respectively. As a robustness check, we also use R&D before the implementation of Reg FD as an alternative criterion to construct treatment and control groups, since previous studies show that firms with more R&D investments are more likely to engage in selective disclosure. These robustness results are reported in Table E2. We set the $Post$ dummy to one for 2000-2003 and zero for 1996-1999.

We first verify whether treatment firms experience a greater decrease in their COC than control firms following Reg FD. Panel A of Table 5 reports the results. The coefficient estimates of $Treated \times Post$ are negative and significant in all regressions, which confirms that treatment firms have a larger drop in the COE, COD, and COC after Reg FD. The COC of treatment firms following Reg FD is decreased by 2.38% lower than that of control firms, which is economically significant.

We next examine whether treatment firms save more from external capital than control firms in the post-Reg FD period as the consequence of reduced COC. Column 1 in Panel B of Table 5 shows that the coefficient estimate of triple interaction term $Treated \times ExCapital \times Post$ is positive and significant, indicating that cash saving from external capital increases significantly among treatment firms relative to control firms following Reg FD.[15] Cash saving from external capital by treatment firms after Reg FD is 30.93% higher than that by control firms.

To address the concern that the results may be due to other confounding factors such as growth opportunities, we also conduct placebo tests based on fictitious event years of 1992 and 2013. The sample period is 8 years surrounding the fictitious event year. If other observed or unobserved factors drive the different sensitivities of cash saving to the COC between control and treatment firms, we should observe similar results in the absence of the shock to the COC. Columns 2 and 3 of Panel B report the results of the placebo tests showing that the coefficient estimates of $Treated \times ExCapital \times Post$ are insignificant, indicating that treatment firms do not save more from external capital when not experiencing a decrease in the COC. Thus, our results are unique to Reg FD and unlikely due to other confounding factors. These findings increase our confidence that the COC affects firms' cash saving from external capital.

It is also possible that the above results simply capture pre-existing divergent trends or differences between treatment and control groups that are unrelated to the shock to the COC. To explore this possibility, we investigate the dynamics of firms' cash saving from external capital sur-

[15]Since Reg FD was implemented during the period of tech bubble, one may be concerned that the results might be driven by high-tech firms. To address this concern, we exclude firms in high-tech industries and find similar results, which are shown in Table E2. High-tech industries (3-digit SIC codes 283, 357, 366, 367, 382, 384, 737) are classified following Brown et al. (2009).

rounding the shock. If this alternative explanation holds true, we should observe more cash saving from external capital by the treatment firms prior to Reg FD. To test this possibility, we replace *Post* with year indicator variables associated with the years surrounding Reg FD. Figure 4 presents the coefficient estimates of the triple interaction term $Treated \times ExCapital \times Year$ with the 90% confidence interval. As shown in the figure, the differences in the sensitivities of cash saving to external capital between treatment and control groups were close to zero before Reg FD. However, treatment firms' cash saving from external capital became significantly higher than that of control firms after Reg FD.

We now test the hypotheses 1b, 1c, and 1d in the setting of Reg FD by dividing the Reg FD sample into high and low hedging motive firms based on the hedging motive measure. As shown in Table 6 Panel A, the coefficient estimate of $Treated \times ExCapital \times Post$ is significant only for firms with high hedging motives, indicating that firms with high hedging motive that experience a larger decline in the COC after Reg FD save more from external capital than control firms. These results provide support for hypothesis 1b that firms with high hedging motives save more when the COC is relatively low.

We also use the Reg FD sample to test whether treated firms with high hedging motive issue more excess capital than firms with low hedging motive after Reg FD. In Panel B, the results show that the coefficient estimate of $Treated \times Post$ is significant only for firms with high hedging motives. These results are consistent with hypothesis 1c that firms with high hedging motives issue excess external capital to save when the COC is lower.

Moreover, we test whether future investment affects firms' current cash saving for firms with high hedging motives. As shown in Table 6 Panel C, the coefficient of $Treated \times Post \times FInvestment$ is positive and significant only for firms with high hedging motives. These results are consistent with hypothesis 1d that future investment affects high hedging motive firms' incentives to save more from external capital when the COC is lower.

6.2 Monetary Policy Shocks

Previous studies show that monetary policy shocks affect the COC by influencing equity premia, term premia, and credit spreads (Bernanke and Kuttner, 2005; Savor and Wilson, 2013; Gertler and Karadi, 2015; Hanson and Stein, 2015; Lucca and Moench, 2015). A more positive monetary policy shock reflects a tighter monetary policy, which should raise the overall financing costs. Using monetary policy shocks as exogenous shocks to the firm-level COC, we examine how these shocks affect cash saving from external capital across firms with different monetary policy exposures.

We employ the methodology developed by Bu, Rogers, and Wu (2021) which applies Fama and MacBeth (1973) two-step regressions to estimate unobservable monetary policy shocks. In the first step, time-series regressions are run to estimate the sensitivities (betas) of one- to thirty-year interest rate changes to Federal Open Market Committee (FOMC) announcements. In the second step, a cross-sectional regression of interest rate changes across different maturities against the corresponding estimated betas obtained from the first step is estimated for each year to recover the aligned monetary policy shock. The series of estimated coefficients obtained from the second-step regression represents the monetary policy shock series. As demonstrated in Bu et al. (2021), this monetary policy shock series is not only largely unpredictable based on the available economic information, but also contains no significant central bank information effect.

The literature suggests that the impacts of monetary policy shocks on firms' COC depend on firms' exposure to monetary policy, which goes beyond simple adjustments to the risk-free rate (Ippolito et al., 2018; Ozdagli and Velikov, 2020). Firms with different characteristics react differently to monetary policy. To capture this, Ozdagli and Velikov (2020) develop a monetary policy exposure (MPE) index based on observable firm characteristics that previous studies link to monetary policy. These firm characteristics capture the effects of various monetary policy transmission mechanisms documented in the literature, including the credit channel, balance sheet liquidity, the discount rate effect, and nominal rigidities. They show that this MPE index captures the multidimensional nature of the cross-sectional variation in policy sensitivity and outperforms other methods of estimating monetary policy exposure. Following their study, we construct the MPE index as follows:

$$\begin{aligned} MPE = & - 1.60 \times WW - 0.87 \times Cash + 0.63 \times CF\text{Duration} \\ & + 4.36 \times CF\text{Volatility} - 5.74 \times \text{Operating Profitability}, \end{aligned} \tag{6}$$

where WW is the WW index. Cash, CF Duration, CF Volatility, and Operating Profitability capture a firm's liquid assets, expected duration of cash flows, cash flow volatility, and profitability, respectively. We define *Treated* as a dummy variable that equals one (zero) if a firm has an MPE index in the top (bottom) tercile.

We first investigate whether monetary policy shocks have differential effects on external financing costs of treated firms than on those of control firms. Table 7 Panel A shows that the coefficient estimates on $Treated \times Shock$ are positive and significant for both COD and COC, indicating that firms with more exposure to contractionary monetary policy shocks experience a greater increase in their external financing costs relative to those with less exposure.

We then examine the impacts of monetary policy shocks on firms' cash saving from external capital by estimating the following regression model:

$$\begin{aligned}\Delta Cash_{it} &= \lambda_0 + \lambda_1 Treated_{it} + \lambda_2 Treated_{it} \times ExCapital_{it} + \lambda_4 Treated_{it} \times Shock_t \\ &+ \lambda_5 ExCapital_{it} \times Shock_t + \lambda_6 Treated_{it} \times ExCapital_{it} \times Shock_t \\ &+ \lambda_7 ExCapital_{it} + \lambda_8 ICF_{it} + \lambda_9 X_{it-1} + f_i + \eta_t + \varepsilon_{it} \qquad (7)\end{aligned}$$

where $Shock$ is a dummy variable that equals one if the average monetary policy shock over a year is above the mean and zero otherwise; X_{it-1} contains a set of control variables as defined previously; and f_i and η_t are firm and year fixed effects, respectively.

The estimation results are reported in Table 7 Panel B.[16] In Column 1, the coefficient estimate of $Treated \times ExCapital$ is positive and significant, indicating that firms with more exposure to monetary policy shocks save more from external capital than firms with less exposure. The variable of interest is $Treated \times ExCapital \times Shock$. The negative and significant coefficient estimate suggests that contractionary monetary policy shocks which increase the COC lead to less cash saving from external capital by firms with greater exposure to monetary policy shocks relative to firms with less exposure.

A potential concern is that these results might be influenced by other differences between firms with high and low exposures to monetary policy shocks. To ease this concern, we conduct falsification tests to verify whether our results remain the same in the absence of a shock to the COC. If the observed effects stem from other confounding factors, then we should observe similar results even without monetary policy shocks. Columns 2 and 3 of Panel B report the results of placebo tests based on randomly generated monetary policy shocks from the standard normal distribution. The

[16]Since the monetary policy shock measure of Bu et al. (2021) is available from 1994 when the Fed started releasing public statements about monetary policy decisions, the analysis in this section is restricted to this period.

coefficients of $Treated \times ExCapital \times Shock$ are insignificant, indicating that there is no significant difference in cash saving from external capital between firms with more and less exposures when there are no shocks to COC. Thus, the treatment effects are attributable to the effects of monetary policy shocks to the COC.

In Table 8, we conduct tests for the effects of monetary policy shocks on cash saving, excess external capital issuance, and cash saving for future investment, conditional on hedging motives. In Panel A for cash saving, the coefficient estimate of $Treated \times ExCapital \times Shock$ is negative and significant only for high hedging motive firms, suggesting that more contractionary monetary policy, which increases the COC, induces high hedging motive firms to reduce cash saving. However, we do not find similar effects for firms with low hedging motives, as evidenced by the insignificant coefficient estimate of $Treated \times ExCapital \times Shock$. In Panel B for excess capital issuance, the coefficient estimate of $Treated \times Shock$ is negative and significant only for high hedging motive firms, suggesting that higher hedging motive firms reduce excess external capital issuance when facing tighter monetary policy. Thus, our results suggest that high hedging motive firms save less from external capital in response to unexpected increases in the COC stemming from monetary policy shocks. In Panel C for the cash saving for future investment, the coefficient estimates of $Treated \times Shock \times Finvestment$ is negative and significant only for high hedging motive firms, which is also consistent with the view that future investment affects high hedging motive firms' incentives to save cash from external capital in response to shocks to the COC.

6.3 Robustness

Although we show that the COC has a significant impact on cash saving from external capital in the quasi-natural experiment settings, an endogeneity concern may still exist due to measurement errors in the COC. As a remedy for measurement errors in the COC, we estimate the model using high-order cumulants as suggested by Erickson et al. (2014). Table E3 in Appendix E reports the estimation results. The coefficient estimates of the interaction between external capital and the COC in Panel A are negative and significant for high hedging motive firms but insignificant for lower hedging motive firms (Columns 1 and 2). These results are consistent with those reported in previous tables.

McKeon (2015) shows that external equity issuance can be driven by employees' exercise of stock options, which is unlikely to reveal managers' motives to raise external capital. To control for the effects of such employee-initiated issuances, we restrict our sample to firms that raise at least 3% or 5% of external capital raised. Since the results are similar when using these two thresholds, we report the estimation results using 3% as the threshold. Columns 3 and 4 in Panel A of Table E3 show that the coefficient estimates remain negative and significant for high hedging motive firms and insignificant for low hedging motive firms, indicating that our results are not driven by employee-initiated equity issuance.

As a robustness check, we show that our results still hold after excluding high-tech industries in Columns 5 and 6 in Panel A of Table Table E3. In the Reg FD setting, we also use R&D as an alternative criterion to construct treatment and control groups and further examine whether the results based on this criterion still hold with the sample excluding high-tech industries. Table E2 shows that our results remain similar with this alternative criterion (Columns 1 and 2) and even after excluding firms in high-tech industries (Columns 3 and 4).

We also examine whether our results are robust to alternative measures of the COC by using the Claus and Thomas (2001) and Li, Ng, and Swaminathan (2013) approaches as specified in Appendix D. There may still be concerns that these models rely on analyst forecasts for future earnings that are not available for all firms and that analyst forecasts may be biased. To mitigate these concerns, we adopt an alternative approach to forecast future earnings without relying on analyst forecasts. Li and Mohanram (2014) propose the use of two cross-sectional models to estimate future earnings: the earning persistence (EP) and residual income (RI) models. They show that the RI model outperforms the cross-sectional model developed by Hou et al. (2012) and EP models in forecasting future EPS. Therefore, we use the Li and Mohanram (2014) RI model approach to forecast future EPS and estimate the implied cost of equity using the Gebhardt et al. (2001) model. The results shown in Table E3 Panel B demonstrate that our findings are robust to these alternative COC measures.

Additionally, we investigate the robustness of our results to different time periods. To this end, we partition our sample into two subperiods: 1981-1999 and 2000-2019 and perform the tests. We observe about 60 per cent of high (low) hedging motive firms in the first subperiod remain high (low) hedging motive firms in the second subperiod. As shown in Panels C of Table E3, the coefficients on $ExCapital \times COC$ remain significant and negative for firms with high hedging motives, but insignificant for firms with low hedging motives. These results indicate that our main findings are not specific to a particular sample period.

To further check the robustness of our results, we construct two additional hedging motive measures. For the first alternative hedging motive measure (Hedging Motive 1), we measure external finance following Rajan and Zingales (1998) as $External = (CapEx - OCF)/CapEx$, where $CapEx$ is capital expenditures; and OCF is the operating income before depreciation and amortization. The industry median $External$ based on the 2-digit SIC code is used as the proxy for external capital needs. To construct the second alternative hedging motive measure (Hedging Motive 2), we follow Baker, Stein, and Wurgler (2003) and use the revised KZ index to measure external finance dependence as follows: $KZ = -1.002CF - 39.368DIV - 1.315CASH + 3.139LEV$, where CF is the operating cash flow before depreciation and amortization divided by net property, plant and equipment at the beginning of the period (PPE); DIV is cash dividend divided by PPE; $CASH$ is cash and equivalents divided by PPE; and LEV is long-term debt divided by long-term debt plus total equity. To measure hedging motive, we obtain annual external capital needs and compute their regression coefficients on individual firms' COC over the sample period. Table E3 Panel D shows that the coefficient estimates of $ExCapital \times COC$ remain significant and negative for firms with high hedging motives, but insignificant for firms with low hedging motives. Thus, our results are robust to alternative hedging motive measures.

