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THE SENSITIVITY OF CASH SAVINGS TO THE COST OF CAPITAL

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ABSTRACT

We show theoretically and empirically that in the presence of a time-varying cost of capital (COC), firms have a hedging motive to reduce the overall COC over time by saving cash when COC is relatively low. The sensitivity of cash savings to COC is especially pronounced with respect to the cost of equity and for firms with greater correlation between COC and financing needs for future investments. Both financially constrained and unconstrained firms respond to low COC by saving cash out of external capital issuance in excess of current financial needs.

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1. Introduction

Capital market frictions make external capital costlier than internally generated funds, which may lead to suboptimal investment decisions (Myers (1984)). While the literature has suggested that firms mitigate such external financing constraints by saving cash from internal cash flows, cash savings from external capital are underexplored.[1] Yet, we find that firms in the United States save 35 cents from each dollar of equity capital raised compared to 20 cents from each dollar of internal cash flows. Moreover, external equity issuance alone explains 16%, while internal cash flows explain only 4%, of corporate cash savings. Intuitively, with time-varying cost of capital (COC), firms are likely to benefit from issuing external capital and saving when COC is relatively low. However, how COC affects firms' cash savings behavior is not well understood.

In this paper, we show that a firm's cash saving is sensitive to COC, and that this sensitivity is driven by the firm's need to hedge against raising external capital at a higher cost for future investments (hedging motive). Firms save to lower the *overall* COC in the presence of time-varying COC. Our theoretical model suggests that firms respond to presently low levels of COC by issuing excess external capital and hoarding cash if they anticipate external financing needs for future investments. Saving cash by raising external capital is costly. Nonetheless, firms choose their optimal savings to balance the current COC and the expected COC for future investments. In particular, firms save more when (i) the current COC is low and (ii) they face high correlation between COC and financing needs for future

[1] See, among others, Almeida, Campello, and Weisbach (2004), Acharya et al. (2007), Han and Qiu (2007), Bates et al. (2009), Chang et al. (2014), and Qiu and Wan (2015).

investments.

To test these predictions, we estimate COC by the weighted average cost of capital. The cost of equity (COE) is estimated by the implied cost of capital which is the internal rate of return obtained by equating the stock price to the present value of future cash flow forecasts by analysts and the cost of debt (COD) by actual yield on the debt carried by the firm.[2] We show that the average cash holdings of firms are negatively associated with the average COC over the 35-year sample period (Figure 1). Moreover, firms save significantly more when the COC is lower relative to its historical average (Figure 2) and when they expect greater future investments (Figure 3). The empirical results also show that firms save significantly more from external capital when their COC decreases.

We measure a firm's hedging motive as the correlation coefficient between COC and its external finance dependence based on the standard proxies used in the literature. A high correlation indicates that the firm faces higher COC when it needs more external capital. Consistent with the predictions of our model, the results show that firms' cash savings from external capital are more sensitive to COC when their hedging needs are greater. Firms with greater hedging needs issue significantly more external capital in excess of current financial needs when COC is relatively low. Future investment needs also influence the sensitivity of cash savings to COC, especially for those with high hedging motives. These findings support our perspective on corporate hedging that firms save to hedge their future investments against high COC.

[2] Claus and Thomas (2001) and Fama and French (2002) use the implied cost of capital (ICC) to measure equity premium; Li, Ng, and Swaminathan (2013) and Lee, So, and Wang (2020) use the ICC to predict stock market return; Burgstahler, Hail, and Leuz (2006), Botosan and Plumlee (2005), Hughes, Liu, and Liu (2009) Frank and Shen (2016), Xu (2020), and Byoun, Ng, and Wu (2016) use the ICC to estimate the cost of equity.

When comparing the relative importance of equity and debt as sources of external capital, we find that firms save cash significantly more from equity issues (35 cents from each dollar of equity raised) relative to debt issues (6 cents from each dollar of debt raised). Moreover, firms' cash savings are much more sensitive to COE than COD.

Our results are robust to alternative COC measures and to adjustments for potential measurement errors. To address the endogeneity concern that cash savings may affect COC, we adopt an identification strategy that uses Regulation Fair Disclosure (Reg FD) effective in 2000 as an exogenous shock to COC and conduct the difference-in-difference analysis. Reg FD reduces COC by leveling the information playing field, especially for firms with high market-to-book ratios or high R&D expenditures relative to other firms as shown in Chen et al. (2010). By exploiting the cross-sectional variation in the impact of Reg FD on COC, we show that an increase in the sensitivity of cash savings to external capital for firms experiencing a larger decline in COC compared to firms with a smaller decline in COC following Reg FD.

We then investigate whether financial constraints explain the sensitivity of cash savings to COC. We find that both financially constrained and unconstrained firms save more in response to low COC and they both save more from external capital than from internal cash flows. Almeida et al. (2004) suggest that financially constrained firms save from cash flows to mitigate underinvestment due to financial constraints. Our findings suggest that firms save not just from cash flows to mitigate the effect of financial constraints, but from external capital to hedge against higher financing costs for future investments. Saving from external capital when COC is relative low reduces underinvestment due to higher COC in the future.

We also explore alternative theories that might explain the sensitivity of cash savings to COC. The most plausible alternative is the market timing motive which suggests that firms save from equity issue proceeds to take advantage of overvalued stock (Alti (2006), Kim and Weisbach (2008), Bates, Kahle, and Stulz (2009), and Hertzel and Li (2010)). External finance dependent firms are known to be particularly sensitive to market timing for their equity issuance decisions (Lamont et al. (2001) and Baker, Stein, and Wurgler (2003)). Thus, according to the market timing hypothesis, external finance dependent firms are more likely to save from equity issue proceeds when COC is lower. Using several proxies for external finance dependence, we do not find support for the market timing motive in explaining our results.

Keynes (1936) suggests that the main purpose of precautionary cash savings is to insulate the firm from external finance by saving from internal cash flows. Thus, the precautionary motive of Keynes does not predict that firms save cash out of external capital issuance when the COC is low as we document. However, McLean (2011) shows that the precautionary motive—measured as R&D, cash flow volatility, dividend payout, and their principal component—explains cash savings from equity issue proceeds. Accordingly, we examine whether firms with greater precautionary motives save more from external capital when COC is relatively low. Although the precautionary motive has a positive effect on cash savings, it does not account for the sensitivity of cash savings to COC. The effects of hedging motive remain significant for both high and low precautionary motive firms.

2. Related Literature

Previous empirical studies raise challenges for existing theories of corporate cash holdings. DeAngelo, DeAngelo, and Stulz (2010) argue that the vast majority of firms with attractive market-timing opportunities fail to issue stocks and many mature firms issue stocks without apparent financial difficulties. Moreover, Dittmar et al. (2019) suggest that the existing theories fail to explain the bulk of the within-firm variation of cash savings. We show that firms save to reduce the overall COC by transferring financial resources to future states with higher COC. Accordingly, the market timing (to take advantage of overvalued stock) and the precautionary motive (to meet uncertain contingencies) are not sufficient conditions for firms to save from external capital because firms will not issue external capital to save if they have no expected capital needs or if they can meet their future capital needs at low COC. Our findings suggest that COC has a significant and independent impact on corporate cash saving decisions and that external capital is an important source of cash savings for firms with greater hedging needs.

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 firms' cash savings and cash flows can be negatively related because firms reduce cash to increase investment after receiving positive cash flow shocks. In the financial constraint models, constrained firms trade off between current and future investments to save from cash flows. In our model, firms trade off not only between current and future investments but also between current COC and future COC to hedge against higher financing costs for future investments. The hedging motive drives the sensitivity of cash savings to COC for both financially constrained and unconstrained firms. Our empirical results also show that cash savings of *both* financially constrained and unconstrained firms increase approximately by 9% relative to the mean when there is one percentage point decrease in COC. With the hedging motive, firms save not only from internal cash flows but also (and especially) from external capital to lower the overall costs of COC, which in turn improves firms' overall investment efficiency.

Acharya, Almeida, and Campello (2007) show that financially constrained firms' preference for cash savings over preserving debt capacity using internal funds depends on their needs to hedge investment opportunities against income shortfalls. Our hedging motive distinguishes itself from their study in that we deal with cash savings from *both* internal cash flows and external capital (especially equity) in response to COC. More importantly, both financially constrained and unconstrained firms save from external capital at relatively low COC to lower the overall COC for future investments.

Our study also complements Azar, Kagy, and Schmalz (2016) who suggest that the cost of carry for cash holdings is an important factor explaining the time trend of corporate cash holdings. Gao, Whited, and Zhang (2020), however, find a hump-shaped relation between cash holdings and interest rates. They rationalize this relationship in a model where firms' precautionary cash demand correlates with interest rates nonmonotonically. They suggest that interest rates are not likely to explain the recent rise in corporate cash. We add to the literature by explaining that the hedging motive is an important determinant of corporate cash savings and that corporate cash savings are closely related to COC, particularly to the cost of equity.

3. Hypothesis Development

3.1 A Model for Cash Savings with External Financing Costs

We develop a two-period model to illustrate how cash savings are affected by the time-varying cost of external finance. The intuition from the analytical solution to the two-period model can also apply to a dynamic model as shown in Appendix 4.