Finally, we discuss alternative theories potentially explaining the sensitivity of cash saving to the COC in Appendix Section C. The results in Table E4 of Appendix E indicate that the sensitivity of cash saving to the time-varying COC cannot be fully explained by alternative theories such as the Acharya et al. (2007) hedging perspective (Panel A), the market timing motive (Panel B), the precautionary motive (Panel C), or the joint market timing and precautionary motives (Bolton et al. (2013)) (Panels D and E). These results suggest that our findings cannot be explained by simply intersecting the market timing and precautionary motives. Moreover, the sensitivity of cash saving to the COC is particularly pronounced for high hedging motive firms regardless of credit risk (Panel F) and agency risk (Panel G).

7. Conclusions and Discussions

We hypothesize that in the presence of a time-varying COC, firms channel funds into future states with a high COC by saving cash from external capital when the current COC is relatively low. Such intertemporal smoothing of the COC matters because a higher future COC could impose financial constraints, even if firms face no immediate constraints. When a firm expects a higher COC for future investments, it will increase cash saving from external capital at a low cost to lower the *overall* COC. The time-varying COC induces firms to hedge future investments against higher COC. Accordingly, cash saving and excess external financing should show a greater sensitivity to the COC for firms with greater hedging needs.

Consistent with these hypotheses, we find that both financially constrained and (presently) unconstrained firms save more cash from external capital when the COC is relatively low. The cash saving of firms with greater hedging needs is particularly sensitive to the COC. Firms with greater hedging needs tend to issue excess external capital to save when the COC is relatively low. Firms expecting greater future investment and having greater hedging needs save more when they face a lower COC. Moreover, the impact of the COE on firms' cash saving from equity issuance is stronger than the impact of the COD on cash saving from debt issuance. Finally, the sensitivity of cash saving to the COC cannot be fully explained by other alternative motives.

In summary, our study illustrates that firms' hedging motive to transfer funds from a low COC state to a higher COC state through cash saving is an important consideration for corporate cash saving policies. Previous studies show that credit lines also play an important role in firms' liquidity and risk management (Sufi (2009) and Acharya et al. (2014)). How the time-varying COC affects firms' choice between cash and credit lines is an interesting issue. Extending our suty to answer this question seems a fruitful area for future research.

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Figure 1: Cash Holdings versus Cost of Capital

This Figure shows the scatter plot between annual average cash holdings as percentage of total assets and the COC. Cash is cash and equivalents divided by total assets.

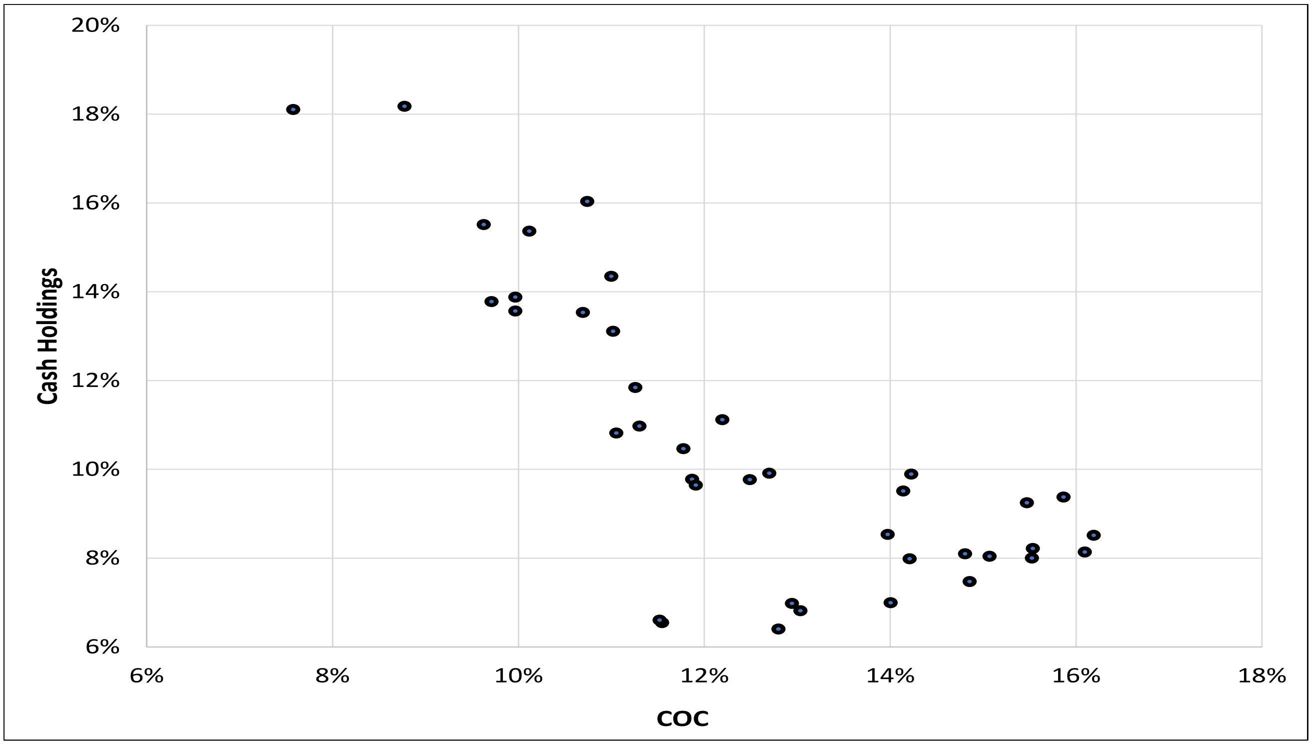
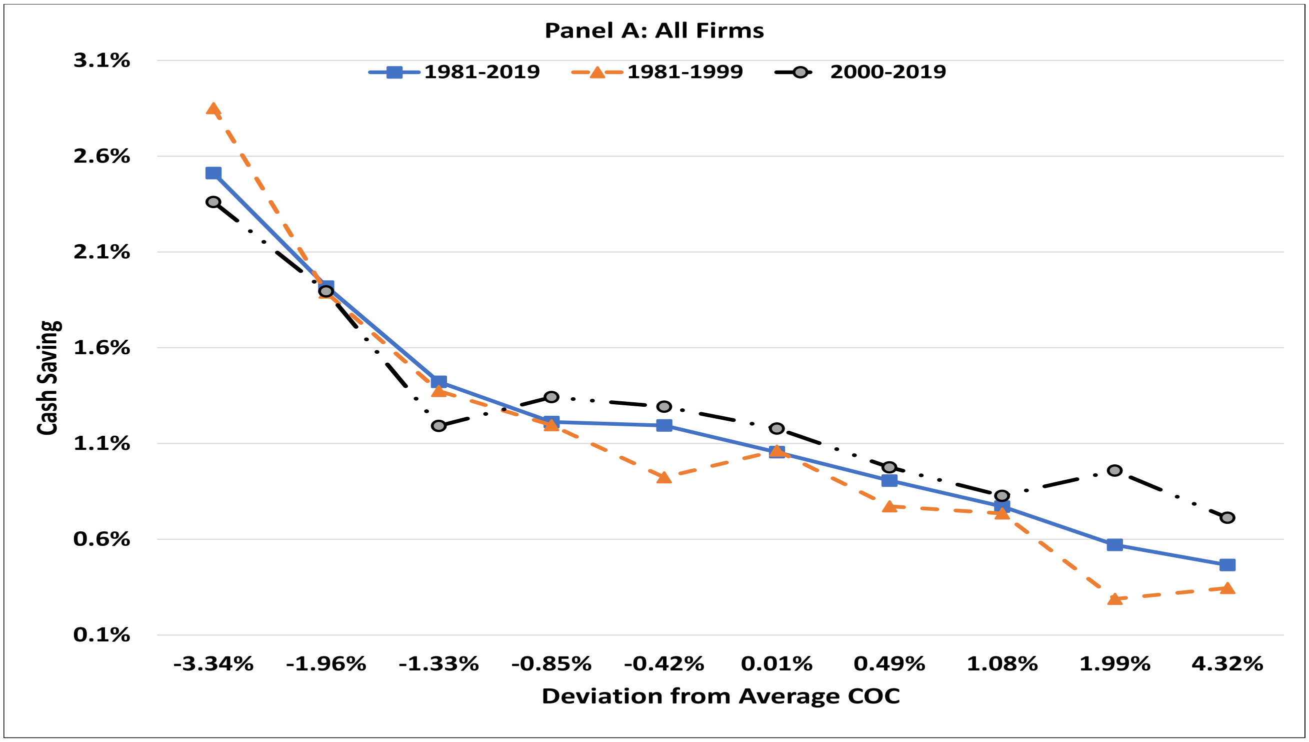


Figure 2: Cash Saving and Deviation in Cost of Capital

The figure presents firms' cash saving percentage of lagged total assets across deciles of the deviation of the cost of capital from its historical average for firms with a minimum of three years of observations for the 1981-2019 sample period and the 1981-1999 and 2000-2019 subsample periods (Panel A), firms with high hedging motives and firms with low hedging motives (Panel B). Cash saving denotes the changes in cash and equivalents divided by total assets at the beginning of the year.



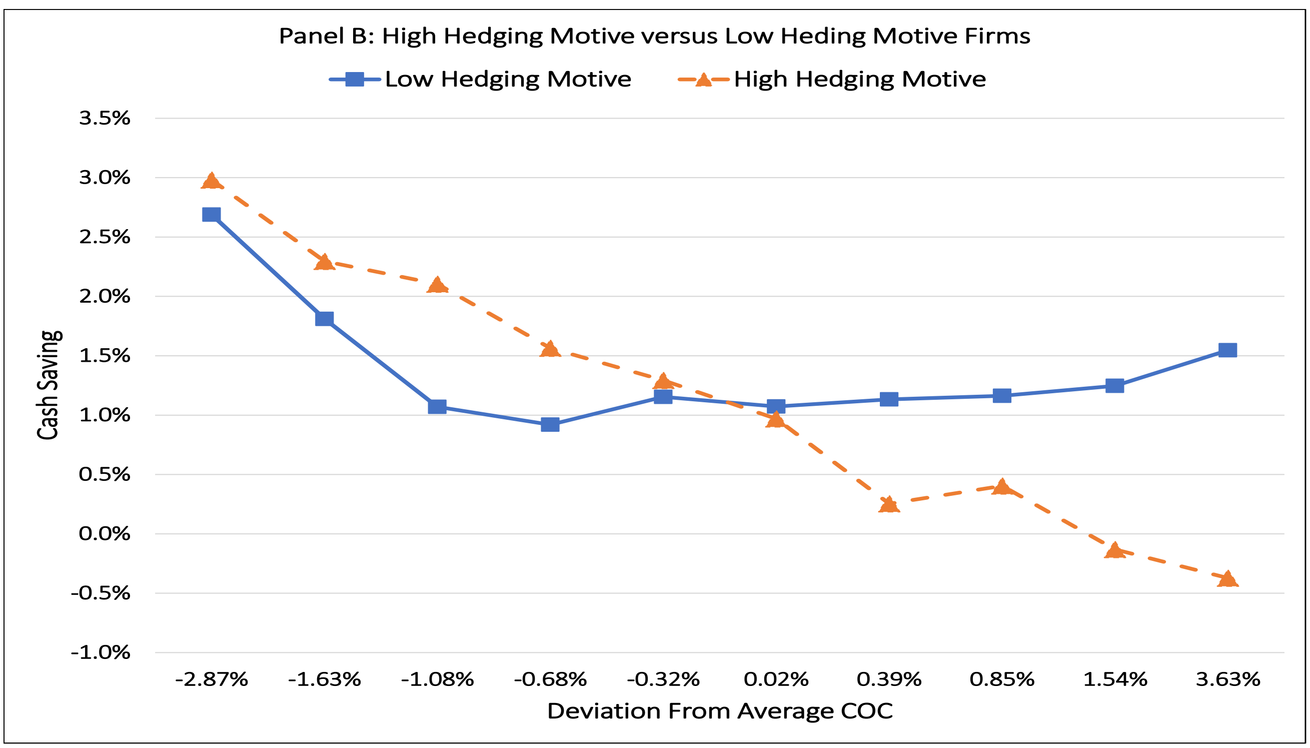


Figure 3: Cash Saving versus Future Investment

This figure plots firms' cash saving relative to future investment deciles. Future investment is defined as the two subsequent year average of net investment. Cash saving is the current year change in cash and equivalents divided by lagged total assets.