We consider a firm, endowed initially with W_t, that faces a two-period investment and financing decisions with zero discount rate. The cash flow from investment at t is given by

$$\Pi(I_t) = \pi(I_t) + z_t, \tag{1}$$

where I_t is investment at the beginning of t which depreciates by the end of the period, $\pi(I_t)$ is the expected cash flows with $\pi_I > 0$ and $\pi_{II} < 0$, and z is i.i.d. with zero mean.[3]

The firm maximizes the current shareholder wealth which is given as

$$\begin{aligned} V_t &= \max_{(I_t, C_t, X_t)} \{W_t - C_t - I_t - \mathbb{1}_{(X_t>0)}\lambda_t(X_t) + E_t V_{t+1}\} \qquad (2) \\ &\quad \text{subject to} \quad X_t = I_t + \mathbb{1}_{(X_t>0)}\lambda_t(X_t) + C_t - W_t \quad \text{and} \quad C_t \geq 0, \\ &\quad \text{where} \quad V_{t+1} = \max_{(I_{t+1}, X_{t+1})} \{\Pi(I_{t+1}) - I_{t+1} - \mathbb{1}_{(X_{t+1}>0)}\lambda_{t+1}(X_{t+1})\}, \end{aligned}$$

where C_t is cash saving at t which returns the same amount at $t+1$, and E_t is expectation given information at t, X_t is external finance. The external financing decision is made

[3] f_x and f_{xx} denote first and second derivatives, respectively, of $f(x)$ with respect to x, and "*i.i.d*" stands for independent and identically distributed across firms and over time.

at the beginning of each period, and there are external finance costs arising from market frictions such as agency and asymmetric information problems. The net proceeds from external finance is reduced from the gross proceeds by the cost of external finance. The external finance cost is represented by $\mathbb{1}_{(X_t>0)}\lambda_t(X_t)$ where $\mathbb{1}_{(X_t>0)}$ is an indicator which is 1 when $X > 0$ with $0 < \lambda_t'(X_t) < 1$ and zero otherwise. The external finance cost function implies that the marginal external finance cost increases with the amount of external capital raised and cannot be greater than its proceeds. The firm's needs for external capital at t is determined by the sum of investment, cash saving, and external financing costs minus initial endowment. The firm pays out funds without costs if X_t is negative.

To explore the optimal cash saving, financing, and investment decisions in (2), we solve the model backwards, starting with the second-period decisions.

$$\begin{aligned} V_{t+1} &= \max_{(I_{t+1}, X_{t+1})} \{\Pi(I_{t+1}) - I_{t+1} - \mathbb{1}_{(X_{t+1}>0)}\lambda_{t+1}(X_{t+1})\} \\ &\qquad \text{subject to} \quad X_{t+1} = I_{t+1} + \mathbb{1}_{(X_{t+1}>0)}\lambda_{t+1}(X_{t+1}) - \Pi(I_t) - C_t. \end{aligned} \tag{3}$$

The external capital raised by the firm at $t+1$ depends on the cash flow generated from investment and cash saved at t. The first-order conditions with respect to the firm's optimal decisions on I_{t+1} and X_{t+1} are

$$\pi_I(I_{t+1}) = 1 + \mu_{t+1} \quad \text{and} \quad \mu_{t+1} = \frac{\lambda_{t+1}'(X_{t+1})}{1 - \lambda_{t+1}'(X_{t+1})}, \tag{4}$$

where μ_{t+1} is the Lagrangian for the constraint on X_{t+1}. These conditions imply that the optimal level of investment is below the first-best level (I_{t+1}^*), satisfying $\pi_I(I_{t+1}^*) = 1$ if the firm raises external capital and pays the financing cost. The first-best level of investment can be achieved when the firm generates sufficiently large cash flow from its initial investment in addition to cash saving at t ($I^*_{t+1} \leq \Pi(I_t) + C_t$). If the cash flow and saved cash are not sufficient to cover the investment, the firm has to rely on external capital and the investment will be determined to satisfy: $\pi_I(\hat{I}_{t+1}) = 1/[1 - \lambda'_{t+1}(\hat{I}_{t+1})] > 1$. Thus, the firm will invest less than the first-best level in the presence of the cost of external capital ($\hat{I} \leq I^*_{t+1}$). In the presence of a fixed cost component of external finance, the firm may invest using the internal cash flow and saved cash from t without raising external capital at $t+1$ for some realization of $\Pi(I_t)$ ($\hat{I}_{t+1} < I_{t+1} < I^*_{t+1}$).

Based on the above observations we now have

$$
\begin{aligned}
E_t V_{t+1} \;=\; & \int_{I^*_{t+1} - C_t - \pi(I_t)}^{\infty} \left\{ \pi(I^*_{t+1}) + \pi(I_t) + z + C_t - I^*_{t+1} \right\} g(z) dz \\
& + \int_{\hat{I}_{t+1} - C_t - \pi(I_t)}^{I^*_{t+1} - C_t - \pi(I_t)} \left\{ \pi(C_t + \pi(I_t) + z) \right\} g(z) dz \\
& + \int_{-\infty}^{\hat{I}_{t+1} - C_t - \pi(I_t)} \left\{ \pi(\hat{I}_{t+1}) - \lambda_{t+1}(X_{t+1}) \right\} g(z) dz,
\end{aligned}
\tag{5}
$$

where $g(z)$ is the probability density function (PDF) of z. Note also that $\hat{I}_{t+1} = \pi(I_t) + z + C_t + X_{t+1} - \lambda_{t+1}(X_{t+1})$.

Moving back to the first period, the first order conditions (FOC) for the firm's maximization problem with respect to I_t, C_t, and X_t are

$$[1+H]\pi_I(I_t) - 1 - \mu_t = 0, \tag{6}$$

$$(1+H) - 1 - \mu_t - \psi_t = 0, \tag{7}$$

$$-\lambda_t'(X_t) + \mu_t[1 - \lambda_t'(X_t)] = 0, \tag{8}$$

where μ_t and ψ_t is the Lagrangian for constraints on X_t and C_t, respectively, and

$$\begin{aligned} H &= \int_{\hat{I}_{t+1}-C_t-\pi(I_t)}^{I^*_{t+1}-C_t-\pi(I_t)} \{\pi_I(C_t+\pi(I_t)+z)-1\}\, g(z)dz \\ &\quad + \int_{-\infty}^{\hat{I}_{t+1}-C_t-\pi(I_t)} \left\{\pi_I(\hat{I}_{t+1}) + \lambda_{t+1}(X_{t+1}) - 1\right\} g(z)dz. \end{aligned}$$

Appendix 1 provides the details of the derivation of these first order conditions. Given $\hat{I}_{t+1} < I_{t+1} < I^*_{t+1}$, we have $\pi_I(\hat{I}_{t+1}) > \pi_I(I_{t+1}) > \pi_I(I^*_{t+1}) = 1$ and hence $H > 0$. H represents the expected loss from underinvestment due to external finance cost and lower cash flow at $t+1$. The FOCs suggest that H is an important consideration for investment and cash saving decisions at t. In particular, when the firm relies on external finance, the firm will choose the optimal investment where the marginal benefit of investment $[1+H]\pi_I(I_t)$ is equal to its marginal cost $1+\mu_t = \frac{1}{1-\lambda_t'(X_t)}$. Similarly, the optimal cash saving decision with external finance is made where the marginal benefit of cash saving $((1+H)-\psi_t)$ is equal to its marginal cost $(1+\mu_t = \frac{1}{1-\lambda_t'(X_t)})$. These conditions also imply that a lower cost of external capital at t increases both investment and cash savings at t.

If the firm is unconstrained at t in that it has sufficient initial endowment to make initial investment and cash saving ($\lambda_t(X_t) = 0$ and $\mu_t = 0$), the optimal cash saving will be set where its marginal benefit is equal to the marginal cost ($(1+H) - \psi_t = 1$). In this case, the firm's optimal investment is set at $(1 + H)\pi_I(I_t) = 1$.

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

For $\hat{X}_t > 0$

$$\frac{\partial \hat{I}_t}{\partial \lambda_{t+1}} = 0, \quad \text{and} \quad \frac{\partial \hat{X}_t}{\partial \lambda_{t+1}} > \frac{\partial \hat{C}_t}{\partial \lambda_{t+1}} > 0. \tag{9}$$

For $\hat{X}_t \leq 0$

$$\frac{\partial \hat{I}_t}{\partial \lambda_{t+1}} = 0, \quad \text{and} \quad \frac{\partial \hat{X}_t}{\partial \lambda_{t+1}} = \frac{\partial \hat{C}_t}{\partial \lambda_{t+1}} > 0.$$

Proof: See Appendix 2.

Proposition 1 suggests that when the firm expects to raise external capital at a higher cost, the firm will raise additional external capital to save more. Even when the firm is not constrained in that it has enough cash at hand to make its investment at t, it will increase cash when expecting a higher cost of external capital. If the firm does not save at t, low internal cash flow at $t + 1$ must result in an increase in the amount of external capital at a higher cost and a reduction in the amount of investment at $t+1$. Thus, whether constrained or not, the firm's cash saving will be sensitive to the relative cost of external capital. When constrained, however, the firm needs external capital at t more than cash savings to cover the external finance cost. Cash saving will be particularly sensitive to COC when the firm expects greater future investment relative to internal cash flow. The optimal investment at t, however, is not affected by the expected COC at $t+1$ because the marginal return on cash remains constant while that on investment is decreasing. Consequently, when the firm expects higher cost of external finance at $t+1$, it is more beneficial to save cash rather than to increase investment at t, since cash saving helps the firm hedge against the higher future cost of external finance at a lower cost. Thus, firms expecting higher external finance costs are likely to increase cash savings by raising external capital beyond current investment, i.e., excess capital issuance. Together with the first order conditions at t, the proposition also suggests that the firm will save more when it faces lower COC at t relative to COC at $t+1$. Cash saved at lower COC at t reduces the amount of external capital needs to be raised at higher COC at $t+1$, which reduces overall COC for the firm.

3.2 Hedging Needs

There should be greater hedging needs if negative shocks to the firm's cash flow make it more costly for the firm to raise external capital (Froot et al. (1993)), especially when the firm is expecting greater future investment. If this is the case, the firm will save more than it otherwise would in order to fund its future investment while making less use of external capital at higher costs.