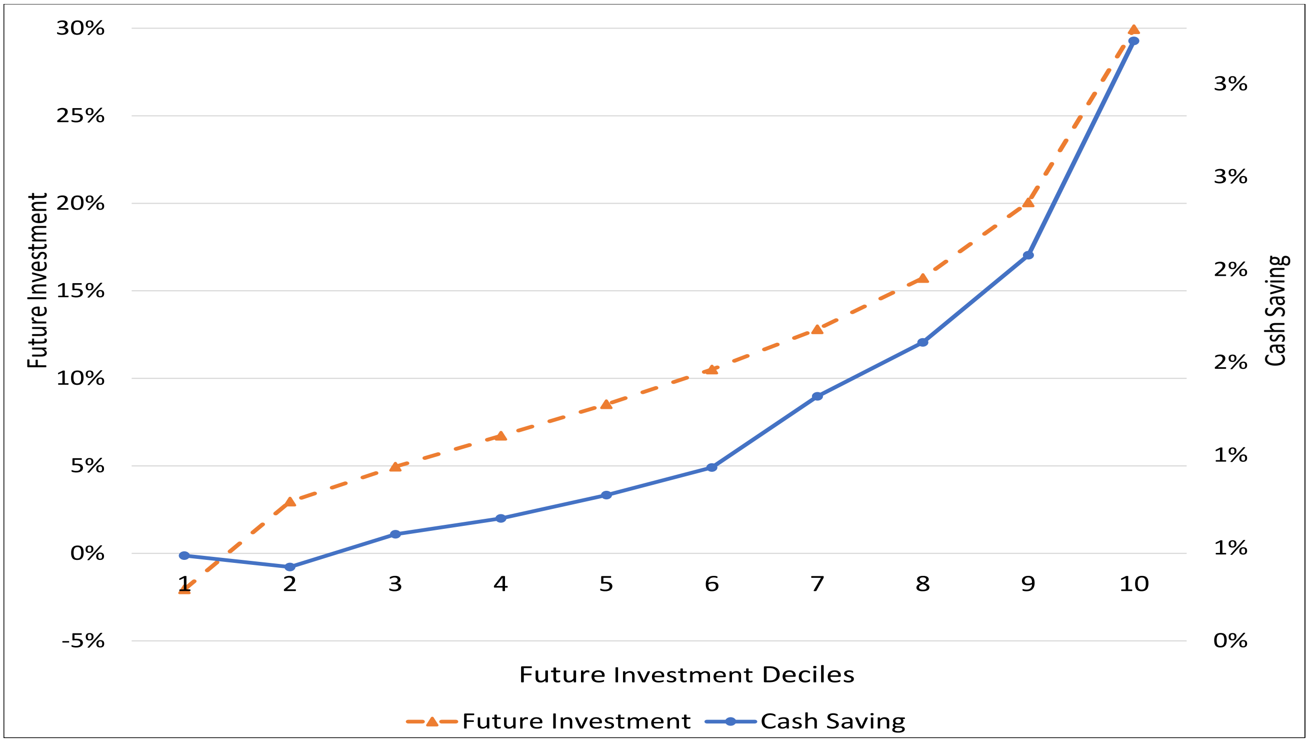


Figure 4: Dynamics of the Effects of Reg FD

This figure plots the differences in the sensitivities of cash saving to external capital around the adoption of Reg FD in October 2000 between the treated and control firms. The treatment control firms are classified based on the top and bottom 30% of M/B ratio in 1999.

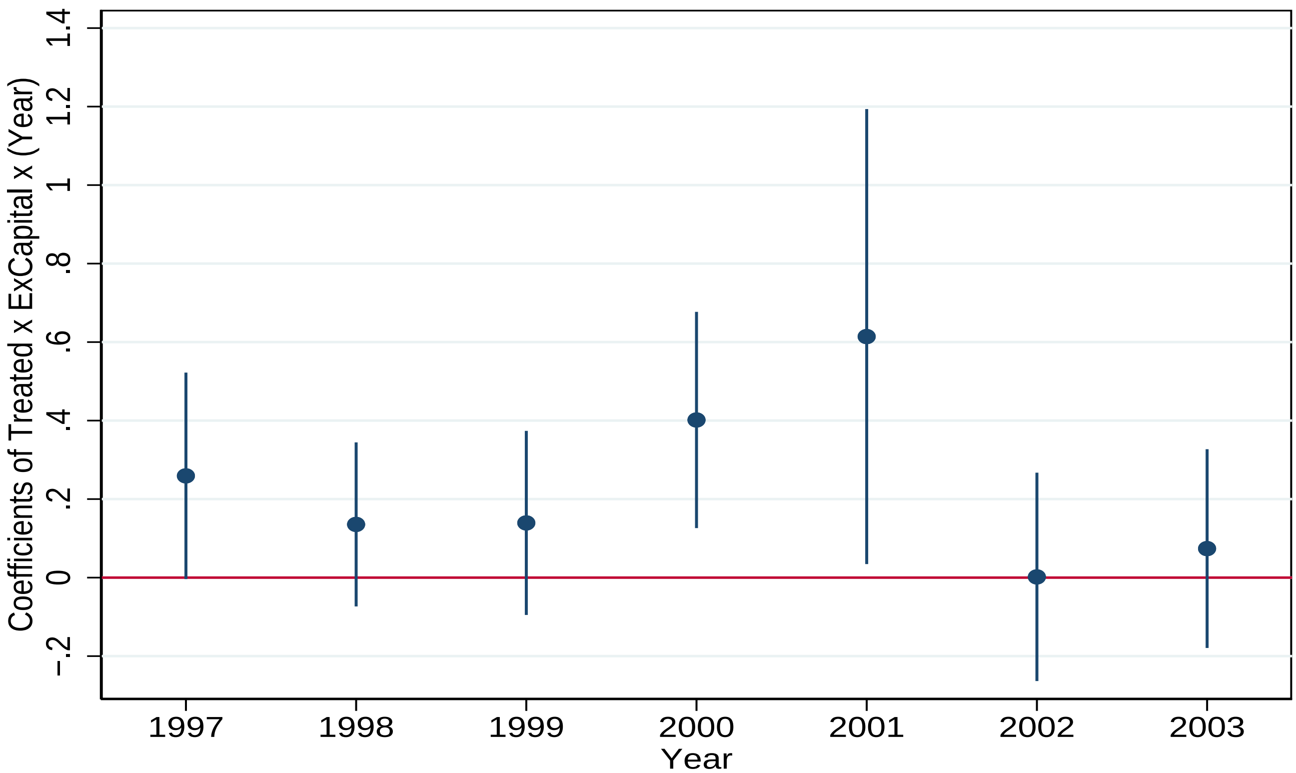


Table 1: Summary Statistics

This table reports the summary statistics of firm characteristics (Panel A), standard deviation of the cost of capital cross firms and over time (Panel B), and standard deviation of the cost of capital over time between high and low hedging motive firms (Panel C). $\Delta Cash$ is the change in cash and equivalents ($Cash$) divided by total assets at the beginning of the year. $ExCapital$ and ICF are external capital and internal cash flow, respectively. NWC is net working capital excluding cash and equivalents. M/B is the market-to-book asset ratio. Vol is cash flow volatility. $CapEx$ denotes capital expenditures. COE denotes cost of equity. COD denotes cost of debt. COC is the weighted average of cost of capital. The detailed variable definitions are provided in Appendix.

Panel A: Summary Statistics

	Mean	Median	Standard Deviation
ΔCash	0.0157	0.0020	0.1105
Cash	0.1272	0.0664	0.1507
ExCapital	0.0381	0.0019	0.1513
ICF	0.1088	0.1009	0.0829
Size	6.8655	6.7158	1.9377
M/B	1.7446	1.3929	1.0033
Vol	0.0200	0.0170	0.0151
Dividend	0.0143	0.0052	0.0201
Leverage	0.2268	0.2143	0.1729
NWC	0.0748	0.0489	0.1697
CapEx	0.1183	0.0796	0.1393
Acquisitions	0.0395	0.0000	0.1550
R&D	0.0271	0.0000	0.0528
COE	0.1220	0.0986	0.0858
COD	0.0678	0.0670	0.0343
COC	0.1011	0.0871	0.0549

Panel B: Decomposition of Standard Deviation

	Cross-section	Time-series
COE	0.0486	0.0691
COD	0.0272	0.0246
COC	0.0316	0.0435

Panel C: Time-Series Standard Deviation

	COE	COD	COC
High Hedging Motive Firms	0.0805	0.0248	0.0501
Low Hedging Motive Firms	0.0786	0.0236	0.0498

Table 2: The Sensitivity of Cash Saving from External Capital to the Cost of Capital

This table reports the sensitivities of cash saving from external capital to the cost of capital, the cost of equity, the cost of debt and sources of cash. The dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. *COC* is the weighted average cost of capital. *ExCapital* and *ICF* are external capital and internal cash flow, respectively, divided by total assets at the beginning of the year. *COE* is the cost of equity. *COD* is the cost of debt. *Eissue* and *Dissue* are equity issues and debt issues, respectively. The detailed variable definitions are provided in Appendix. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	(1)	(2)
COC	-0.0219**	
	[0.0111]	
ExCapital	0.6101***	
	[0.0260]	
ExCapital×COC	-0.7984***	
	[0.2163]	
COE		-0.0171***
		[0.0055]
COD		-0.0934***
		[0.0177]
Eissue		0.7072***
		[0.0361]
Dissue		0.4407***
		[0.0158]
Eissue×COE		-0.6546*
		[0.3423]
Dissue×COD		0.0123
		[0.1374]
ICF	0.4546***	0.4355***
	[0.0116]	[0.0111]
Controls	Yes	Yes
Firm FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	76,821	76,821
Adj. R^2	0.4210	0.4296

Table 3: Constrained versus Unconstrained Firms

This table compares the sensitivities of cash saving to the cost of capital and sources of cash between financially constrained and unconstrained firms (hypothesis 1a). Constrained and unconstrained firms are defined as firms that do not have a credit rating and firms that have a credit rating (Columns 1 and 2)and firms at the top and bottom 30% of the HP index (Hadlock and Pierce (2010))(Columns 3 and 4), respectively. The dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. *ExCapital* and *ICF* are external capital and internal cash flow, respectively, divided by total assets at the beginning of the year. *COC* is the weighted average cost of capital. Firm and year fixed effects are controlled for. The detailed variable definitions are provided in Appendix. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	Rating		HP Index	
	Unconstrained	Constrained	Unconstrained	Constrained
	(1)	(2)	(3)	(4)
COC	-0.0341**	-0.0411**	-0.0294**	-0.034
	[0.0165]	[0.0187]	[0.0122]	[0.0220]
ExCapital	0.5412***	0.6461***	0.5107***	0.6840***
	[0.0494]	[0.0357]	[0.0280]	[0.0424]
ICF	0.2955***	0.5158***	0.3574***	0.5007***
	[0.0168]	[0.0156]	[0.0157]	[0.0160]
ExCapital×COC	-0.8427**	-0.7143**	-0.5638***	-1.1054***
	[0.3486]	[0.3215]	[0.2075]	[0.3893]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	28,885	38,808	39,284	36,847
Adj. R^2	0.3941	0.4573	0.3951	0.4638

Table 4: High versus Low Hedging Motive Firms

This table compares the impacts of the cost of capital on the sensitivity of cash saving to external capital (hypothesis 1b), excess capital issuance (hypothesis 1c), and the influence of future investment on the sensitivity of cash saving to the COC (hypothesis 1d) between firms with high and low hedging motives. High and low hedging motive firms are defined as those in the top 30 percent and those in the bottom 30 percent based on the hedging motive measure. In Panel A, the dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. $ExCapital$ and ICF are external capital and internal cash flow, respectively, divided by total assets at the beginning of the year. COC is the weighted average cost of capital. In Panel B, the dependent variable is excess capital issues. In Panel C, the dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. $FInvestment$ is future investment defined as the average of subsequent two years of capital expenditures plus acquisitions plus R&D divided by lagged total assets. The detailed variable definitions are provided in Appendix. Firm and year fixed effects are controlled for. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: Cash Saving		
	High Hedging Motive	Low Hedging Motive
	(1)	(2)
COC	-0.0929***	0.0692***
	[0.0197]	[0.0163]
ExCapital	0.7189***	0.4103***
	[0.0592]	[0.0341]
ICF	0.4549***	0.3071***
	[0.0217]	[0.0196]
ExCapital×COC	-2.0920***	-0.2225
	[0.4246]	[0.2700]
Controls	Yes	Yes
Firm FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	23,202	23,194
Adj. R^2	0.4217	0.2919

Panel B: Excess Issuance		
	High Hedging Motive	Low Hedging Motive
	(1)	(2)
COC	-0.9977***	0.0456
	[0.1169]	[0.0699]
Controls	Yes	Yes
Firm FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	23,202	23,194
Adj. R^2	0.1401	0.1063

Panel C: Future Investment		
	High Hedging Motive	Low Hedging Motive
	(1)	(2)
FInvestment	0.1499***	0.0477
	[0.0476]	[0.0295]
FInvestment× COC	-1.0971***	-0.0372
	[0.3011]	[0.2684]
COC	-0.1521***	0.0027
	[0.0341]	[0.0324]
Controls	Yes	Yes
Firm FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	23,202	23,194
Adj. R^2	0.1969	0.1264

Table 5: The Effect of Reg FD Shock to the Cost of Capital on Cash Saving

This table reports the effects of a shock to the firm-level cost of capital on cash saving from external capital. We use Regulation Fair Disclosure of 2000 as a shock to the cost of capital. The dependent variable is the cost of equity, the cost of debt, and the weighted average cost of capital, respectively in Panel A and the change in cash and equivalents divided by total assets at the beginning of the year in Panel B. We set the *Post* dummy to zero for 1996-1999 and one for 2000-2003. The treated and control firms are classified based on the top and bottom 30% of M/B ratio in 1999. Panel B Columns 2 and 3 report the results of placebo tests based on fictitious event years 1992 and 2013, respectively. Firm and year fixed effects are controlled for. The detailed variable definitions are provided in Appendix. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: The Impact on the COC

	COE	COD	COC
	(1)	(2)	(3)
Treated×Post	-0.0362***	-0.0063***	-0.0238***
	[0.0027]	[0.0014]	[0.0017]
Controls	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
Observations	11,970	11,970	11,970
Adj. R^2	0.6579	0.4676	0.6873

Panel B: The Impact on Cash Saving from External Capital

	Reg FD	Placebo 1	Placebo 2
	(1)	(2)	(3)
Treated×Post	0.0102*	0.0071**	-0.0075*
	[0.0052]	[0.0035]	[0.0038]
ExCapital×Post	0.0408	0.0804***	-0.0227
	[0.0420]	[0.0300]	[0.0306]
Treated×ExCapital×Post	0.3093***	-0.0984	-0.0559
	[0.1149]	[0.0610]	[0.0578]
Treated×ExCapital	-0.0657	0.0641	0.1159**
	[0.0615]	[0.0408]	[0.0487]
ExCapital	0.6155***	0.4152***	0.6863***
	[0.0431]	[0.0279]	[0.0306]
ICF	0.4109***	0.4540***	0.4163***
	[0.0336]	[0.0261]	[0.0242]
Controls	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
Observations	11,970	8,730	10,914
Adj. R^2	0.3652	0.4339	0.5647