We formalize these hedging needs for cash savings by generalizing the external finance cost function to be $\lambda_{t+1}(X_{t+1}, \gamma)$, where γ measures the strength of the correlation between the cost of external finance γ and external capital needs $(I_{t+1} - \Pi(I_t))$. We now make the following assumptions about the nature of $\lambda_{t+1}(X_{t+1}, \gamma)$ to reflect that the effects of γ on the marginal cost of external finance:

Assumption 1 *The external finance cost function, λ, satisfies:*

for $\hat{X} > 0$*,*

$$\begin{aligned}
&(i) \qquad && \frac{\partial\lambda(\hat{X},\gamma)}{\partial X} = \lambda^{'}(\hat{X},\gamma) \in (0,1); \\
&(ii) \qquad && \frac{\partial^2\lambda(\hat{X},\gamma)}{\partial X\partial\gamma} = \lambda^{'}_{\gamma}(\hat{X},\gamma) > 0; \quad \textit{and} \\
&(iii) \qquad && \frac{\partial^2\lambda(\hat{X},\gamma)}{\partial\lambda\partial\gamma} > 0;
\end{aligned} \tag{10}$$

for $\hat{X} \leq 0$*,*

$$\lambda(\hat{X},\gamma) = \lambda^{'}(\hat{X},\gamma) = \frac{\partial^2\lambda(\hat{X},\gamma)}{\partial\lambda\partial\gamma} = 0.$$

(i) implies that the marginal cost of external finance increases with $\hat{X}$, whereas (ii) and (iii) imply that the firm faces higher marginal cost of external finance when the correlation between external capital needs and COC is greater. The assumption for $\hat{X} \leq 0$ implies that there is no cost when the firm does not raise external capital.

Proposition 2 establishes the properties on the effects of the correlation between external capital needs and external finance cost on the optimal decisions at t.

Proposition 2 *The optimal levels of cash saving $\hat{C}_t$, external finance, $\hat{X}_t$, and investment, $\hat{I}_t$, exhibit :*

$$\frac{\partial^2\hat{C}_t}{\partial\lambda_{t+1}\partial\gamma} > 0; \quad \frac{\partial^2\hat{X}_t}{\partial\lambda_{t+1}\partial\gamma} > 0; \quad \text{and} \quad \frac{\partial^2\hat{I}_t}{\partial\lambda_{t+1}\partial\gamma} = 0; .$$

Proof: See Appendix 3.

Proposition 2 suggests that the sensitivities of the optimal cash saving and external finance decisions are magnified by the correlation between external capital needs and external finance cost as measured by γ. Thus, firms with high γ face greater hedging needs. When expecting higher COC at $t+1$, without cash savings the firm with greater hedging needs may have to reduce future investments due to higher external finance cost. Alternatively, the firm can issue external capital at time t at a lower cost and save for future investment, thereby reducing the overall costs of external finance. Consequently, the amount of cash savings and excess capital issuance should be larger when the firm expects greater investment but higher COC in the future.

Propositions 1 and 2 lead to the following hedging motive hypotheses:

Hypothesis 1a Firms with a high correlation between external capital needs and COC will save more when COC is relatively low.

Hypothesis 1b Firms with a high correlation between external capital needs and COC will issue more excess external capital when COC is relatively low.

Hypothesis 1c Firms with greater future expected investments will save more when COC is relatively low.

4. The Data and Variables

4.1 The Sample

The initial sample consists of all U.S. firms from the annual Compustat files for the period of 1981–2015. We require that firms have positive values for assets, equity, cash holdings and net sales. Financial firms (SIC codes 6000-6799) and regulated utilities (SIC codes 4900-4999) are excluded from the sample. Observations with missing net income and stock issuance proceeds are also excluded. Stock price information is from the Center for Research in Security Prices (CRSP), the nominal GDP growth rates from the Bureau of Economic Analysis, and the interest rates from Federal Reserve Bank of St. Louis.

To estimate the implied cost of capital, we obtain analysts' earnings and growth forecasts from 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 projecting the long-term growth rate on the prior year's earnings forecast.

4.2 Cost of Capital

We estimate the COE using the implied cost of capital approach with three different models proposed by Claus and Thomas (2001), Gebhardt, Lee, and Swaminathan (2001), and Li, Ng, and Swaminathan (2013). The implied cost of capital is the discount rate that equates a stock's present value of expected cash flows to its current price. Detailed procedures are provided in Appendix 6. Given that firms are required to file their financial statements within 90 days of the fiscal year end, we estimates COE using earliest forecasts available after three months of the prior fiscal year end. The reported results are based on the Li, Ng, and Swaminathan (2013) approach and are robust to alternative COE estimates.

We estimate the COC as follows:

$$COC_{i,t} = \frac{Debt_{i,t}}{MVA_{i,t}} COD_{i,t}(1 - TaxRate) + (1 - \frac{Debt_{i,t}}{MVA_{i,t}})COE_{i,t}, \tag{11}$$

where $COC_{i,t}$ is the weighted average cost of capital for firm i in year t. $\frac{Debt_{it}}{MVA_{it}}$ is the market leverage ratio. $COD_{i,t}$ is COD for firm i in year t, measured as the actual yield on the debt carried by the firm, as in Frank and Shen (2016).

4.3 Hedging Motive Measures

We measure hedging motive by the correlation coefficient between external capital needs and COC. Three proxies are used to capture firms' needs for external capital: KZ index, External Finance Dependence, and Financial Deficit. Following Baker, Stein, and Wurgler (2003), we use the KZ index to measure external finance dependence as follows:

$$KZ = -1.002CF - 39.368DIV - 1.315CASH + 3.139LEV, \tag{12}$$

where CF is operating cash flow 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.

Following Rajan and Zingales (1998), external finance is measures by:

$$External = (CapEx - OCF)/CapEx, \tag{13}$$

where $CapEx$ is capital expenditures; and OCF is operating cash flow.

We also follow Shyam-Sunder and Myers (1999), Frank and Goyal (2003), and Byoun (2008) to define financial deficit as follows:

$$Deficit = (Div + Acq + Inv - ICF1)/TA, \tag{14}$$

where Div is cash dividend; Acq is acquisitions; Inv is net investments; $ICF1$ is income before extraordinary items plus depreciation and amortization; and TA is total assets at the beginning of the period.

We use the industry median $External$ and $Deficit$ based on the 2-digit SIC code and the firm-level KZ as proxies for external capital needs. To measure hedging needs, we obtain annual external capital needs measures and compute their correlation coefficients with individual firms' COCs. Based on the correlation coefficients, we define firms in the top 30 percent as high hedging-needs firms and those in the bottom 30 percent as low hedging-needs firms, dropping the middle 40 percent. Hedging motives 1-3 below are based on $External$, $Deficit$, and KZ, respectively.

5. Empirical Analysis

5.1 Univariate Analysis

The summary statistics of firm characteristic variables and COC are reported in Table 1 Panel A. The average cash holding is 14% of total assets and the cash saving rate is about 1.75% of total assets. The average COC is 9.41% with the average cost of equity (COE) of 9.89% and the average cost of debt (COD) of 8.43%. Panel B shows the decomposition of standard deviation of COC across firms and over time. As expected, COD exhibit less variation than COE cross-sectionally and over time.

Table 1

Figure 1 plots average annual cash holdings relative to average COC, COE, and COD over the sample period. The striking symmetry of the two series suggests that firms increase (decrease) cash when COC is low (high). Thus, COC appears to be an important driver of corporate cash holding behavior over time as well. Notably, COC has been declining significantly until early 2000s, which may explain the increasing trend in cash holdings over the same period documented by Bates et al. (2009).

Figure1

To further examine how relatively low COC drives corporate cash savings, we obtain a firm's COC minus its historical average for firms with a minimum of 3-year data. Figure 2 plots cash savings across deciles of the deviation of COC from the historical average for the sample period of 1981-2015 and the subsample periods of 1981-1998 and 1999-2015. The downward-sloping graphs indicate that firms save more when COC is lower than the historical average.

Figure 2

Figure 3 plots current year cash savings across future investment deciles. The figure shows that firms with greater future investment save more cash in the current year, which is consistent with the hedging motive of cash savings.

Figure 3

5.2 Sensitivities of Cash Savings to Cash Sources

Firms may save cash from internal or external capital. To examine how cash savings are associated with cash sources in a multivariate setting, we run the following regression:

$$\Delta Cash_{it} = \lambda_0 + \lambda_1 ExCapital_{it} + \lambda_2 ICF_{it} + \lambda_3 X_{it-1} + f_i + \varepsilon_{it} \tag{15}$$

where $\Delta Cash_{it}$ is the change in cash and equivalents for firm i in year t; ICF_{it} is internal cash flow; $ExCapital_{it}$ is the sum of net equity issue and net debt issue. 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 is firm fixed effects. Following Opler et al. (1999) and Bates et al. (2009), we include the following control variables: M/B_{it-1}, market-to-book asset ratio; $Cash_{it-1}$, lagged cash-to-asset ratio; Vol, cash flow volatility; $Leverage_{it-1}$, leverage ratio; $Size_{it-1}$, 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 $t-1$; $Divdend_{it}$, cash dividend divided by total assets at $t-1$; $Tbill_t$, the one-year treasury bill rate; $Spread_t$, the credit spread between the 10-year BBB bond yield and maturity-matched treasury bond yield.[4] We also include indicator variables, $D90$ and $D00$, allowing the intercept to change in the 1990s and the 2000s (2000-2014). We winsorize all variables except for $Tbill$, $Spread$, and dummy variables, at 2 and 98 percentiles in order to mitigate the effects of outliers.

We first estimate the model without firm fixed effects. The results are reported in Table 2. The coefficient estimate of external capital ($ExCapital$) is 0.2897 and significant,

[4] The T-bill rate and the bond yields are published by the Federal Reserve Bank of St. Louis.

whereas that of internal cash flows (ICF) is 0.2340 and significant. To evaluate the relative importance of external capital to internal cash flows, we estimate the standardized beta coefficients. Column 3 of Table 2 shows that the standardized beta coefficient of external capital is much larger than that of internal cash flow (0.5502 vs. 0.2476), which indicates that external capital is the major source of firms' cash savings.

Table 2

When we include firm fixed effects (column 2), the coefficient estimates of the cash sources remain positive and significant. The estimates also show that M/B, T-bill rate and credit spread have positive effects, while lagged cash, dividend, leverage, firm size, net working capital, capital expenditures, and acquisitions have negative effects. The positive coefficients on $D00$ indicate that the later years (2000s) are associated with more cash savings.

5.3 Cost of Capital and Cash Savings

To test whether firm's cash savings are sensitive to COC, we include COC and its interactions with external capital ($ExCapital$) and internal cash flows (ICF) in equation 15. The estimation results are reported in Table 3. For brevity, we do not report estimates on control variables. The negative and significant coefficient estimates of COC suggest that firms save less when COC is high. The economic magnitude of the impact is also significant. One percentage point decrease in COC is associated with approximately 9% increase in cash savings relative to the mean. The negative coefficient estimates of its interaction with external capital indicate that firms save significantly more from external capital when COC is lower. The coefficient estimates of the interaction between COC and ICF are also negative but marginally significant, which suggests that firms may also save more from internal cash flows when the COC is relatively low.

Table 3

6. Hedging Motive

Our model suggests that in the presence of time-varying cost of capital, cash savings enable firms to transfer resources from the low cost state to the high cost state. Moreover, firms with a high correlation between their COC and external financing needs (high hedging motive) have more incentives to do so. We test these predictions in this section.

6.1 Hedging Needs and Cash Savings

To test hypothesis 1a that firms with high hedging motives will save more when COC is relatively low, we examine whether the sensitivity of cash savings to COC is more pronounced for firms with high hedging needs. We split the sample into high and low hedging needs firms based on the hedging motive measures and report the results in Table 4. Hedging Motives 1 to 3 represent the correlation coefficients between COC and each of the three measures of external capital needs ($External$, $Deficit$, and KZ), respectively. The coefficient estimates of the interaction terms between external finance proceeds and COC ($ExCapital \times COC$) are significant and negative only for high hedging needs firms, indicating that firms with greater hedging motives save more from external capital when the COC is relatively low. The results are consistent with hypothesis 1a.

Table 4

6.2 Hedging Needs and Excess Capital Issuance

Hypothesis 1b predicts that firms with greater hedging needs issue excess capital when COC is relatively low. To test this prediction, we define excess capital issuance as net external capital issue proceeds minus financial deficit, which represents the portion of external capital that is saved as cash. Panel A of Table 5 reports the results for high and low hedging needs firms based on three hedging motive measures. The coefficient estimates of COC are negative and significant only for firms with high hedging needs. These results are consistent with hypothesis 1b, indicating that firms with high hedging needs issue excess external capital to save as cash when the COC is lower.

Table 5

6.3 Future Investment and Cash Savings

We now test hypothesis 1c which predicts that firms save cash to fund future investments with the following regression:

$$\Delta Cash_{it} = \alpha_0 + \alpha_1 FInvest_{it} + \alpha_2 ICC_{it} + \alpha_3 FInvest_{it} \times ICC_{it} + \alpha_4 X_{it-1} + f_i + \varepsilon_{it} \quad (16)$$

where $FInvest_{it}$ is future investment at time t for firm i, defined as the average of investments in subsequent two years scaled by lagged total assets.[5] The same set of control variables as in equation 15 are included. We expect firms to save more when they expect greater future investment ($\alpha_1 > 0$) because firms' realized future investment will be positively correlated with managers' ex ante expected investment. We estimate model 16 separately for firms with

[5]The use of realized future investment is in line with the use of future stock returns in previous studies (Baker et al. (2003) and DeAngelo et al. (2010)).

low and high hedging needs. Since the incentive to save cash for future expected investment will be greater when facing relatively low COC, we expect a negative sign for α_3, especially for firms with greater hedging needs.

Panel B in Table 5 reports the results for high and low hedging needs firms based on three hedging motive measures. The coefficient estimates of future investment are positive and significant only for high hedging needs firms. Moreover, the coefficient estimates of the interaction term between future investment and COC are all negative and significant only for high hedging needs firms. These findings provide support for hypothesis 1c that firms save cash at a low cost for future investments.

6.4 Debt vs Equity

Thus far, our results show that firms save cash from external capital and this saving behavior is affected by COC. As equity and debt are two main sources of external capital, we investigate their relative importance for firms' cash savings. We first run a simple regression for each of the cash sources. The results are reported in Table 6 Panel A. The coefficient estimate of net equity issues ($EIssue$) is 0.3462 and significant with adjusted R^2 of 16.19%. The coefficient estimate of debt issues ($DIssue$) is mere 0.0567 and the adjusted R^2 is 0.6%. The estimated coefficient of internal cash flows (ICF) is 0.2030 and statistically significant with the adjusted R^2 of 4.37%. When we include all cash sources along with control variables (column 4) and firm fixed effects (column 5), coefficient estimates of all the cash sources remain positive and significant. Overall, equity is the most important source for cash savings.

We then examine the relative importance of COE and COD for firms' cash savings by including the interaction terms of COE (COD) with net equity issue proceeds (net debt issue proceeds) and internal cash flows into our regression model. As shown in Table 6 Panel B, the coefficient estimates of COE are mostly negative and significant, while the coefficient estimates of COD are mostly insignificant. For all firms in Column (1), the coefficient estimates of both $Eissue \times COE$ and $ICF \times COE$ are negative and significant. The coefficient estimate of $Dissue \times COD$ is also negative and significant but that of $ICF \times COD$ is insignificant. These results suggest that firms cash savings from equity issuance and internal cash flows are both sensitive to COE, whereas cash savings from internal cash flows show little sensitivity to COD.

When the sample is split into high and low hedging needs firms in the remaining columns, we find that the coefficient estimates of both $Eissue \times COE$ and $ICF \times COE$ are significant and negative only for high hedging needs firms. Thus, COE appears to be an important consideration in firms' cash saving decisions particularly for high hedging needs firms.

6.5 Exogenous Shock to Cost of Capital

An endogeneity concern may arise if firms' cash savings affect their cost of capital. To ease this concern and buttress our results for the causal effects of COC on cash savings, we exploit an exogenous event that affects firms' COC. In particular, we use Regulation Fair Disclosure (Reg FD) as a shock to COC and investigate whether firms experiencing a greater reduction in COC in the post-Reg FD period save more from external capital than firms experiencing a smaller reduction in COC. Reg FD, effective on October 23, 2000, prohibits selective disclosure of material information to a subset of market participants, such as analysts and institutional investors, without simultaneously disclosing it to the public. By curtailing selective disclosure, the Securities and Exchange Commission (SEC) believed that Reg FD would encourage continued widespread investor participation in capital markets, enhancing market efficiency and liquidity, and more effective capital raising. As a result, the Reg FD lowered COC for firms with selective disclosure before Reg FD (Chen et al. (2010)).

Following Chen et al. (2010), we use market-to-book ratios (M/B) and R&D as firm characteristics indicative of selective disclosure and classify firms into treated and control groups. Specifically, treatment and control firms are defined as top and bottom 30% of M/B or as top 50% of R&D-to-Sales ratio among positive R&D firms and zero-R&D firms, respectively. We set the *Post* dummy as one for 2000-2002 and zero for 1997-1999.

Columns (1) and (2) in Table 7 show the results for M/B- and R&D-based measures of selective disclosure, respectively. For both measures, the coefficient estimates of the triple interaction term $Treated \times ExCapital \times Post$ are positive and significant, which suggests that cash savings from external capital have significantly increased for firms with a larger reduction in COC relative to firms with a smaller reduction in COC following the legislation. We also conduct placebo tests based on fictitious event years of 2006 and 2011. The results of placebo tests reported in columns (3)-(6) show that none of the coefficient estimates of $Treated \times ExCapital \times Post$ are significant. Thus, the results appear to be unique around the Reg FD and are less likely due to other confounding factors. These findings boost our confidence that COC has a causal impact on corporate cash savings from external capital.

6.6 Robustness

Even though we have shown that COC has a significant impact on cash savings in the natural experimental setting, there can be an endogeneity concern due to measurement errors in COC. As another remedy for measurement errors in COC, we estimate the model using the high-order cumulants as suggested by Erickson et al. (2014). Table A1 in Appendix 7 reports the estimation results. The coefficient estimates of the interaction of external capital and COC in Columns (1) and (2) are negative and significant for high hedging motive firms, whereas it is insignificant for lower hedging motive firms. The results are consistent with our main estimations. We also examine whether our results are robust to alternative measures of COC using the Claus and Thomas (2001) and Gebhardt, Lee, and Swaminathan (2001) approaches as specified in Appendix 6. The results in Columns (3)-(6) remain robust to these alternative COC measures.

7. Financial Constraints and Other Measures of Hedging Motives

7.1 Financial Constraints

Since financial constraint is an important consideration for firms' cash saving decisions (Almeida et al. (2004)), it is possible that our results simply reflect financial constraints. To investigate this possibility, we examine whether financial constraints explain the cash saving behavior observed in Table 3. Following the previous studies, we use credit rating, the WW (Whited and Wu (2006)) index, and the HP (Hadlock and Pierce (2010)) index to define financially constrained and unconstrained firms. Financially constrained (unconstrained) firms are defined as those without (with) credit ratings or in the top (bottom) 30 percent of the WW index or the HP index.