Table 6: The Effect of Reg FD Shock to the Cost of Capital: High versus Low Hedging Motives

This table compares the impacts of a shock to the cost of capital on cash saving from external capital (Panel A), excess issuance (Panel B), and the influence of future investment on cash saving (Panel C) between firms with high and low hedging motives using the Reg FD sample. High and low hedging motive firms are defined as those in the top 30 percent and those in the bottom 30 percent based on the hedging motive measure. In Panel A, the dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. *ExCapital* and *ICF* are external capital and internal cash flow, respectively, divided by total assets at the beginning of the year. *Post* dummy is zero for 1996-1999 and one for 2000-2003. The treated and control firms are classified based on the top and bottom 30% of M/B ratio in 1999. In Panel B, the dependent variable is excess capital issues. In Panel C, the dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. *FInvestment* is future investment defined as the average of subsequent two years of capital expenditures plus acquisitions plus R&D divided by lagged total assets. The detailed variable definitions are provided in Appendix. Firm and year fixed effects are controlled for. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: Cash Saving		
	High Hedging Motive	Low Hedging Motive
	(1)	(2)
Treated×Post	0.0318*	-0.0027
	[0.0180]	[0.0072]
ExCapital×Post	-0.0087	0.0023
	[0.1552]	[0.0564]
Treated×ExCapital×Post	0.7251**	0.2354
	[0.3415]	[0.2008]
Treated×ExCapital	-0.2746	0.0179
	[0.1670]	[0.1039]
ExCapital	0.5966***	0.4229***
	[0.1059]	[0.0643]
ICF	0.4713***	0.2739***
	[0.0864]	[0.0395]
Controls	Yes	Yes
Firm FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	3,565	3,455
Adj. R^2	0.3186	0.3010

Panel B: Excess Issuance		
	High Hedging Motive	Low Hedging Motive
	(1)	(2)
Treated×Post	0.0558***	0.0179
	[0.0126]	[0.0113]
Controls	Yes	Yes
Firm FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	3,565	3,455
Adj. R^2	0.3454	0.3334

Panel C: Future Investment		
	High Hedging Motive	Low Hedging Motive
	(1)	(2)
FInvestment	0.0012	-0.0240
	[0.2342]	[0.1099]
FInvestment×Post	0.2298	0.0279
	[0.3613]	[0.0721]
Treated×Post×FInvestment	0.4443**	0.0236
	[0.2227]	[0.0969]
Treated×Post	-0.0171	-0.0022
	[0.0214]	[0.0136]
Treated×Finvestment	-0.1625	-0.1252
	[0.1803]	[0.1348]
Controls	Yes	Yes
Firm FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	3,565	3,455
Adj. R^2	0.2223	0.1100

Table 7: The Effect of Monetary Policy Shocks to the Cost of Capital

This table reports the effects of plausible exogenous monetary policy shocks to the firm-level cost of capital on cash saving. Monetary policy shocks are captured using the unified measure developed by Bu et al. (2021). The dependent variable is the cost of equity, the cost of debt, and the weighted average cost of capital, respectively in Panel A and the change in cash and equivalents divided by total assets at the beginning of the year in Panel B. The *Shock* dummy equals one if the average monetary policy shocks over a year is above the mean and zero otherwise. *Treated* is a dummy equal to one (zero) if a firm has the monetary policy exposure (MPE) index in the top (bottom) tertile, where the MPE index is constructed following Ozdagli and Velikov (2020). Panel B Columns 2 and 3 report the results of placebo tests based on randomly generated shocks from the standard normal distribution. Firm and year fixed effects are controlled for. The detailed variable definitions are provided in Appendix. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: The Impact on the COC			
	COE	COD	COC
	(1)	(2)	(3)
Treated×Shock	0.0008	0.0023***	0.0011*
	[0.0012]	[0.0006]	[0.0006]
Controls	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
Observations	24,949	24,949	24,949
Adj. R^2	0.4802	0.5210	0.5629

Panel B: The Impact on Cash Saving			
	Monetary Policy Shocks	Placebo 1	Placebo 2
	(1)	(2)	(3)
Treated	0.0175***	0.0151***	0.0169***
	[0.0037]	[0.0037]	[0.0037]
Treated×ExCapital	0.1799***	0.1360***	0.1390***
	[0.0344]	[0.0291]	[0.0336]
Treated×ExCapital×Shock	-0.0926**	-0.0229	-0.0263
	[0.0413]	[0.0379]	[0.0415]
Treated×Shock	-0.0014	0.0025	-0.0002
	[0.0018]	[0.0017]	[0.0017]
ExCapital×Shock	0.0827***	-0.0657***	-0.0088
	[0.0236]	[0.0223]	[0.0236]
ExCapital	0.4724***	0.5617***	0.5264***
	[0.0242]	[0.0201]	[0.0250]
ICF	0.4475***	0.4477***	0.4466***
	[0.0190]	[0.0190]	[0.0190]
Controls	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
Observations	24,949	24,949	24,949
Adj. R^2	0.4684	0.4709	0.4681

Table 8: The Effect of Monetary Policy Shocks: High versus Low Hedging Motives

This table compares the effects of monetary shocks on cash saving from external capital (Panel A), excess issuance (Panel B), and the influence of future investment on cash saving (Panel C) between firms with high hedging motives and firms low hedging motives. The *Shock* dummy equals one if the average monetary policy shocks over a year is above the mean and zero otherwise. *Treated* is a dummy equal to one (zero) if a firm has the monetary policy exposure (MPE) index in the top (bottom) tercile and zero, where the MPE index is constructed following Ozdagli and Velikov (2020). Firm and year fixed effects are controlled for. The detailed variable definitions are provided in Appendix. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: Cash Saving		
	High Hedging Motive	Low Hedging Motive
	(1)	(2)
Treated	0.0308***	-0.0001
	[0.0073]	[0.0053]
Treated×ExCapital	0.2689***	0.1058***
	[0.0573]	[0.0358]
Treated×ExCapital×Shock	-0.1840**	-0.0273
	[0.0770]	[0.0503]
Treated×Shock	-0.0049	0.002
	[0.0031]	[0.0028]
ExCapital×Shock	0.0823*	0.0715***
	[0.0487]	[0.0261]
ExCapital	0.4852***	0.3133***
	[0.0427]	[0.0327]
ICF	0.4601***	0.2987***
	[0.0312]	[0.0308]
Controls	Yes	Yes
Firm FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	7,509	6,921
Adj. R^2	0.4991	0.3245

Panel B: Excess Issuance		
	High Hedging Motive	Low Hedging Motive
	(1)	(2)
Treated	0.1543***	0.0092
	[0.0311]	[0.0659]
Treated×Shock	-0.0334**	0.0181
	[0.0160]	[0.0260]
Controls	Yes	Yes
Firm FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	8,468	7,692
Adj. R^2	0.0895	0.0419

Panel C: Future Investment		
	High Hedging Motive	Low Hedging Motive
	(1)	(2)
Treated	0.0164	0.0007
	[0.0127]	[0.0077]
Treated×Finvestment	0.3337***	0.0732
	[0.1017]	[0.0499]
Treated×Shock×FInvestment	-0.1509*	0.1064*
	[0.0898]	[0.0597]
Treated×Shock	0.0030	-0.0068
	[0.0084]	[0.0054]
Shock×FInvestment	0.1323**	-0.0391
	[0.0620]	[0.0453]
Finvestment	-0.3375***	-0.1367***
	[0.0768]	[0.0530]
Controls	Yes	Yes
Firm FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	7,509	6,921
Adj. R^2	0.1718	0.1046

Appendix

The Sensitivity of Cash Savings to the Cost of Capital

A. The Model

To identify the crux of how variation in COC affects cash saving, we consider a model wherein a firm endowed with cash W_0 faces two-period financing and investment decisions with a time-varying discount rate. At $t = 0$, the firm invests I_0 which returns $\pi(I_0)$ at $t = 2$ along with an investment opportunity to expand its operation at $t = 1$. The firm also chooses external finance X_0 and saves $C_0 = W_0 + X_0 - I_0$ for its investment opportunity at $t = 1$. We also assume that cash holdings earn zero return. At $t = 1$, the firm raises additional capital X_1, if needed, to invest I_1 which produces $\pi(I_1)$ at $t = 2$. We assume that $\pi_I > 0$ and $\pi_{II} < 0$.[17] There is also a random cash flow shock to assets in place at $t = 1$, denoted by z_1. We assume that z_1 is i.i.d., normal with a zero mean and a variance of σ^2.[18] The following time line illustrates the firm's cash flows and decisions.

t=0	1	2
Firm endowed with W_0	Cash flow: z_1	Cash flow: $\pi(I_0) + \pi(I_1)$
raise X_0, save C_0,	cash available: $W_1 = C_0 + z_1$	
invest $I_0 = W_0 + X_0 - C_0$	raise X_1	
	invest $I_1 = X_1 + W_1$	

The firm faces the COC at $t = 0$, δ_0, and at $t = 1$, δ_1. The firm maximizes current shareholder wealth as follows:

$$\begin{aligned} V_0 \;=\; & \max_{(X_0, C_0, I_0} \left\{ E_0 \left[\frac{\pi(I_0)}{(1+\delta_0)^2} + \frac{V_1}{(1+\delta_0)} \right] - X_0 \right\} \\ & \text{subject to} \quad X_0 = I_0 + C_0 - W_0, \\ & \text{where} \quad V_1 = \max_{X_1, I_1} \left\{ E_1 \left[\frac{\pi(I_1)}{(1+\delta_1)]} \right] - X_1 \right\} \\ & \text{subject to} \quad X_1 = I_1 - C_0 - z_1. \end{aligned} \tag{A.1}$$

To explore the optimal cash saving, financing, and investment decisions, we solve the model backwards. At $t = 1$, the firm has the sum of the cash flow and cash saving from $t = 0$: $W_1 = C_0 + z_1$. It will maximize V_1. With μ_1 being the Lagrange multiplier on the constraint, the FOCs imply:

$$\mu_1 = \pi_I(I_1) = (1 + \delta_1). \tag{A.2}$$

The firm can avoid issuing external capital, i.e., $X_1 = 0$, if it has sufficient cash at $t = 1$ after realizing z_1 ($I_1^* \leq W_1$ where I_1^* satisfying $\pi_I(I_1^*) = 1$).[19] If W_1 cannot cover the investment, the firm must rely on external finance, that is, $X_1 > 0$ and its investment I_1 will be determined based on

[17] f_x and f_{xx} denote the first and second partial derivatives, respectively, of $f(x, y)$ with respect to x.
[18] "$i.i.d$" stands for independent and identical distribution across firms and over time.
[19] Here, for simplicity, we assume that any surplus cash at $t = 1$ is distributed at $t = 2$.

the cost of capital, δ_1. Given these observations, we obtain the following expected value at $t = 1$:

$$E_0[V_1] = \int_{-\infty}^{I_1^*-C_0} \left\{ \frac{\pi(I_1)}{(1+\delta_1)} - X_1 \right\} g(z)dz + \int_{I_1^*-C_0}^{\infty} \{\pi(I_1^*) - I_1^* + W_1\} g(z)dz,$$

where $g(z)$ is the probability density function (PDF) of z_1 and $X_1 = I_1 - W_1$ when $W_1 < I_1^*$.

Moving back to the first period, the firm maximizes V_0. We derive the first order conditions (FOCs) below which imply that optimal cash saving and investment decisions satisfy the following condition:

$$\pi_I(I_0) = (1+\delta_0)^2 = G, \tag{A.3}$$

where $G = \frac{1}{(1+\delta_0)} \left(1 + \int_{-\infty}^{I_1^*-C_0} \left\{ \frac{\pi_I(I_1)}{(1+\delta_1)} + 1 \right\} g(z)dz \right)$ is the marginal benefit of cash saving which reflects the hedging benefit that cash allows the firm to make larger investments and not constrained at date 1. The FOCs suggest that the firm's optimal investment and saving decisions are made by trading off between the current COC and the marginal benefit of cash saving. There will be little benefit of cash saving if the firm does not expect any future investment. Thus, the expected marginal benefit of cash due to hedging motive is an important consideration for the investment and cash saving decisions at $t = 0$.

From the optimization of the model, we derive the following results:

Result 1 *The optimal external finance, $\hat{X}_0$, cash saving, $\hat{C}_0$, and investment, $\hat{I}_0$, exhibit the following properties:*

$$\frac{\partial \hat{X}_0}{\partial \delta_0} < 0, \quad \frac{\partial \hat{C}_0}{\partial \delta_0} < 0, \quad \text{and} \quad \frac{\partial \hat{I}_0}{\partial \delta_0} < 0.$$

Proof: For the optimization program considered above, the Lagrangian can be written as follows:

$$L = \max_{(X_0, I_0, C_0)} \frac{\pi(I_0)}{(1+\delta_0)^2} - X_0 + \mu[W_0 + X_0 - C_0 - I_0]$$

$$+ \frac{1}{(1+\delta_0)} \int_{-\infty}^{I_1^*-C_0} \left\{ \frac{\pi(I_1)}{(1+\delta_1)} - X_1 \right\} g(z)dz \tag{A.4}$$

$$+ \frac{1}{(1+\delta_0)} \int_{I_1^*-C_0}^{\infty} \{\pi(I_1^*) - I_1^* + W_1\} g(z)dz, \tag{A.5}$$

where μ is a Lagrange multiplier for the constraint, $I_0 = W_0 + X_0 - C_0$, $W_1 = C_0 + z_1$, and $I_1 = W_1 + X_1$. We also assume $\gamma > 0$.[20]

[20] The case of $\gamma < 0$ implies that firms face lower COC when they have a negative cash flow shock.