Table 8

The results in Table 8 Panel A show that both financially constrained and unconstrained firms save more when COC is relatively low. In terms of economic magnitude, one percentage point decrease in COC is associated with approximately 9% increase in cash savings relative to the mean for both constrained and unconstrained firms.[6] Moreover, the results suggest that external capital is a more important source of cash saving than internal cash flows for both constrained and unconstrained firms.

The estimated coefficients of $ExCapital \times COC$ are negative and significant for both constrained and unconstrained firms. Firms' cash savings from external capital in response to COC are also economically significant for both financially constrained and unconstrained firms. When $ExCapital \times COC$ decreases by one standard deviation, cash savings of financially unconstrained (constrained) firms increase by 17% (12%). The estimated coefficients of $ICF \times COC$ are also negative and significant for both constrained and unconstrained firms based on bond ratings, but significant only for financially constrained firms based on WW and HP indexes. The results indicate that cash savings from internal cash flows are more sensitive to COC for financially constrained firms.

We further test whether financial constraints help explain firms' excess capital issuance in response to low COC and the effects of future investments on cash savings. To this

[6] The average cash saving ratio of constrained and unconstrained firms is 2.06% and 0.83%, respectively.

end, we partition firms with high (low) hedging motives into financially constrained and unconstrained firms. The unreported tables show that both financially constrained and unconstrained firms with high hedging motives raise external capital in excess of current financial needs when COC is relatively low.[7] The estimated coefficients of $FInvest \times COC$ are negative and significant for both constrained and unconstrained firms with high hedging motives, while the coefficients are insignificant for both constrained and unconstrained firms with low hedging motives. Overall, these results suggest that financial constraints cannot fully explain the sensitivities of cash savings to COC.

7.2 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 flow from current operations and its industry-level median R&D expenditures. We investigate whether their hedging needs measure explains the sensitivity of cash savings to 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 in Panel B of Table 8. 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 in Panel A that both financially constrained and unconstrained firms save from external capital when COC is relatively low.

[7] The tables are available upon request.

When the AAC measure is used, however, the coefficient estimate of $ExCapital \times COC$ are insignificant for both financially constrained and unconstrained firms, whereas the coefficient estimate of $ICF \times COC$ is negative and significant for constrained firms. The results are consistent with the finding of Acharya et al. (2007) that financially constrained firms save from internal funds when their hedging needs against cash flow shortage are high.

8. Alternative Explanations

8.1 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 non-fundamental components of the stock price such as investor sentiment which affects COC directly but not cash flows (Campbell, Polk, and Vuolteenaho, 2010). When such mispricing drives current COC lower relative to the expected COC, the firm may see an opportunity to issue external capital and save. Such cash savings, however, are not motivated by future investments (Bolton, Chen, and Wang, 2013). If market timing is the motive for firms' cash saving behavior, the effect should be captured by the sensitivity of excess capital to COC for firms that depend more on external finance (Baker et al., 2003). These arguments lead to the following market timing hypotheses:

Hypothesis 2a External finance dependent firms save more from external capital when COC is relatively low than do less external finance dependent firms.

Hypothesis 2b External finance dependent firms issue more excess external capital when

COC is relatively low than do less external finance dependent firms.

We conduct a series of tests to investigate whether the marketing timing motive can explain our results. To test for the market timing hypothesis 2a, we estimate the regression models for firms with high and low external finance dependence based on three external finance dependence measures. As shown in Table 9 Panel A, the coefficient estimates of $ExCapital \times COC$ are negative and significant for low external finance dependent firms, but insignificant for high external finance dependent firms. The results are inconsistent with the market timing hypothesis 2a. Thus, the market timing motive does not fully explain the sensitivity of cash savings to COC.

Table 9

In Panel C, we test the market timing hypothesis 2b on excess external capital. The results show that the coefficient estimates of COC are negative and significant for both low and high external finance dependence, ruling out the possibility that excess capital issues are mainly driven by the market timing motive.

We also investigate whether the market timing motive explains the effects of future investment on cash savings by estimating model (16) separately for high and low market timing firms. In Panel D, the coefficient estimate of $FInvest \times COC$ is insignificant for firms with high market timing motive, but significant for firms with low market timing motive. Thus, the market timing motive does not explain firms' sensitivities of cash savings to COC when expecting future investments.

8.2 Precautionary Motive

The precautionary motive argues that 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 relatively low COC is not considered as the main reason for precautionary cash savings. In particular, Keynes (1936) argues that the quantity of cash demanded for precautionary purposes is not too sensitive to changes in 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 firms save from equity issuance for the precautionary motive (McLean, 2011), we examine whether cash savings of firms with greater precautionary motives are more sensitive to COC. Specifically, we test the following precautionary motive hypotheses:

Hypothesis 3a Firms with greater precautionary motives save more when COC is relatively low than do firms with less precautionary motives.

Hypothesis 3b Firms with greater precautionary motives issue more excess external capital when COC is relatively low than do firms with less precautionary motives.

We then test whether the precautionary motive explains the sensitivity of cash savings to COC. Following the previous studies, we use R&D spending, cash flow volatility, and non-dividend payout as measures of precautionary motives which represent unforeseen opportunities and contingencies requiring sudden expenditures. Cash flow volatility is the 10-year standard deviation of average industry cash flow based on the 2-digit SIC code. We pay particular attention to the precautionary measure of 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 non-dividend-paying firms as high precautionary firms and dividend-paying firms as low precautionary firms. Table 9 Panel B shows that the estimated coefficients of $ExCapital \times COC$ are all negative and significant for both low and high precautionary firms. The results provide no support for the precautionary hypothesis 3a.

We test the precautionary hypothesis 3b on excess external capital and find that the coefficient estimates of COC are negative and significant for both low and high precautionary motive firms (Panel C). The results are inconsistent with hypothesis 3b, indicating that capital issues in excess of current financial needs are not mainly driven by the precautionary motive.

We also examine whether the precautionary motive explains the effects of future investment on cash savings. As shown in Panel D, the coefficient estimates of $FInvest \times COC$ are both insignificant for firms with high or low precautionary motives. Thus, there is no supportive evidence that the precautionary motive explain the effects of future investments on firms' sensitivities of cash savings to COC.

9. Conclusions

We develop a theoretical model showing that in the presence of time-varying COC, firms channel funds into future states of high COC by saving cash from external capital when current COC is relatively low. In particular, when a firm expects a higher COC for future investments, it will increase cash savings from external capital at a low cost to lower the *overall* cost of capital. Cash savings and excess external financing of firms with greater hedging needs are more sensitive to COC.

Consistent with the theoretical predictions, we find that both financially constrained and unconstrained firms save more cash from external capital than from internal cash flows. Cash savings of firms with greater hedging needs are particularly sensitive to their COC. Moreover, firms with greater hedging needs tend to issue excess external capital when COC is relatively low. Our findings cannot be fully explained either by the precautionary motive or by the market timing motive. Our study illustrates that firms' hedging motive to transfer funds from the states of low COC to the states of higher COC through cash savings is an important consideration for corporate cash saving policies.

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Figure 1: Cash Holdings versus Cost of Capital

This figure plots firms' average cash holdings relative to the level of the cost of capital (COC, COE, COD) from 1981 to 2015. Cash is cash and equivalents divided by total assets.

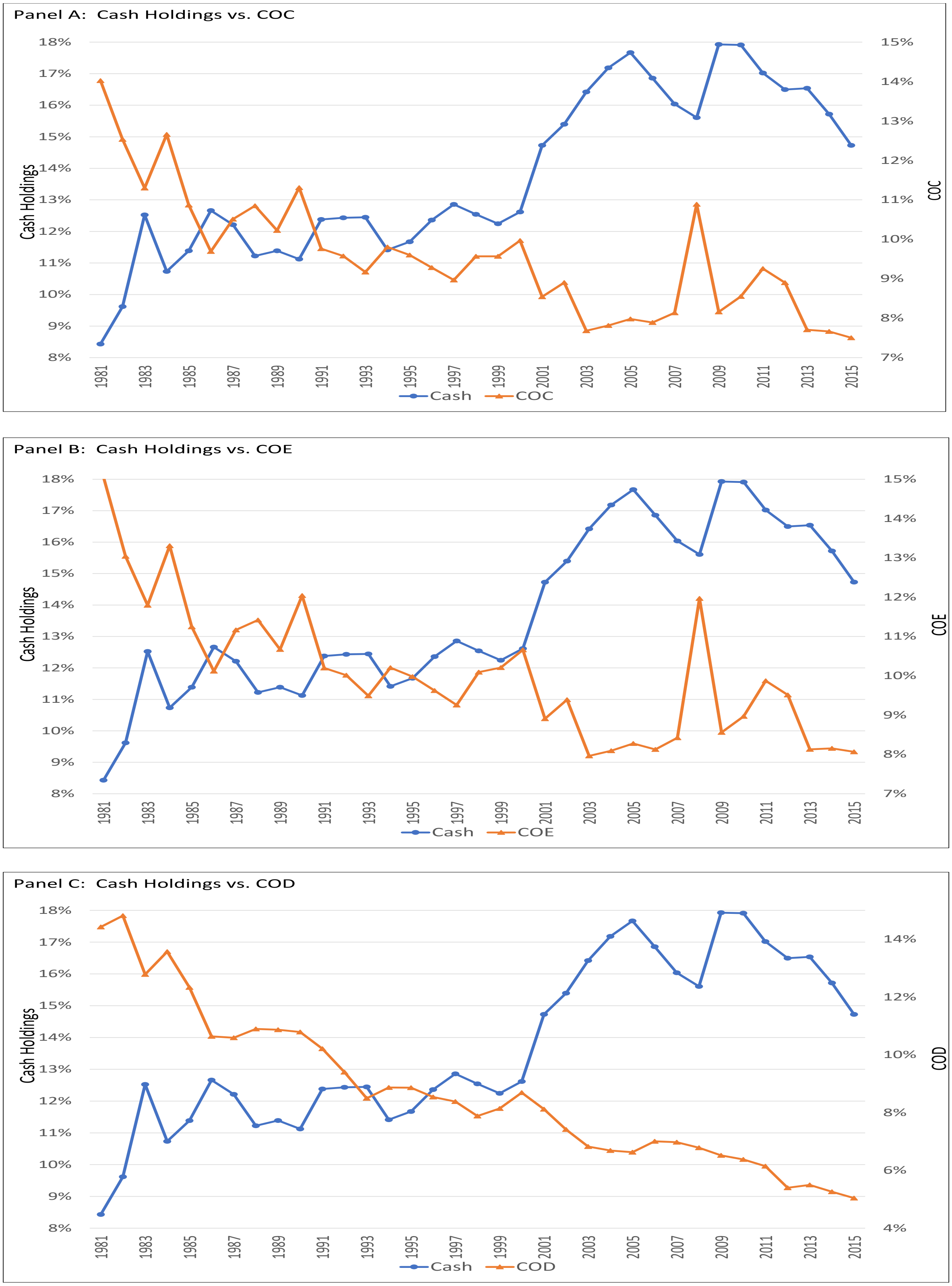

Figure 2: Cost of Capital and Cash Savings

The figure presents firms' cash savings across deciles of the deviation of cost of capital (COC) from its historical average for firms with a minimum of three-year observations for the sample period of 1981-2015 and the subsample periods of 1981-1998 and 1999-2015. Cash savings is the changes in cash and equivalents divided by total assets at the beginning of the year.

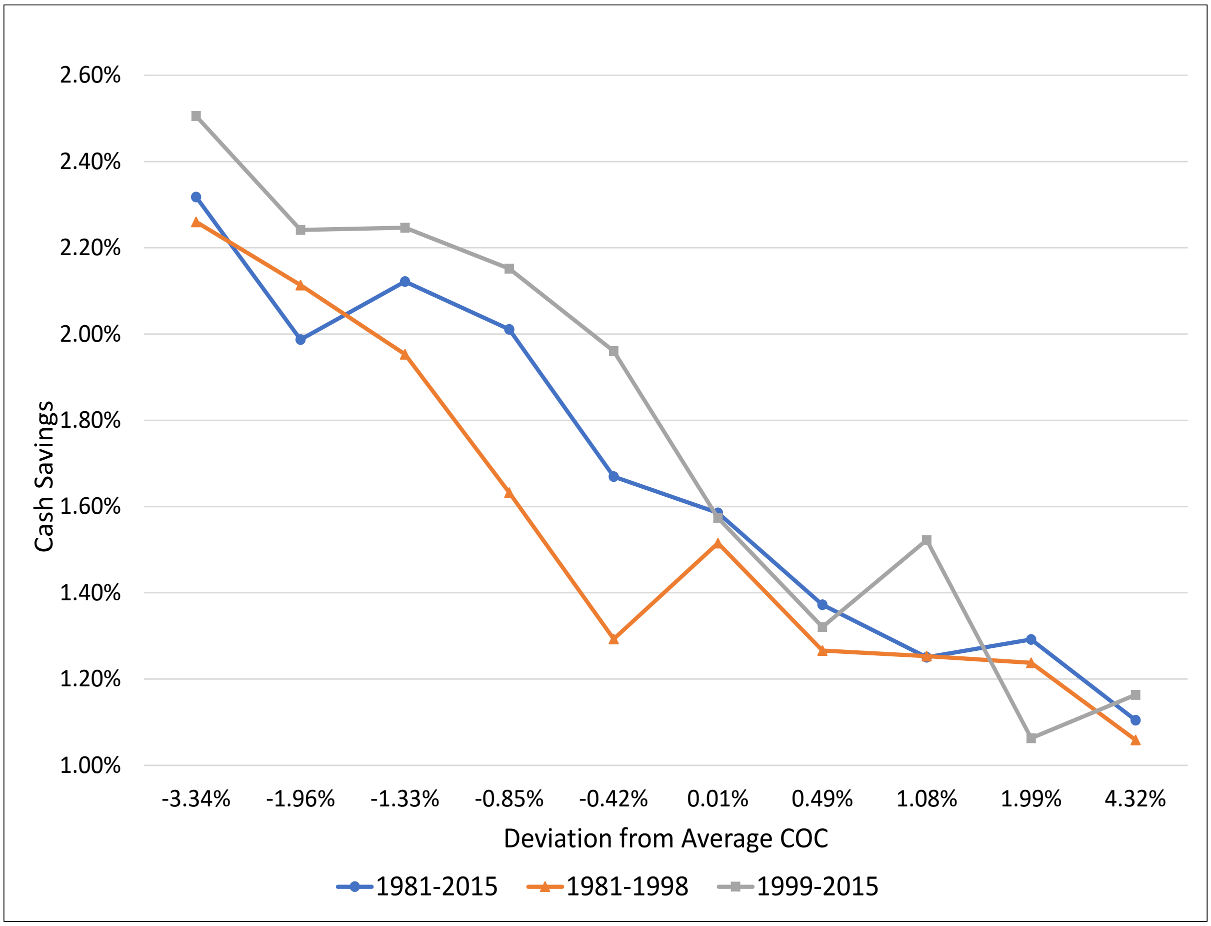

Figure 3: Cash Savings versus Future Investment

This figure plots firms' cash savings relative to future investment deciles. Future investment is defined as the two subsequent year average of capital expenditures plus acquisitions and R&D divided by lagged total assets. Cash saving is the current year change in cash and equivalents divided by lagged total assets.

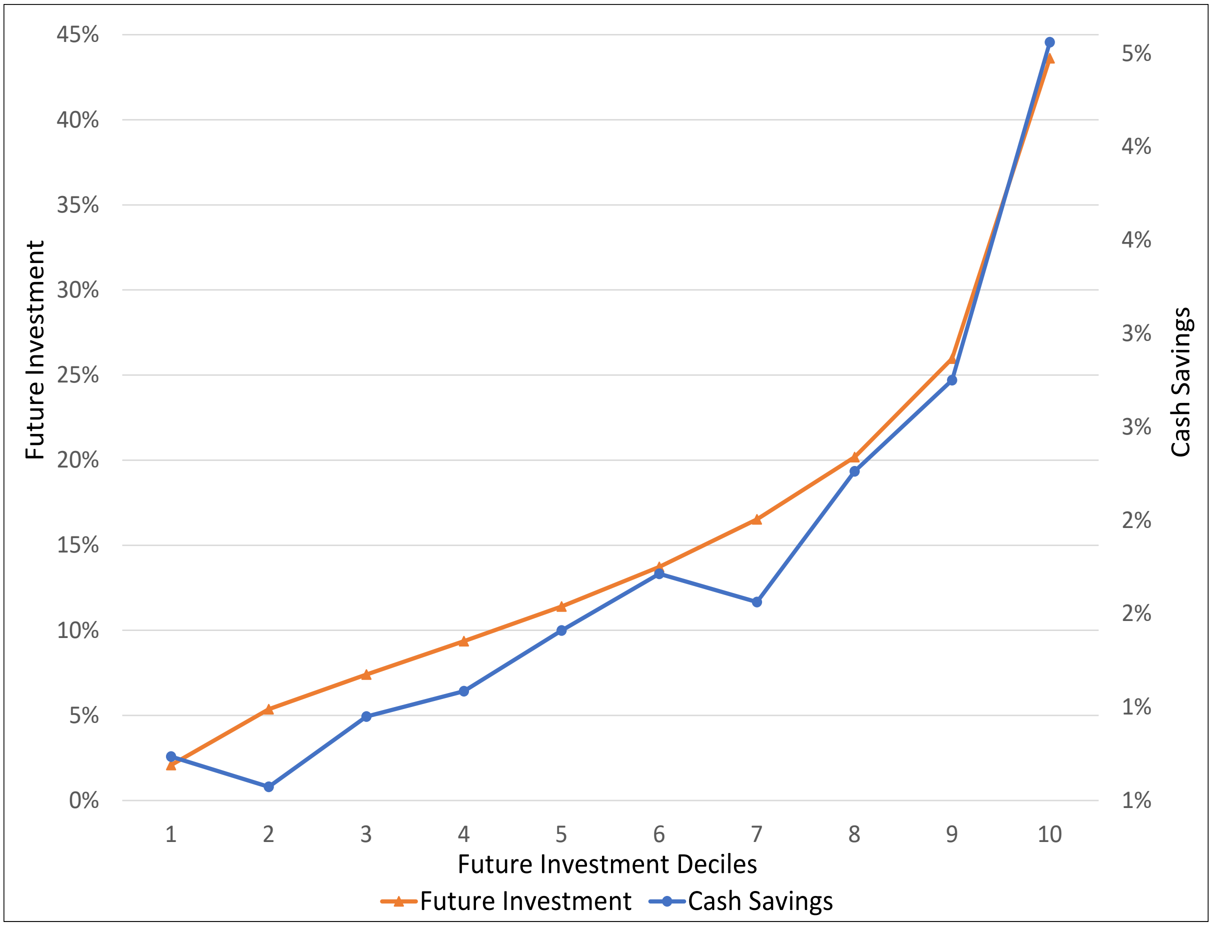

Table 1: Summary Statistics

This table reports the summary statistics of firm characteristics (Panel A) and standard deviation of cost of capital cross firms and over time (Panel B). ΔCash 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 market-to-book asset ratio. Vol is cash flow volatility. $CapEx$ is capital expenditures. COE is cost of equity. COD is cost of debt. COC is weighted average of cost of capital. Detailed variable definitions are provided in the Appendix.