Applying the Leibnitz integral rule, the FOCs are as follows:

$$\frac{\partial L_0}{\partial I_0} = \frac{\pi_I(I_0)}{(1+\delta_0)^2} - \mu = 0; \quad \text{(A.6)}$$

$$\frac{\partial L_0}{\partial X_0} = -1 + \mu = 0; \quad \text{(A.7)}$$

$$\begin{aligned}\frac{\partial L_0}{\partial C_0} &= -\mu + \frac{1}{(1+\delta_0)} + \frac{1}{(1+\delta_0)} \int_{-\infty}^{I_1^*-C_0} \left\{ \frac{\pi_I(I_1)}{(1+\delta_1)} + 1 \right\} g(z)dz \\ &= -\mu + G = 0; \quad \text{(A.8)}\end{aligned}$$

$$\frac{\partial L_0}{\partial \mu} = W_0 + X_0 - C_0 - I_0 = 0, \quad \text{(A.9)}$$

where

$$G = \frac{1}{(1+\delta_0)} \left(1 + \int_{-\infty}^{I_1^*-C_0} \left\{ \frac{\pi_I(I_1)}{(1+\delta_1)} + 1 \right\} g(z)dz \right) > 0.$$

Therefore, the FOCs imply

$$(1+\delta_0)^{-2}\pi_I(I_0) - 1 = 0; \quad \text{(A.10)}$$

$$G - 1 = 0; \quad \text{(A.11)}$$

$$W_0 + X_0 - C_0 - I_0 = 0. \quad \text{(A.12)}$$

We now differentiate the FOCs with respect to δ_0 to obtain the comparative statics.

$$(1+\delta_0)^{-2}\pi_{II}\frac{d\hat{I}_0}{d\delta_0} + 0\frac{d\hat{C}_0}{d\delta_0} - 0\frac{d\hat{X}_0}{d\delta_0} - 2(1+\delta_0)^{-3}\pi_I(I_0) = 0, \quad \text{(A.13)}$$

$$0\frac{d\hat{I}_0}{d\delta_0} + G_C\frac{d\hat{C}_0}{d\delta_0} - 0\frac{d\hat{X}_0}{d\delta_0} - (1+\delta_0)^{-2}G = 0, \quad \text{(A.14)}$$

$$-\frac{d\hat{I}_0}{d\delta_0} - \frac{d\hat{C}_0}{d\delta_0} + \frac{d\hat{X}_0}{d\delta_0} = 0, \quad \text{(A.15)}$$

where $\hat{I}_0$, $\hat{C}_0$, and $\hat{X}_0$ are the optimal decisions satisfying the FOCs, and

$$G_C = \frac{1}{(1+\delta_0)} \int_{-\infty}^{I_1^*-C_0} \frac{\pi_{II}(I_1)}{(1+\delta_1)} g(z)dz < 0.$$

G_C represents the rate of change in the marginal benefit of cash due to an increase in cash at $t = 0$.

The determinant of the Jacobian matrix of the derivatives is given by[21]

$$\begin{aligned} D &= \begin{vmatrix} (1+\delta_0)^{-2}\pi_{II} & 0 & 0 \\ 0 & G_C & 0 \\ -1 & -1 & 1 \end{vmatrix} \\ &= (1+\delta_0)^{-2}\pi_{II}(\hat{I}_0)G_C > 0. \end{aligned} \tag{A.16}$$

By the implicit function theorem and Cramer's rule, we obtain the following:

$$\begin{aligned} \frac{\partial \hat{I}_0}{\partial \delta_0} &= \frac{\begin{vmatrix} 2(1+\delta_0)^{-3}\pi_I(\hat{I}_0) & 0 & 0 \\ (1+\delta_0)^{-2}G & G_C & 0 \\ 0 & -1 & 1 \end{vmatrix}}{D} \\ &= \frac{2(1+\delta_0)^{-3}\pi_I(I_0)G_C}{D} < 0, \end{aligned} \tag{A.17}$$

$$\begin{aligned} \frac{\partial \hat{C}_0}{\partial \delta_0} &= \frac{\begin{vmatrix} (1+\delta_0)^{-2}\pi_{II} & 2(1+\delta_0)^{-3}\pi_I(\hat{I}_0) & 0 \\ 0 & (1+\delta_0)^{-2}G & 0 \\ -1 & 0 & 1 \end{vmatrix}}{D} \\ &= \frac{(1+\delta_0)^{-2}\pi_{II}(1+\delta_0)^{-2}G]}{D} < 0, \end{aligned} \tag{A.18}$$

$$\begin{aligned} \frac{\partial \hat{X}_0}{\partial \delta_0} &= \frac{\begin{vmatrix} (1+\delta_0)^{-2}\pi_{II} & 0 & 2(1+\delta_0)^{-3}\pi_I(\hat{I}_0) \\ 0 & G_C & (1+\delta_0)^{-2}G \\ -1 & -1 & 0 \end{vmatrix}}{D} \\ &= \frac{(1+\delta_0)^{-2}\pi_{II}(1+\delta_0)^{-2}G + 2(1+\delta_0)^{-3}\pi_I(I_0)G_C}{D} < 0. \end{aligned} \tag{A.19}$$

These results suggest that the optimal investment, cash saving, and external finance at $t = 0$ decrease when facing a higher COC. QED.

Result 1 suggests that the firm reduces (increases) cash saving and external capital raised at $t = 0$ when facing a higher (lower) COC (δ_0). If the firm is currently constrained ($W_0 < I_0^*$), where I_0^* is the first-best investment satisfying $\pi_I(I_0^*) = (1+\delta_0)^2$, both external finance constraints at $t = 0$ and 1 are binding and the firm will increase external finance, cash saving and investment in response to a lower COC to satisfy the FOCs. It will choose optimal cash saving by issuing excess capital until the marginal benefit of cash saving, G, is equal to the marginal cost of external finance. If the firm is currently unconstrained but "overall" intertemporally constrained ($I_0^* \leq W_0 < I_0^* + I_1^*$), although the current external finance constraint is not binding, the external finance constraint at $t = 1$ is still binding. It may currently make the optimal investment without incurring external

[21] Here D takes the same form as the Hessian matrix of the FOCs. Since D is negative definite, the second-order conditions are also satisfied.

finance costs and pay out the remaining to shareholders if it does not consider future financing needs. However, when facing future financing needs with uncertainty, the firm will not pay out but increase X_0 to save cash until its marginal benefit is equal to the marginal cost. If δ_0 is lower, the firm will issue more external capital X_0 to save for I_1. Thus, both currently constrained and future constrained firms save by issuing excess capital $(X_0 - I_0)$ when the COC is lower. Cash saved today reduces future external capital needs and the total costs of external capital.

It is possible that for a firm with sufficiently large initial endowment $(W_0 \geq I_0^* + I_1^*)$, the external finance constraints are not binding because the firm has enough cash for investment at $t = 0$. However, facing uncertain investment opportunities and cash flows, no firm will be completely insulated from the external capital market. The precautionary motive suggests that a firm's cash saving is driven by uncertain future cash needs, whereas the market timing suggests that external financing is driven by a lower COC.[22] As shown below, what distinguishes the hedging motive from these alternative motives is that the correlation between the cost of capital and external capital needs, denoted by γ, drives the sensitivity of cash saving from external capital issuance to the COC.

Firms differ in general in their correlations between the COC and external finance needs due to market frictions, such as asymmetric information, agency problems, and limited intermediation, and uncertainty of cash flows. We specify $\delta_1 = (1+\gamma)\bar{\delta_1}$, where $\bar{\delta_1}$ is the average COC at $t = 1$. With this specification the firm's optimal investment using external financing at $t = 1$ is given by $\pi_I(I_1) = 1 + (1+\gamma)\bar{\delta_1}$. Thus, with a higher γ, the firm incurs higher costs on additional external financing and its investment needs to be reduced due to a higher COC. A higher γ becomes particularly onerous if the firm faces a negative cash flow shock and expects large investment. Such a firm will have a greater incentive to save when facing a lower COC at $t = 0$.

Given that the effect of external finance is greater for a higher γ, firms with a high γ will have stronger incentives to save when the COC is relatively low. Thus, we can consider cross-sectional variation in cash saving motive by examining firms' optimal saving decision at $t = 0$ with respect to γ:

Result 2 *The correlation between external capital needs and the COC, γ, increases the sensitivities of optimal cash saving $\hat{C}_0$ to the δ_0;*

$$\frac{\partial^2 \hat{C}_0}{\partial \delta_0 d\gamma} = \frac{\partial^2 (\hat{X}_0 - \hat{I}_0)}{\partial \delta_0 d\gamma} < 0.$$

Proof: To see how γ affects optimal decisions at $t = 0$, we note $\delta_1 = \bar{\delta_1}(1+\gamma)$ and differentiate equations (A.13)-(A.15) w.r.t. γ and obtain the following:

$$\frac{\partial^2 \hat{C}_0}{\partial \delta_0 d\gamma} \quad = \quad \frac{(1+\delta_0)^{-2} G_\gamma}{G_{C\gamma}} < 0, \tag{A.20}$$

[22] Market timing occurs when the securities are overpriced or the COC is lower. If there is no fluctuation in the COC, then firms have no needs to time markets. Thus, the market timing motive can be captured by the variation in the COC. The precautionary motive is to save for uncertain cash needs. The uncertain cash needs arise when investments exceed available cash $(I_1 - C_0 - z_1)$. If the difference is constant, then there will be no need for precautionary cash saving. The precautionary motive becomes stronger as the volatility of the difference increases. Thus, the precautionary motive can be captured by the variance of the difference: $Var(I_1 - C_0 - z_1) = \sigma^2$, which is the variance of cash flow.

and

$$\frac{\partial^2 \hat{C}_0}{\partial \delta_0 d\gamma} = \frac{\partial^2 \hat{X}_0}{\partial \delta_0 d\gamma} - \frac{\partial^2 \hat{I}_0}{\partial \delta_0 d\gamma} = \frac{\partial^2 (\hat{X}_0 - \hat{I}_0)}{\partial \delta_0 d\gamma},$$

and where

$$G_{C\gamma} = -\frac{1}{(1+\delta_0)} \int_{-\infty}^{I_1^* - C_0} \left\{ \frac{\bar{\delta}_1 \pi_{II}(I_1)}{[1+\bar{\delta}_1(1+\gamma)]^2} \right\} g(z)dz > 0,$$

and

$$G_{\gamma} = -\frac{1}{(1+\delta_0)} \int_{-\infty}^{I_1^* - C_0} \left\{ \frac{\bar{\delta}_1 \pi_{I}(I_1)}{[1+\bar{\delta}_1(1+\gamma)]^2} \right\} g(z)dz < 0,$$

These results suggest that the sensitivity of cash saving to COC is greater for higher γ. QED.

The above results show the direct effect of the correlation between external capital needs and COC on the sensitivities of the optimal cash saving decisions to the COC. Firms with a high γ may have to reduce investment due to higher external finance costs when facing lower cash flows and hence have higher marginal value of cash saving (G). Accordingly, such firms can issue excess external capital ($X_0 - I_0$) and save for future investment, thereby reducing their overall cost of external finance. Consequently, the amount of cash saving and excess capital issuance in response to the COC at $t = 0$ should be greater when firms face a higher γ.

B. Definitions of Variables

The following are variable definitions used in this study. Items in parentheses are variable names as used in the Compustat annual database. To account for the change in accounting rule regarding operating leases in 2019, we subtract rouant from at and ppent, subtract llc from dlc, and subtract lllt from dltt after firms adopted the new rule.

Acquisitions = acquisitions (aqc) / lagged total assets (at)

Altman Z-score = 1.2working capital (wcap) / total assets (at) + 1.4retained earnings (re) / total assets (at) + 3.3earnings before interest and taxes (ebit) /total assets (at)+ 0.6market value of equity (prcc_f×csho) /total liabilities (lt) + 0.999sales (sale)/total assets (at)

Cash = cash and cash Equivalents (che) / total assets (at)

Cost of Capital (*COC*) = weighted average cost of capital

ΔCash = change in cash and cash equivalents (chech) / lagged total assets (at)

Cost of Debt (*COD*) = whichever is the greater: interest expense (xint) divided by the average of total debt at the beginning and the end of the year ; or AAA-rated bond yield (also winsorized at 6 and 94 percent)

Cost of Equity (COE) = Implied Cost of capital

Dividend = cash dividend (dv) / lagged total assets (at)

External Capital ($ExCapital$) =Net Equity Issuance ($EIssue$) + Net Debt Issuance ($DIssue$)

External Finance ($External$) = [Capital expenditures (capx) - Operating cash flow (oibdp)]/capx

External Finance Dependence (KZ) = $-1.002CF - 39.368DIV - 1.315CASH + 3.139LEV$, where CF = operating cash flow (oibdp)/ lagged plant and equipment (ppent)

Excess Capital Issuance = Net Equity Issuance ($EIssue$) + Net Debt Issuance ($DIssue$) $-$ Financial Deficit ($Deficit$)

External Capital Needs ($ExNeeds$) = [dividends + acquisitions + net investment - internal cash flow]/ lagged total assets (at)

Free Cash Flow = Earnings before interest, tax, depreciation and amortization (ebitda)- total income taxes paid (txpd) - total interest and related expenses (xint) - dividends paid on common stock(dvc) - dividends paid on preferred stock (dvp)/ book value of equity (seq)

Future Investment ($FInvest$) = the average of two subsequent years of [capital expenditures (capx) + R&D]/ lagged total assets (at)

HP index = $-0.737Size + 0.043Size^2 - 0.04Age$, where $Size$ is the natural logarithm of total assets capped by $4.65 billion and Age is the number of years since the firm's initial offering capped by 37

Internal Cash Flow (ICF) = [income before extraordinary items (ibc) + depreciation and amortization (dpc)] / lagged total assets (at)

Leverage = [short-term debt (dlc) + long-term debt (dltt)] / total assets (at)

M/B = market value of assets / total assets (at), where market value of assets is given by total assets (at) - common equity (ceq) + market value of common equity (common shares outstanding (csho) × share price (prcc))

MPE = Monetary policy exposure as defined in Ozdagli and Velikov (2020). $MPE = -1.60 \times WW - 0.87 \times Cash + 0.63 \times CFDuration + 4.36 \times CFVolatility - 5.74 \times OP$, where WW is the financial constraint measure of Whited and Wu (2006); *Cash* is defined as cash and short-term investments (CHE) scaled by market capitalization; *CFDuration* is the cash flow duration measure estimated following Dechow et al. (2004). *CFVolatility* is calculated as standard deviation over the last 6 years of operating cash flows, measured by sales (sale) - cost of goods sold (cogs) - selling, general and administrative expense (xsga) - change in working capital (wcap) scaled by total assets; and *OP* is defined as sales (sale) - cost of goods sold (cogs), scaled by total assets. Following Ozdagli and Velikov (2020), the percentile ranks of *WW* index and *CFDuration* within each fiscal year cross-section are used

Net Debt Issuance ($DIssue$) = [long-term debt issues (dltis) - long-term debt reduction (dltr) + change in current debt (dlcch)] / lagged total assets (at)

Net Equity Issuance ($EIssue$) = [sale of common and preferred stock (sstk) - purchase of common and preferred stock (prstkc)] / lagged total assets (at)

Net Investment (INV) = [increase in investment (invch) + capital expenditures (capx) + other use of funds (fuseo)- sales of property and plants (sppe) - sales of investment (siv) - short-term investment change (ivstch) -other investment activities (ivaco)]/lagged total assets (at)

Net Working Capital NWC = [current assets (act) - Current Liabilities (lct) - Cash (che)] / total assets

Precaution = the first principal component of firm-level R&D and 2-digit industry cash flow volatility ($CFRisk$).