	Panel A: Summary Statistics		
	Mean	Median	Standard Deviation
ΔCash	0.0175	0.0027	0.0912
Cash	0.1394	0.0793	0.1547
ExCapital	0.0423	0.0011	0.1761
ICF	0.0655	0.0623	0.0940
Size	6.4990	6.3408	1.8776
M/B	1.8535	1.4849	1.1855
Vol	0.0180	0.0153	0.0103
Dividend	0.0145	0.0042	0.0239
Leverage	0.2118	0.1974	0.1710
NWC	0.1079	0.0925	0.1709
CapEx	0.0709	0.0514	0.0976
Acquisitions	0.0433	0.0000	0.1190
R&D	0.0334	0.0000	0.0610
COE	0.0989	0.0939	0.0330
COD	0.0843	0.0762	0.0315
COC	0.0941	0.0904	0.0283

	Panel B: Decomposition of Standard Deviation	
	Cross-section	Time-series
COE	0.0267	0.0254
COD	0.0260	0.0229
COC	0.0231	0.0217

Table 2: Sensitivities of Cash Savings to Cash Sources

This table reports the sensitivities of cash savings to external capital and internal cash flows. 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*, leverage ratio; *Size*; *NWC*, net working capital excluding cash and equivalents; *M/B*, market-to-book asset ratio; *Vol*, cash flow volatility, *CapEx*, capital expenditures; *Acquisitions*; *Divdend*; *Cash*; *Tbill*, the one-year treasury bill rate; *Spread*, the credit spread; and *D*90 and *D*00, dummy variables for 1990s and 2000s. Standardized beta coefficients are reported in Column (3). Detailed variable definitions are provided in the Appendix. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	(1)	(2)	(3)
ExCapital	0.2897***	0.2959***	0.5502
	[0.0064]	[0.0071]	
ICF	0.2340***	0.2277***	0.2476
	[0.0082]	[0.0095]	
Cash	-0.0651***	-0.1937***	-0.1159
	[0.0037]	[0.0067]	
M/B	0.0051***	0.0048***	0.0741
	[0.0006]	[0.0007]	
Vol	0.2667***	0.3529***	0.0312
	[0.0346]	[0.0590]	
Dividend	-0.3706***	-0.3902***	-0.1006
	[0.0169]	[0.0303]	
Leverage	-0.0239***	0.0006	-0.0457
	[0.0022]	[0.0042]	
Size	-0.0017***	-0.0115***	-0.0361
	[0.0002]	[0.0008]	
NWC	-0.0280***	0.0582***	-0.0522
	[0.0026]	[0.0063]	
CapEx	-0.1722***	-0.1959***	-0.1849
	[0.0068]	[0.0089]	
Acquisitions	-0.2717***	-0.2764***	-0.362
	[0.0072]	[0.0080]	
R&D	0.1142***	0.0166	0.0791
	[0.0082]	[0.0274]	
Tbill	0.1479***	0.0252	0.0536
	[0.0188]	[0.0219]	
Spread	0.8222***	0.5981***	0.0607
	[0.0605]	[0.0624]	
D90	0.0052***	0.0107***	0.0278
	[0.0012]	[0.0014]	
D00	0.0143***	0.0309***	0.0814
	[0.0016]	[0.0021]	
Fixed Effects	No	Yes	No
Observations	60,003	59,353	60,003
Adj. R^2	0.2669	0.3196	0.2669

Table 3: Cost of Capital and Cash Savings

This table reports the sensitivities of cash savings to cost of capital 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 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. Detailed variable definitions are provided in the 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)	(3)	(4)	(5)	(6)
COC	-0.1257***	-0.1454***	-0.1192***	-0.1790***	-0.1860***	-0.1611***
	[0.0141]	[0.0157]	[0.0157]	[0.0177]	[0.0191]	[0.0193]
ExCapital	0.3407***	0.2898***	0.3407***	0.3513***	0.2942***	0.3509***
	[0.0149]	[0.0064]	[0.0150]	[0.0155]	[0.0070]	[0.0155]
ICF	0.2342***	0.2490***	0.2492***	0.2270***	0.2699***	0.2678***
	[0.0082]	[0.0259]	[0.0260]	[0.0095]	[0.0269]	[0.0271]
ExCapital×COC	-0.5630***		-0.5630***	-0.6378***		-0.6330***
	[0.1520]		[0.1521]	[0.1546]		[0.1541]
ICF×COC		-0.1528	-0.1528		-0.4336*	-0.4155*
		[0.2206]	[0.2224]		[0.2278]	[0.2302]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	No	No	No	Yes	Yes	Yes
Observations	60,003	60,003	60,003	59,353	59,353	59,353
Adj. R^2	0.2695	0.2686	0.2695	0.3229	0.322	0.323

Table 4: Hedging Motive

This table compares the impacts of cost of capital on the sensitivities of cash savings 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 30 percent and those in the bottom 30 percent, respectively based on the correlation between industry-level external finance and COC (Hedging Motive 1), the correlation between financial deficit and COC (Hedging Motive 2), and the correlation between KZ index and COC (Hedging Motive 3). Detailed variable definitions are provided in the Appendix. Firm 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.

	Hedging Motive 1		Hedging Motive 2		Hedging Motive 3	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.1092***	-0.1969***	-0.1109***	-0.1872***	-0.3948***	0.0397
	[0.0361]	[0.0376]	[0.0349]	[0.0375]	[0.0417]	[0.0330]
ExCapital	0.3798***	0.2990***	0.3559***	0.3169***	0.3902***	0.2647***
	[0.0257]	[0.0284]	[0.0261]	[0.0299]	[0.0271]	[0.0274]
ICF	0.2834***	0.2096***	0.2538***	0.2555***	0.2637***	0.1836***
	[0.0546]	[0.0405]	[0.0502]	[0.0416]	[0.0572]	[0.0394]
ExCapital×COC	-0.8291***	-0.2064	-0.7168***	-0.1893	-0.9471***	-0.0296
	[0.2484]	[0.2938]	[0.2503]	[0.3070]	[0.2665]	[0.2633]
ICF×COC	-0.5681	0.1698	-0.4671	-0.0515	-0.7487*	0.319
	[0.4535]	[0.3672]	[0.4079]	[0.3803]	[0.4471]	[0.3477]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,410	17,418	17,379	17,430	17,430	17,494
Adj. R^2	0.3405	0.3205	0.3293	0.3365	0.3596	0.2995

Table 5: Excess Capital Issuance and Future Investment

This table compares the sensitivities of excess capital issuance to cost of capital (Panel A) and the sensitivities of cash savings to future investment (Panel B) between firms with high and low hedging motives. The dependent variable in Panel A is excess capital issues. COC is weighted average cost of capital. The dependent variable in Panel B is the change in cash and equivalents divided by total assets at the beginning of the year. $FInvest$ is future investment defined as the average of two subsequent years of capital expenditures plus acquisitions plus R&D divided by lagged total assets. High and low hedging-need firms are defined as those in the top 30 percent and those in the bottom 30 percent, respectively based on the correlation between industry-level external finance and COC (Hedging Motive 1), the correlation between financial deficit and COC (Hedging Motive 2), and the correlation between KZ index and COC (Hedging Motive 3). Detailed variable definitions are provided in the 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: Excess Issuance					
	Hedging Motive 1		Hedging Motive 2		Hedging Motive 3	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.7991***	0.0277	-0.9412***	-0.0404	-1.3122***	0.2517***
	[0.0633]	[0.0639]	[0.0698]	[0.0610]	[0.0800]	[0.0566]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,379	17,430	17,410	17,418	17,430	17,494
Adj. R^2	0.2709	0.2442	0.2610	0.2457	0.2793	0.2537

	Panel B: Future Investment					
	Hedging Motive 1		Hedging Motive 2		Hedging Motive 3	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
FInvest	0.0935***	0.0163	0.0769***	0.0327	0.1025***	0.0074
	[0.0278]	[0.0265]	[0.0267]	[0.0269]	[0.0288]	[0.0266]
FInvest× COC	-0.8049***	0.1511	-0.5442*	0.1088	-0.8223***	0.2661
	[0.2942]	[0.2727]	[0.2834]	[0.2834]	[0.3047]	[0.2758]
COC	-0.2794***	-0.2262***	-0.2479***	-0.2328***	-0.6819***	0.0900**
	[0.0507]	[0.0498]	[0.0465]	[0.0516]	[0.0553]	[0.0456]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,410	17,418	17,379	17,430	17,430	17,494
Adj. R^2	0.1558	0.1466	0.1583	0.143	0.1761	0.1486

Table 6: Cash Savings: Equity vs Debt

This table compares cash savings from equity issues versus debt issues versus internal cash flows (Panel A) and the sensitivities of cash savings to sources of cash and cost of capital between firms with high and low hedging motives (Panel B). The dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. High and low hedging-need firms are defined as those in the top 30 percent and those in the bottom 30 percent, respectively based on the correlation between industry-level external finance and COC (Hedging Motive 1), the correlation between financial deficit and COC (Hedging Motive 2), and the correlation between KZ index and COC (Hedging Motive 3). Detailed variable definitions are provided in the 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: Equity vs Debt				
	(1)	(2)	(3)	(4)	(5)
Eissue	0.3462***			0.3967***	0.4039***
	[0.0076]			[0.0085]	[0.0096]
Dissue		0.0567***		0.1985***	0.2091***
		[0.0051]		[0.0075]	[0.0081]
ICF			0.2030***	0.2246***	0.2145***
			[0.0076]	[0.0079]	[0.0092]
Controls	No	No	No	Yes	Yes
Firm Fixed Effects	No	No	No	No	Yes
Observations	64,405	64,405	64,405	60,003	59,353
Adj. R^2	0.1619	0.0060	0.0437	0.2791	0.3289