R&D = research and development expense (xrdq) / Sales

Size = logarithm of total assets (at)

Tax Rate ($Taxr$) =whichever is the lower: tax payment (txt) divided by pretax income (pi) or the statutory maximum tax rate

Timing 1 = $\hat{cov}(ExCapital, M/B)$

Timing 2 = $\overline{M/B} * \overline{ExCapital}$

Timing 3 = mispricing proxy based on the average of a stock's ranking percentiles for each of 11 anomaly variables

Vol (Cash Flow Volatility)] = standard deviation of 2-digit SIC industry average cash flow (ICF) for the prior ten years

WW index = -0.091ICF-0.062 Div+0.021LTD-0.044Size+0.102ISG-0.035SG, where Div is an indicator for dividend; LTD is long-term debt ratio; ISG is industry sales growth rate; and SG is the firm's sales growth rate

C. Alternative Explanations

C.1 Acharya, Almeida, and Campello (2007) Hedging Measure

Acharya et al. (2007) (AAC, henceforth) suggest that financially constrained firms save cash to hedge investment opportunities against income shortfalls, while unconstrained firms do not have a propensity to save cash out of cash flows. They measure a firm's hedging needs by the correlation between the firm's cash flows from current operations and its industry-level median R&D expenditures. We investigate whether their hedging needs measure explains the sensitivity of cash saving to the COC.

We conduct tests based on our hedging motive and AAC hedging needs measures for financially constrained and unconstrained firms. We report the results of high hedging motive firms based on these measures in Panel A of Table E4. The coefficient estimates of $ExCapital \times COC$ are negative and significant for both constrained and unconstrained firms when our hedging motive measure is used. These results are consistent with the finding shown in Table 3 Panel A that both financially constrained and unconstrained firms save from external capital when the COC is relatively low. When the AAC measure is used, however, the coefficient estimate of $ExCapital \times COC$ is insignificant among financially unconstrained firms, whereas the coefficient is negative and significant among constrained firms. These results are consistent with the finding reported by Acharya et al. (2007) that financially constrained firms save when they have high hedging needs against a cash flow shortage. However, the AAC hedging measure does not fully capture firms' cash saving from external capital in response to a lower COC.

C.2 Market Timing Motive

The market timing hypothesis suggests that firms may time the market and issue equity when it is overvalued. Mispricing in the stock market may be driven by nonfundamental components of the stock price, such as investor sentiment, which directly affects the COC but not cash flows (Campbell, Polk, and Vuolteenaho, 2010). When such mispricing drives the current COC below the expected COC, the firm may see an opportunity to issue external capital and save. Such cash saving, however, is not motivated by future investments. If market timing drives firms' cash saving behavior, the sensitivity of excess capital to the COC should be greater among firms with a stronger market timing motive. These arguments lead to the following market timing hypotheses:

Hypothesis 2a Firms with higher market timing motives save more from external capital when the COC is relatively low than firms with lower market timing motives.

Hypothesis 2b Firms with higher market timing motives issue more excess external capital when the COC is relatively low than firms with lower market timing motives.

Using three market timing measures, we conduct a series of tests to investigate whether the market timing motive can explain our results. The first market timing measures is yearly timing (Timing 1) constructed by Kayhan and Titman (2007), which is the sample covariance between external financing and the M/B ratio over a five-year period. This market timing measure captures the idea that a firm raises more external capital by taking advantage of short-term overvaluation determined by the firm's current M/B ratio relative to its M/B in surrounding years. The second market timing measure is long-term timing (Timing 2) as defined in Kayhan and Titman (2007), which is the product of the average M/B ratio and the average external financing over a five-year period. This measure captures a firm's market timing incentive by its M/B ratio relative to all firms in general. The third market timing measure (Timing 3) is the mispricing proxy developed by Stambaugh et al. (2015). This measure is constructed as the average of a stock's ranking percentiles for each of 11 anomaly variables, and a higher rank is associated with a greater relative degree of overpricing based on the given anomaly variable. The most overpriced stocks have the highest composite rankings. For each measure of market timing, we define firms in the top 30 percent as firms with high market timing motives and those in the bottom 30 percent as firms with low market timing motives.

To test market timing hypothesis 2a, we estimate regression models for firms with high or low market timing motives based on the three market timing measures. As shown in Table E4 Panel B, the coefficient estimates of $ExCapital \times COC$ are insignificant for firms with high market timing motives (Columns 1, 3, 5), while negative and significant for firms with low market timing motives when Timing 1 and Timing 2 measures are used (Columns 2 and 4). These results are inconsistent with market timing hypothesis 2a that firms with greater market timing motives save more from external capital when the COC is relatively low.

In Panel E, we test market timing hypothesis 2b regarding excess external capital. The results show that the coefficient estimates of the COC are negative and significant for both low and high market timing motive firms, which is inconsistent with the hypothesis that excess capital issues are mainly driven by the market timing motive. Both low and high market timing motive firms issue excess external capital to save when the COC is lower. These results indicate that market timing motive cannot fully explain our results.

C.3 Precautionary Motive

According to the precautionary motive, firms can avoid external financing by saving cash from internal cash flows (Fazzari et al. (1998), Almeida et al. (2004), Opler et al. (1999), and Bates et al. (2009)). Taking advantage of a relatively low COC to save cash from external capital is not considered the main reason for precautionary cash saving. In particular, Keynes (1936) argues that the quantity of cash demanded for precautionary purposes is not sensitive to changes in the COC because it is mainly determined by the general activity of the economic system and the level of income. Nevertheless, given the recent finding that the precautionary motive drives firms to save from equity issuance (McLean (2011)), we examine whether the cash saving of firms with stronger precautionary motives is more sensitive to the COC. Specifically, we test the following precautionary motive hypotheses:

Hypothesis 3a Firms with higher precautionary motives save more from external capital when the COC is relatively low than firms with lower precautionary motives.

Hypothesis 3b Firms with higher precautionary motives issue more excess external capital when the COC is relatively low than firms with lower precautionary motives.

To test these hypotheses, we follow previous studies and use R&D spending, cash flow volatility, and no-dividend as measures of precautionary motives that represent unforeseen opportunities and contingencies requiring sudden expenditures. Cash flow volatility is the 10-year standard deviation of the average industry cash flow based on the 2-digit SIC code. We pay particular attention to the precautionary measure used by McLean (2011) based on the first principal component of R&D spending and cash flow volatility. For R&D spending, cash flow volatility and their first principal component, we define the top 30% of firms as high precautionary firms and the bottom 30% as low precautionary firms. We also treat nondividend-paying firms as high precautionary firms and dividend-paying firms as low precautionary firms.

Table E4 Panel C shows that the estimated coefficients of $ExCapital \times COC$ are negative and significant for both low and high precautionary firms when no-dividend and R&D spending are used to measure precautionary motive (Columns 1-4). The coefficients of $ExCapital \times COC$ are insignificant for both low and high precautionary firms using cash flow volatility as the proxy for precautionary motive (Columns 5 and 6). When the precautionary measure of McLean (2011) is used, the coefficient of $ExCapital \times COC$ is insignificant for high precautionary firms and significant for low hedging motive firms (Columns 7 and 8). These results are not consistent with precautionary hypothesis 3a, which states that firms with greater precautionary motives save more at a lower COC.[23]

In Panel E, we test precautionary hypothesis 3b regarding excess external capital and find that the coefficient estimates of the COC are negative and significant for both low and high precautionary motive firms. These results are inconsistent with hypothesis 3b, which states that firms with higher precautionary motives issue more capital in excess of the current financial needs than firms with lower precautionary motives when the COC is relatively low. Additionally, we include the precautionary motive measure to our baseline estimations and find that our results in Table 4 still hold after controlling for the precautionary motive effect.[24] These results reinforce our conclusion that firms' cash saving from external capital in response to the time-varying COC cannot be fully explained by precautionary motive.

C.4 Market Timing and Precautionary Motives

Bolton et al. (2013) develop a dynamic model in which firms have both a precautionary-saving motive and a market timing motive for external financing. Under stochastic financing conditions, the dynamics of cash and financing decisions depend on the relative importance of the market timing and precautionary saving motives, which vary with the firm's cash holdings. They show that firms with a considerable amount of cash do not time the market because the market timing option is out of the money. In contrast, firms with low cash holdings have incentives to raise external capital when relatively inexpensive financing opportunities are available. Firms time favorable market conditions to shield against crises through precautionary cash holdings. Accordingly, we test the following hypotheses:

Hypothesis 4a Firms with low cash holdings save more from external capital when the COC is relatively low than firms with high cash holdings.

Hypothesis 4b Firms with low cash holdings issue more excess external capital when the COC is relatively low than firms with high cash holdings.

To test these hypotheses, we define firms with high (low) cash holdings as firms in the top (bottom) 30 percent based on their lagged cash ratio or cash balance. As shown in Table E4 Panel D, the coefficients of $ExCapital \times COC$ are negative and insignificant among firms with high cash ratios and firms with low cash ratios (Columns 1 and 2). The coefficients of $ExCapital \times COC$ are negative and significant among firms with high cash balance and firms with low cash balance (Columns 3 and 4). These results are inconsistent with hypothesis 4a, which states that firms with low cash holdings tend to time favorable market conditions to save cash more than firms with high cash holdings. These results indicate that our finding that firms with high hedging motives save more from external capital when the COC is relatively low cannot be fully explained by the model developed by Bolton et al. (2013).

[23]The reasons that our results differ from McLean (2011)'s finding that increases in precautionary motives lead to large increases in share issuance saving rates when issuance costs are low might be because we focus on cash saving from external capital rather than equity issuances and the sample period is different.

[24]The table is available upon request.

We test hypothesis 4b by investigating excess capital issuance in response to the varying COC among firms with high cash holdings and firms with low cash holding. Since the results based on the cash ratio and cash balance are similar, Panel E presents the estimations based on the cash ratio. As shown in Columns 5 and 6), both cash-rich and cash-poor firms issue more excess capital when the COC is relatively low. The results provide no support for hypothesis 4b and indicate that raising excess capital at a low cost to save as cash is not driven by the dominant market timing motive among cash-poor firms as predicted by the model developed in Bolton et al. (2013).

C.5 Credit Risk

As shown by Acharya et al. (2012), cash reserves are positively related to credit risk. Riskier firms choose to hold more cash as a buffer against a possible cash flow shortfall in the future. Accordingly, firms' cash saving decisions might be driven by their credit risk. We explore this possibility by investigating whether high-risk and low-risk firms behave differently in their cash saving decisions. We use two measures to capture a firm's credit risk: the Altman Z-score and leverage. Since the results are similar when using these two approaches, we report the results based on the Altman Z-score. Firms with the Altman Z-score above (below) the industry median value are classified as low (high) risk firms. Table E4 Panel F show that the coefficients on $ExCapital \times COC$ are negative and significant for firms with high hedging motives (Columns 1 and 3) and insignificant for firms with low hedging motives (Columns 2 and 4). Such difference in cash saving exists among firms with high credit risk and firms with low credit risk. These results indicate that credit risk does not fully explain the sensitivity of cash saving to the COC.

C.6 Agency Risk

Jensen (1986) develops the agency costs of free cash flow hypothesis, which suggests that entrenched managers prefer to retain cash. This hypothesis is supported by studies showing that firms with greater agency problems hold more cash in both within-country and cross-country analyses (Dittmar et al. (2003), Dittmar and Mahrt-Smith (2007), Harford et al. (2008)). To investigate whether agency problems of free cash flow may explain the observed cash saving behavior, we examine the differences in the impacts of the COC on firms' cash saving from external capital between firms with high free cash flows and firms with low free cash flows. We measure free cash flow following Lehn and Poulsen (1989) and classify firms with high (low) free cash flows as those with free cash flows above (below) the median level. As shown in Table E4 Panel G, the coefficients on $ExCapital \times COC$ are negative and significant for firms with high hedging motives (Columns 1 and 3) and insignificant for firms with low hedging motives (Columns 2 and 4) for both high and low agency risk firms. Regardless of the level of free cash flows, high hedging motive firms are more likely to save from external capital as the COC declines. These results indicate that agency risk cannot fully explain firms' cash saving behavior.

D. Estimation procedure for the COE

The model developed in Li, Ng, and Swaminathan (2013) is as follows:

$$P_t = \sum_{k=1}^{15} \frac{FE_{t+k} \times [1 - b_{t+1} + \frac{(b_{t+1} - \frac{g_t}{ICC_t})}{15} \times (k-1)]}{(1 + ICC_t)^k} + \frac{FE_{t+15} \times (1 - b_t)}{(ICC_t - g_t)(1 + ICC_t)^{15}}. \tag{A.1}$$

The model has the following two aspects: 1) the present value of cash flows up to year $(t + 15)$; and 2) the present value of cash flows beyond year $t + 15$. For the first two years' earnings, we use the median forecasts made by analysts and forecast earnings FE_{t+k} from year $t + 3$ to year $t + T + 1$ as $FE_{t+k} = FE_{t+2} \times (1 + g_{t+3} \exp\{g_t^g \times (k - 2)\})$. We assume that earnings growth rate g_{t+3} will mean-revert exponentially to steady-state values by year $t + T + 2$. The assumption implies that $g_{t+3} \exp\{g_t^g \times 15\} = g_t$ with g_t^g being the growth rate of growth rate g_{t+2}, which yields $g_t^g = \ln\left(\frac{g_t}{g_{t+3}}\right)/15$. For g_{t+3}, we use the median long-term growth rate forecast by analysts. If the long-term growth rate forecast is not available, we estimate it using the first two years' forecast earnings as follows: $g_{t+3} = \frac{FE_{t+2}}{FE_{t+1}} - 1$. The steady-state earning growth rate (g_t) is assumed to be a rolling average of the annual GDP growth rate.

We construct the stream of dividends as $D_{t+k} = FE_{t+k} \times (1 - b_{t+k})$ for $1 \leq k \leq 15$. The initial retention ratio is estimated as $b_{t+1} = $ [1- Cash Dividend$_t$ /Net Income$_t$]. For years $t+2$ to $t+T+1$, we estimate the retention rate as $b_{t+k} = b_{t+1} - \frac{(b_{t+1} - \frac{g_t}{ICC_t})}{15} \times (k - 1)$. The retention rate is assumed to revert linearly to a steady-state rate $b_t = \frac{g_t}{ICC_t}$ by year $t + T + 1$. After the terminal year, we estimate the terminal value of the remaining cash flows using the Gordon growth model as follows: $FE_{t+15} \times (1 - b_t)/(ICC_t - g_t)$.

The model developed by Gebhardt, Lee, and Swaminathan (2001) is based on the following equation:

$$P_t = BE_t + \sum_{k=1}^{12} \frac{(ROE_{t+k} - ICC_t)BE_{t+k-1}}{(1 + ICC_t)^k} + \frac{(ROE_{t+12} - ICC_t)BE_{t+11}}{ICC_t(1 + ICC_t)^{12}} \tag{A.2}$$

where ROE_{t+k} is the return on equity at $t + k$ which is assumed to revert linearly to the median industry ROE by year $t + 12$ starting with ROE_{t+3}. The industry median ROE is the past 10-year average of the industry median based on the 2-digit SIC code after excluding firms with losses. For the first three years' earnings, we use the median forecasts by analysts FE_{t+k} and the book value of equity is estimated by $BE_{t+k} = BE_{t+k-1} + FE_{t+k} \times b_{t+1}$, where b_{t+1} is the retention ratio at $t+1$. Beyond the third year, we use the linear interpolation to the industry median ROE to forecast the firm ROE. We assume that economic profits $(ROE - ICC)$ after year 12 are zero.

The Claus and Thomas (2001) model is based on the economic profit of shareholders as expressed in the following equation:

$$P_t = BE_t + \sum_{k=1}^{5} \frac{FE_{t+k} - ICC_t \times BE_{t+k-1}}{(1+ICC_t)^k} + \frac{(FE_{t+5} - ICC_t \times BE_{t+4})(1+g_t)}{(ICC_t - g_t)(1+ICC_t)^5} \tag{A.3}$$

where P_t is the current stock price and the growth rate after 5 years, g_t, is estimated by the inflation rate. We obtain the initial forecast value of equity as $BE_{t+1} = BE_t + FE_{t+1} \times b_{t+1}$, where BE_t is the book equity value per share at t; FE_{t+1} is the forecast earnings per share at $t+1$; and b_{t+1} is the retention ratio as defined above.

Motivated by the residual income models in Ohlson (1995) and Feltham and Ohlson (1995, 1996), Li and Mohanram (2014) develop the following RI model:

$$E_{t+n} = \delta_0 + \delta_1 NegE_t + \delta_2 E_t + \delta_3 NegE_t \times E_t + \delta_r B_t + \delta_5 TACC_t + \varepsilon, \tag{A.4}$$

where E_{t+n} is the EPS in year $t+n$ ($n = 1$ to 5). $NegE_t$ is an indicator variable that equals 1 for negative earnings, and 0 otherwise. B_t is the book value of equity divided by the number of outstanding shares. $TACC$ is the total accruals defined as the sum of the change in non-cash working capital, in net non-current operating accruals, and in net financial assets divided by the number of outstanding shares. The change in non-cash working capital is the change in current assets net of cash and short-term investments minus that in current liabilities net of short-term debt. The change in non-current operating accruals is measured as the change in non-current assets net of long-term non-equity investments and advances minus the change in non-current liabilities net of long-term debt. The change in net financial assets is measured as the change in short- and long-term investments minus the change in short-term debt, long-term debt, and preferred stock. The missing values of total accruals are set to zero.

The model is estimated cross-sectionally using the previous ten years of data to ensure no look-ahead bias. Specifically, one-year-ahead earnings in year t (E_{t+1}) are estimated using data from year $t-10$ to $t-1$, two-year-ahead earnings (E_{t+2}) are estimated using data from year $t-11$ to

$t-2$, and so forth. The model is estimated for firms with non-missing independent variables in year t. For each firm in year t, the forecasted EPS for years $(t+1)$–$(t+5)$ (FE_{t+1}–FE_{t+5}) is estimated by using the estimated coefficients from regression (A.4) and variables at t. Using the forecasted EPS, we estimate the implied cost of equity from the model developed by Gebhardt et al. (2001).

E. Additional Results

Table E1: Sensitivities of Cash Saving to Cash Sources

This table reports cash saving from external capital and internal cash flows (Panel A), and cash saving from equity issues and debt issues (Panel B). The dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. *ExCapital* and *ICF* are external capital and internal cash flow, respectively. Control variables include *Leverage*, the leverage ratio; *Size*; *NWC*, net working capital excluding cash and equivalents; *M/B*, the market-to-book asset ratio; *Vol*, cash flow volatility, *CapEx*, capital expenditures; *Acquisitions*; *Dividend*; and *lagged Cash*. In Panel A, firm fixed effects are included in Column 2. Year fixed effects are included in Column 3. Firm and year fixed effects are included in Column 4. Standardized beta coefficients are reported in Column 5. In Panel B, *Eissue* and *Dissue* are equity issues and debt issues, respectively. The specific variable definitions are provided in Appendix. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: External Capital vs Internal Cash Flows					
	(1)	(2)	(3)	(4)	(5)
ExCapital	0.5385***	0.5584***	0.5413***	0.5557***	0.7702
	[0.0136]	[0.0141]	[0.0136]	[0.0140]	
ICF	0.4566***	0.4628***	0.4608***	0.4583***	0.3718
	[0.0102]	[0.0117]	[0.0104]	[0.0117]	
Cash	-0.0535***	-0.1770***	-0.0564***	-0.1844***	-0.0775
	[0.0041]	[0.0076]	[0.0042]	[0.0077]	
M/B	0.0080***	0.0072***	0.0087***	0.0081***	0.0821
	[0.0006]	[0.0009]	[0.0007]	[0.0009]	
Vol	-0.0288	0.1588***	-0.0197	0.0810**	-0.0043
	[0.0222]	[0.0382]	[0.0234]	[0.0402]	
Dividend	-0.7700***	-0.7629***	-0.7764***	-0.7478***	-0.1546
	[0.0221]	[0.0403]	[0.0226]	[0.0412]	
Leverage	-0.0273***	-0.0115**	-0.0254***	-0.004	-0.0465
	[0.0021]	[0.0050]	[0.0022]	[0.0051]	
Size	-0.0007***	-0.0052***	-0.0011***	-0.0141***	-0.014
	[0.0002]	[0.0007]	[0.0002]	[0.0012]	
NWC	-0.0403***	0.0567***	-0.0392***	0.0642***	-0.0639
	[0.0026]	[0.0069]	[0.0026]	[0.0070]	
CapEx	-0.5042***	-0.5511***	-0.5037***	-0.5466***	-0.6762
	[0.0109]	[0.0118]	[0.0109]	[0.0117]	
Acquisitions	-0.0608***	-0.0478***	-0.0611***	-0.0496***	-0.0909
	[0.0078]	[0.0082]	[0.0078]	[0.0081]	
R&D	0.1177***	-0.0201	0.1155***	-0.0353	0.0621
	[0.0097]	[0.0408]	[0.0096]	[0.0401]	
Firm FEs	No	Yes	No	Yes	No
Year FEs	No	No	Yes	Yes	No
Observations	76,821	76,821	76,821	76,821	76,821
Adj. R^2	0.3552	0.411	0.3625	0.4197	0.3552

Panel B: Equity vs Debt				
	(1)	(2)	(3)	(4)
Eissue	0.4510***			0.6622***
	[0.0149]			[0.0185]
Dissue		0.0828***		0.4522***
		[0.0074]		[0.0131]
ICF			0.2770***	0.4361***
			[0.0079]	[0.0112]
Controls	No	No	No	Yes
Firm FEs	No	No	No	Yes
Year FEs	No	No	No	Yes
Observations	82,565	82,565	82,565	76,821
Adj. R^2	0.1574	0.007	0.0431	0.4355

Table E2: Reg FD: Robustness Checks

This table reports the results of two robustness tests using Reg FD as a shock to the COC. The first robustness test use R&D before the implementation of Reg FD as an alternative criterion to construct treatment and control group. The second robustness test excludes high-tech industries using M/B before the implementation of Reg FD to construct treatment and control group. High-tech industries are classified following Brown et al. (2009). We compare the impacts of a shock to the cost of capital on cash saving from external capital (Panel A), excess issuance (Panel B), and the influence of future investment on cash saving (Panel C) between firms with high and low hedging motives. High and low hedging motive firms are defined as those in the top 30 percent and those in the bottom 30 percent based on the hedging motive measure. In Panel A, the dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. $ExCapital$ and ICF are external capital and internal cash flow, respectively, divided by total assets at the beginning of the year. $Post$ dummy is zero for 1996-1999 and one for 2000-2003. The treated firms are the top 50% of R&D-to-Sales ratio among positive R&D firms and control firms are zero-R&D firms in 1999. In Panel B, the dependent variable is excess capital issues. In Panel C, the dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. $FInvestment$ is future investment defined as the average of subsequent two years of capital expenditures plus acquisitions plus R&D divided by lagged total assets. The detailed variable definitions are provided in Appendix. Firm and year fixed effects are controlled for. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: Cash Saving				
	Alternative Criterion		Exclude High-Tech Firms	
	High Hedging	Low Hedging	High Hedging	Low Hedging
	(1)	(2)	(3)	(4)
Treated×Post	0.0176**	0.0011	0.0179*	0.0046
	[0.0089]	[0.0174]	[0.0093]	[0.0060]
ExCapital×Post	-0.0192	-0.0021	-0.1513	0.0532
	[0.0418]	[0.0268]	[0.1519]	[0.0379]
Treated×ExCapital×Post	0.1851**	0.1194	0.3424*	0.0384
	[0.0796]	[0.1093]	[0.1780]	[0.0636]
Treated×ExCapital	0.0641	0.0975	-0.1855	0.0020
	[0.1163]	[0.1777]	[0.1722]	[0.0494]
ExCapital	0.3845***	0.2976***	0.5724***	0.2693***
	[0.0429]	[0.0414]	[0.0989]	[0.0631]
ICF	0.4125***	0.2757***	0.3783***	0.1667***
	[0.0476]	[0.0435]	[0.1071]	[0.0335]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,659	2,811	2,675	2,817
Adj. R^2	0.4475	0.3103	0.3636	0.2050

Panel B: Excess Capital				
	Alternative Criterion		Exclude High-Tech Firms	
	High Hedging	Low Hedging	High Hedging	Low
	(1)	(2)	(3)	(4)
Treated×Post	0.0927***	0.0398	0.0576***	0.012
	[0.0245]	[0.0335]	[0.0130]	[0.0122]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,659	2,811	2,675	2,817
Adj. R^2	0.2772	0.3023	0.3254	0.2507

Panel C: Future Investment				
	Alternative Criterion		Exclude High-Tech Firms	
	High Hedging	Low Hedging	High Hedging	Low Hedging
	(1)	(2)	(3)	(4)
FInvestment	0.0137	-0.0029	0.3668*	0.1570*
	[0.0553]	[0.0357]	[0.1983]	[0.0950]
FInvestment×Post	-0.0593	-0.0371	-0.2427	-0.0508
	[0.0468]	[0.0306]	[0.1593]	[0.0663]
Treated×Post×FInvestment	0.5148***	0.0299	0.2726*	0.0667
	[0.1797]	[0.2705]	[0.1599]	[0.0815]
Treated×Post	-0.0427	0.0110	0.0101	-0.0030
	[0.0360]	[0.0464]	[0.0170]	[0.0107]
Treated×Finvestment	-0.3009	-0.0559	-0.2604	-0.1679
	[0.2259]	[0.2716]	[0.1971]	[0.1156]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,659	2,811	2,675	2,817
Adj. R^2	0.2683	0.1747	0.2545	0.0838

Table E3: Hedging Motive: Robustness

This table reports the robustness of the impacts of the cost of capital on the sensitivity of cash saving to external capital between firms with high and low hedging motives. The dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. *ExCapital* and *ICF* are external capital and internal cash flow, respectively, divided by total assets at the beginning of the year. High and low hedging need firms are defined as those in the top and bottom 30 percent based on the hedging motive measure. In Panel A Columns (1) and (2), we use high-order cumulants (Erickson et al. (2014)) to account for measurement errors in the cost of capital measure. Columns (3) and (4) present the results for firms raising a minimum of 3% excess capital. In Columns (5) and (6), firms in high-tech industries following Brown et al. (2009). Panel B presents the results when using Li et al. (2013) (Columns 1 and 2), Claus and Thomas (2001) (Columns 3 and 4), and Li and Mohanram (2014) (Columns 5 and 6) as alternative COE measures. Panels C reports the results for subperiods 1981-1999 and 2000-2019. Panel D reports the results using the alternative hedging motive measures: the correlation between industry-level external finance and the COC (Hedging Motive 1) and the correlation between the *KZ* index and the COC (Hedging Motive 2). The detailed variable definitions are provided in Appendix. Firm and year fixed effects are controlled. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	Panel A: Robustness					
	Measurement Errors		Active Issuances		Exclude High-tech Industries	
	High Hedging	Low Hedging	High Hedging	Low Hedging	High Hedging	Low Hedging
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.0116	0.1146***	-0.0763***	0.1106***	-0.0929***	0.0692***
	[0.0295]	[0.0312]	[0.0284]	[0.0261]	[0.0197]	[0.0163]
ExCapital	0.6243***	0.3798***	0.6896***	0.3800***	0.7189***	0.4103***
	[0.0324]	[0.0277]	[0.0626]	[0.0376]	[0.0592]	[0.0341]
ICF	0.4789***	0.3092***	0.4186***	0.2847***	0.4549***	0.3071***
	[0.0218]	[0.0190]	[0.0289]	[0.0262]	[0.0217]	[0.0196]
ExCapital×COC	-0.6968***	0.2162	-2.0428***	-0.1574	-2.0920***	-0.2225
	[0.1703]	[0.1928]	[0.4295]	[0.2770]	[0.4246]	[0.2700]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	No	No	Yes	Yes	Yes	Yes
Year FEs	No	No	Yes	Yes	Yes	Yes
Observations	23,218	23,242	12,692	12,725	23,202	23,194
Adj. R^2			0.4578	0.2878	0.4217	0.2920

Panel B: Alternative COC Measures						
	Li et al. (2013)		Claus and Thomas (2001)		Li and Mohanram (2014)	
	High Hedging	Low Hedging	High Hedging	Low Hedging	High Hedging	Low Hedging
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.5884***	0.3735***	-0.4737***	0.3354***	-0.6491***	0.4938***
	[0.0443]	[0.0361]	[0.0454]	[0.0396]	[0.0526]	[0.0390]
ExCapital	0.5659***	0.3262***	0.4575***	0.4519***	0.4215***	0.2107***
	[0.0340]	[0.0307]	[0.0420]	[0.0441]	[0.0356]	[0.0282]
ICF	0.3948***	0.3380***	0.2955***	0.3297***	0.3142***	0.2546***
	[0.0173]	[0.0151]	[0.0165]	[0.0184]	[0.0141]	[0.0114]
ExCapital×COC	-2.2147***	-0.5234	-1.3825***	-0.6647	-1.4226***	0.2363
	[0.3816]	[0.3393]	[0.4012]	[0.4565]	[0.5075]	[0.3851]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,746	19,738	15,258	15,388	19,623	19,579
Adj. R^2	0.4392	0.3362	0.3770	0.4006	0.3208	0.2635

Panel C: Subperiods				
	1981-1999		2000-2019	
	High Hedging	Low Hedging	High Hedging	Low Hedging
	(1)	(2)	(3)	(4)
COC	-0.1588***	0.0947***	-0.3140***	0.1724***
	[0.0247]	[0.0212]	[0.0441]	[0.0346]
ExCapital	0.6206***	0.2909***	0.7067***	0.4047***
	[0.0490]	[0.0349]	[0.0384]	[0.0385]
ICF	0.2458***	0.2617***	0.1913***	0.1706***
	[0.0548]	[0.0275]	[0.0596]	[0.0316]
ExCapital×COC	-1.2632***	0.2464	-1.0022**	-0.0436
	[0.2726]	[0.2209]	[0.3897]	[0.4139]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	10,263	10,450	12,698	12,697
Adj. R^2	0.4349	0.3117	0.4861	0.3469

	Panel D: Alternative Hedging Measures			
	Hedging Motive 1		Hedging Motive 2	
	High Hedging	Low Hedging	High Hedging	Low Hedging
	(1)	(2)	(3)	(4)
COC	-0.0139	-0.0227	-0.0592***	0.0382**
	[0.0184]	[0.0221]	[0.0165]	[0.0166]
ExCapital	0.6414***	0.5143***	0.5208***	0.3945***
	[0.0468]	[0.0460]	[0.0337]	[0.0283]
ICF	0.4760***	0.4289***	0.3555***	0.3739***
	[0.0201]	[0.0217]	[0.0187]	[0.0180]
ExCapital×COC	-0.6775**	-0.2316	-0.6482***	0.0488
	[0.2928]	[0.4105]	[0.2180]	[0.2115]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	23,586	22,721	23,273	23,403
Adj. R^2	0.4373	0.4039	0.3894	0.3836

Table E4: Alternative Motives

This table reports the test results of the alternative motives for cash saving. The dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. Panel A compares cash saving from external capital and internal capital for financially constrained and unconstrained firms with a high hedging motive using our hedging measure and using the measure described in Acharya et al. (2007). The reported results are based on the HP index. Panel B compares the impacts of the cost of capital on the sensitivities of cash saving to external capital between firms with high and low market timing motives. We measure market timing by the yearly timing (Timing 1), long-term timing (Timing 2) following Kayhan and Titman (2007), and mispricing proxy (Timing 3) developed by Stambaugh et al. (2015). For each measure, we define firms in the top 30 percent as firms with high market timing motive and those in the bottom 30 percent as firms with a low market timing motive while removing the middle 40 percent. Panel C compares the impacts of the cost of capital on the sensitivities of cash saving to external capital issues between firms with high and low precautionary motives. Firms with high (low) precautionary motives are defined as firms without (with) dividend payments, firms in the top 30 percent (bottom 30 percent) based on R&D expenditures, the industry-level median cash flow volatility (*CF Risk*), and a precautionary motive measure (*Precaution*), respectively. In Panel D, we test the predictions of model developed by Bolton et al. (2013) that considers both the market timing and precautionary motives. We compare the impacts of the cost of capital on the sensitivity of cash saving to external capital sources between firms with high and low cash holdings. Firms with high (low) cash holdings are classified as those in the top 30 percent (bottom 30 percent) based on the past two-year average cash ratios or the cash balance. *ExCapital* and *ICF* are external capital and internal cash flow, respectively, divided by total assets at the beginning of the year. Panel E test whether the market timing or precautionary motive explains the sensitivities of excess capital issuance to the cost of capital. For brevity, the results based on the Timing 1 measure, *Precaution*, and cash balance are reported. Panel F reports differences between firms with high hedging motives (Columns 1 and 3) and firms with low hedging motives (Columns 2 and 4) for high credit risk firms and low credit risk firms. Panel G reports differences between firms with high hedging motives (Columns 1 and 3) and firms with low hedging motives (Columns 2 and 4) for high agency risk firms and low agency risk firms. Firm and year fixed effects are controlled. The detailed variable definitions are provided in Appendix. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: Compare with AAC Measure				
	High Hedging Motive		High AAC Measure	
	Unconstrained	Constrained	Unconstrained	Constrained
	(1)	(2)	(3)	(4)
COC	-0.0605***	-0.2100***	-0.0606*	-0.0499
	[0.0207]	[0.0406]	[0.0339]	[0.0603]
ExCapital	0.4837***	0.9039***	0.6314***	0.8193***
	[0.0439]	[0.0831]	[0.0454]	[0.0987]
ICF	0.3778***	0.4647***	0.4081***	0.5089***
	[0.0291]	[0.0300]	[0.0367]	[0.0332]
ExCapital×COC	-0.6602***	-3.6461***	-0.4448	-2.4221***
	[0.2460]	[0.7232]	[0.3309]	[0.8512]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	12,432	10,605	5,440	5,602
Adj. R^2	0.3440	0.4928	0.5112	0.5128

	Panel B: Market Timing Motive					
	Timing 1		Timing 2		Timing 3	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.0176	-0.0380*	-0.0636**	-0.0751***	0.0116	-0.0853***
	[0.0272]	[0.0220]	[0.0318]	[0.0209]	[0.0259]	[0.0207]
ExCapital	0.6038***	0.5579***	0.5605***	0.5168***	0.4393***	0.6615***
	[0.0435]	[0.0378]	[0.0407]	[0.0344]	[0.0438]	[0.0591]
ICF	0.4603***	0.4215***	0.4204***	0.4146***	0.2786***	0.5573***
	[0.0210]	[0.0202]	[0.0216]	[0.0208]	[0.0245]	[0.0251]
ExCapital×COC	-0.4889	-0.5223*	-0.0710	-0.5619**	-0.6269	-0.6083
	[0.3638]	[0.3022]	[0.3724]	[0.2610]	[0.4163]	[0.4192]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,640	15,766	15,811	15,976	17,147	17,547
Adj. R^2	0.4431	0.4383	0.4502	0.3802	0.3544	0.4691

	Panel C: Precautionary Motive							
	Dividend		R&D		CFSD		Precaution	
	High	Low	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COC	-0.0185*	-0.0796***	-0.0141	-0.0325**	-0.0660**	-0.0223	-0.0114	-0.0543***
	[0.0107]	[0.0308]	[0.0183]	[0.0140]	[0.0260]	[0.0313]	[0.0274]	[0.0200]
ExCapital	0.4204***	0.7185***	0.8037***	0.4279***	0.5372***	0.6298***	0.6467***	0.5391***
	[0.0234]	[0.0434]	[0.0442]	[0.0273]	[0.0405]	[0.0565]	[0.0509]	[0.0342]
ICF	0.3366***	0.5071***	0.5309***	0.3722***	0.4447***	0.4290***	0.4673***	0.4440***
	[0.0144]	[0.0158]	[0.0167]	[0.0156]	[0.0177]	[0.0265]	[0.0258]	[0.0166]
ExCapital×COC	-0.4517***	-0.8105*	-1.3856***	-0.3685	-0.0332	-0.3556	-0.5376	-0.5748**
	[0.1685]	[0.4409]	[0.3903]	[0.2249]	[0.3664]	[0.5236]	[0.4544]	[0.2752]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	46,057	29,997	31,754	44,888	19,571	19,588	22,256	24,153
Adj. R^2	0.3337	0.4694	0.5003	0.3387	0.4243	0.4614	0.4448	0.4084

	Panel D: Market Timing and Precautionary Motives			
	Cash Ratio		Cash Balance	
	High	Low	High	Low
	(1)	(2)	(3)	(4)
COC	-0.1247***	0.0047	-0.0478***	-0.0144
	[0.0303]	[0.0094]	[0.0145]	[0.0227]
ExCapital	0.8486***	0.1264***	0.6711***	0.4106***
	[0.0515]	[0.0175]	[0.0374]	[0.0388]
ICF	0.6577***	0.1157***	0.4251***	0.3207***
	[0.0192]	[0.0136]	[0.0188]	[0.0200]
ExCapital×COC	-0.7493	0.0268	-1.1242***	-0.5483*
	[0.5199]	[0.1345]	[0.2618]	[0.3277]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	21,948	22,660	23,475	21,786
Adj. R^2	0.5496	0.2314	0.4420	0.3529

	Panel E: Excess Issuance					
	Market Timing		Precautionary		Market Timing and Precautionary	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.9747***	-0.4816***	-0.7709***	-0.5723***	-0.3529***	-0.7278***
	[0.2025]	[0.0624]	[0.1095]	[0.0919]	[0.0825]	[0.1325]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,811	15,976	22,256	24,153	23,475	21,786
Adj. R^2	0.0806	0.2595	0.1412	0.1513	0.1249	0.2278

	Panel E: Credit Risk			
	High Risk		Low Risk	
	High Hedging Motive	Low Hedging Motive	High Hedging Motive	Low Hedging Motive
	(1)	(2)	(3)	(4)
COC	-0.0906***	0.0217	-0.1147***	0.1084***
	[0.0274]	[0.0280]	[0.0278]	[0.0188]
ExCapital	0.8465***	0.4634***	0.4843***	0.3503***
	[0.0846]	[0.0550]	[0.0522]	[0.0388]
ICF	0.5308***	0.3776***	0.3288***	0.2227***
	[0.0286]	[0.0309]	[0.0308]	[0.0212]
ExCapital×COC	-2.6755***	-0.1097	-0.9946**	-0.4975
	[0.6090]	[0.4193]	[0.4073]	[0.3233]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	13,170	12,441	9,981	10,716
Adj. R^2	0.4743	0.3180	0.3212	0.2636

	Panel F: Agency Risk			
	High Agency Risk		Low Agency Risk	
	High Hedging Motive	Low Hedging Motive	High Hedging Motive	Low Hedging Motive
	(1)	(2)	(3)	(4)
COC	-0.0738***	0.0400*	-0.1405***	0.1137***
	[0.0223]	[0.0229]	[0.0394]	[0.0230]
ExCapital	0.5998***	0.4275***	0.8567***	0.4024***
	[0.0877]	[0.0533]	[0.0870]	[0.0446]
ICF	0.4336***	0.3216***	0.4608***	0.3025***
	[0.0272]	[0.0247]	[0.0321]	[0.0313]
ExCapital×COC	-1.2381**	-0.2832	-3.3823***	-0.2656
	[0.5274]	[0.3477]	[0.7918]	[0.4600]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	12,770	11,776	10,432	11,418
Adj. R^2	0.3809	0.2930	0.4600	0.2983