	Panel B: Cost of Equity vs Cost of Debt						
		Hedging Motive 1		Hedging Motive 2		Hedging Motive 3	
	All	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
COE	-0.1207***	-0.0775***	-0.1362***	-0.0737***	-0.1439***	-0.2688***	0.0133
	[0.0143]	[0.0275]	[0.0273]	[0.0245]	[0.0280]	[0.0314]	[0.0242]
COD	-0.0453*	0.0102	-0.1626***	-0.0419	-0.0746*	-0.0433	-0.0374
	[0.0231]	[0.0413]	[0.0428]	[0.0385]	[0.0435]	[0.0447]	[0.0402]
Eissue	0.4452***	0.5161***	0.4072***	0.4695***	0.4229***	0.5278***	0.3339***
	[0.0253]	[0.0428]	[0.0465]	[0.0197]	[0.0455]	[0.0421]	[0.0462]
Dissue	0.2635***	0.2686***	0.2341***	0.2100***	0.3015***	0.2534***	0.2635***
	[0.0149]	[0.0280]	[0.0260]	[0.0158]	[0.0266]	[0.0275]	[0.0262]
ICF	0.2884***	0.3285***	0.2018***	0.3154***	0.2766***	0.3150***	0.1874***
	[0.0281]	[0.0574]	[0.0423]	[0.0261]	[0.0423]	[0.0582]	[0.0453]
Eissue×COE	-0.4789*	-1.1845***	0.0021	-0.8090***	-0.0402	-1.2565***	0.4166
	[0.2560]	[0.4246]	[0.4764]	[0.2040]	[0.4644]	[0.4327]	[0.4437]
Dissue×COD	-0.6275***	-0.6317**	-0.5259**	-0.0818	-1.0319***	-0.4384	-0.8728***
	[0.1500]	[0.2694]	[0.2593]	[0.1656]	[0.2591]	[0.2784]	[0.2396]
ICF×COE	-0.5976***	-0.8045**	-0.1334	-0.6262***	-0.3149	-0.9764***	0.0469
	[0.1863]	[0.3664]	[0.2935]	[0.1718]	[0.3116]	[0.3614]	[0.2898]
ICF×COD	-0.1728	-0.2947	0.1952	-0.5977**	-0.173	-0.3566	0.0789
	[0.1972]	[0.3628]	[0.3245]	[0.2353]	[0.3273]	[0.3513]	[0.3449]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	59,353	17,410	17,418	17,379	17,430	17,430	17,494
Adj. R^2	0.3322	0.347	0.3392	0.3388	0.3492	0.3722	0.3143

Table 7: The Effect of Exogenous Shock to Cost of Capital on Cash Savings
This table reports the effects of exogenous shocks to cost of capital on cash savings for firms with high hedging motive. We use Regulation Fair Disclosure of 2000 (Reg FD) (Columns 1 and 2) as a shock to cost of capital. We set the *Post* dummy as zero for 1997-1999 and one for 2000-2002. The remaining columns report placebo tests based on fictitious event years of 2006 (Columns 3 and 4) and 2011 (Columns 5 and 6). In columns 1, 3, and 5, 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 columns 2, 4, and 6, treated and control firms are defined as top and bottom 30% of book-to-market ratio, respectively, measured in the event year. The dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. Detailed variable definitions are provided in the 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.

	Reg FD		Placebo 1		Placebo 2	
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.0227	0.0215*	-0.0173	-0.0071	-0.0121*	-0.0180
	[0.0162]	[0.0126]	[0.0128]	[0.0095]	[0.0062]	[0.0142]
Treated×Post	-0.0422*	0.0212	0.0001	0.0024	-0.0006	-0.0013
	[0.0251]	[0.0136]	[0.0148]	[0.0127]	[0.0135]	[0.0112]
ExCapital×Post	-0.0703	0.0689*	0.1919	0.0533	0.0680	0.0304
	[0.0623]	[0.0409]	[0.1566]	[0.0389]	[0.0490]	[0.0373]
ICF×Post	-0.5139**	0.0817	0.0357	-0.0140	0.2382**	0.1041**
	[0.2361]	[0.0856]	[0.2758]	[0.0933]	[0.0962]	[0.0522]
Treated×ExCapital×Post	0.2748**	0.2236***	-0.1430	-0.0254	-0.1241	-0.0145
	[0.1116]	[0.0750]	[0.1655]	[0.0864]	[0.0902]	[0.0861]
Treated×ICF×Post	0.6021*	-0.1281	0.0441	0.0534	-0.2385*	-0.0915
	[0.3209]	[0.1249]	[0.2879]	[0.1328]	[0.1356]	[0.1223]
Treated×ExCapital	0.0741	0.0756	0.2064*	0.1066	0.0704	0.1489**
	[0.0864]	[0.0583]	[0.1213]	[0.0769]	[0.0813]	[0.0620]
Treated×ICF	-0.0275	0.0932	-0.0631	-0.0730	0.1927*	0.1505*
	[0.1747]	[0.1212]	[0.2072]	[0.1223]	[0.0991]	[0.0832]
ExCapital	0.2388***	0.2059***	0.1355	0.2835***	0.3440***	0.2967***
	[0.0753]	[0.0327]	[0.0993]	[0.0510]	[0.0467]	[0.0424]
ICF	0.2741*	0.2025**	0.1694	0.3079***	0.0374	0.1483***
	[0.1466]	[0.0822]	[0.2040]	[0.0828]	[0.0595]	[0.0455]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,161	2,169	1,614	2,603	1,540	2,426
Adj. R^2	0.4966	0.4119	0.2954	0.3031	0.4017	0.3717

Table 8: Constrained vs Unconstrained Firms

This table compares the sensitivities of cash savings to cost of capital and sources of cash between financially constrained and unconstrained firms (Panel A). 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), top and bottom 30% of WW index (Whited and Wu (2006)) (Columns 3 and 4), top and bottom 30% of HP index (Hadlock and Pierce (2010)) (Columns 5 and 6), 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. Panel B compares cash saving from external capital and internal capital for financially constrained and unconstrained firms with high hedging motive using our hedging measure and using the Acharya et al. (2007) measure. The reported results are based on WW index and Hedging Motive 1 measure. Detailed variable definitions are provided in the Appendix. The coefficient estimates on 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 Savings and Cost of Capital						
	Rating		WW Index		HP Index	
	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained	Constrained
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.0826***	-0.1889***	-0.0750***	-0.1822***	-0.1377***	-0.1754***
	[0.0227]	[0.0262]	[0.0246]	[0.0382]	[0.0251]	[0.0422]
ExCapital	0.2883***	0.3683***	0.2685***	0.3748***	0.2652***	0.3794***
	[0.0311]	[0.0180]	[0.0316]	[0.0292]	[0.0345]	[0.0235]
ICF	0.2270***	0.2860***	0.2313***	0.3421***	0.1730***	0.3168***
	[0.0423]	[0.0326]	[0.0388]	[0.0402]	[0.0476]	[0.0439]
ExCapital×COC	-0.9598***	-0.5716***	-0.8544***	-0.6891**	-0.7893**	-0.4032*
	[0.2951]	[0.1791]	[0.3058]	[0.2728]	[0.3091]	[0.2330]
ICF×COC	-0.8359**	-0.4532*	-0.5761	-1.0025***	0.0104	-0.7275**
	[0.3831]	[0.2697]	[0.3857]	[0.3528]	[0.4455]	[0.3476]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,386	39,560	17,479	16,920	17,738	16,894
Adj. R^2	0.2307	0.3393	0.1997	0.3379	0.193	0.3865

Panel B: Compare with AAC Measure				
	High Hedging Motive		High AAC Measure	
	Unconstrained	Constrained	Unconstrained	Constrained
	(1)	(2)	(3)	(4)
COC	-0.0443	-0.1465**	-0.0512	-0.1741***
	[0.0511]	[0.0602]	[0.0444]	[0.0533]
ExCapital	0.3039***	0.3911***	0.2435***	0.3482***
	[0.0532]	[0.0504]	[0.0494]	[0.0366]
ICF	0.0994	0.3435***	0.2512***	0.3626***
	[0.0855]	[0.0604]	[0.0611]	[0.0635]
ExCapital×COC	-0.7974*	-1.1449**	-0.6358	-0.4136
	[0.4689]	[0.4723]	[0.4872]	[0.3427]
ICF×COC	0.2981	-1.3072**	-0.8785	-1.1528**
	[0.8058]	[0.5080]	[0.6448]	[0.5497]
Controls	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Observations	4,033	5,276	7,933	8,715
Adj. R^2	0.2371	0.3293	0.1956	0.3463

Table 9: Alternative Motives

This table reports the test results of alternative motives for cash saving: market timing and precautionary Motive. The dependent variable is the change in cash and equivalents divided by total assets at the beginning of the year. Panel A compares the impacts of cost of capital on the sensitivities of cash savings to external capital between high and low external finance dependent firms. We use $Financial\ Deficit$ (EFD 1), $External\ Finance$ (EFD 2), and KZ Index (EFD 3) to measure external finance dependence. For each measure, we define firms in the top 30 percent as high external finance dependent firms and those in the bottom 30 percent as low external finance dependence firms, dropping the middle 40 percent. Panel B compares the impacts of cost of capital on sensitivities of cash savings to equity issues between firms with high and low precautionary motives. Firms with high (low) precautionary motives are defined as those without (with) dividend payments, those 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. *ExCapital* and ICF are external capital and internal cash flow, respectively, divided by total assets at the beginning of the year. Panel C and D test whether market timing or precautionary motive explains the sensitivities of excess capital issuance to cost of capital and the sensitivities of cash savings to future investment. Firm fixed effects are controlled. Detailed variable definitions are provided in the 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: Market Timing Motive					
	EFD 1		EFD 2		EFD 3	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.1686***	-0.3399***	-0.1503***	-0.3098***	-0.0740***	-0.2304***
	[0.0374]	[0.0664]	[0.0267]	[0.0707]	[0.0228]	[0.0478]
ExCapital	0.2723***	0.4533***	0.2832***	0.4374***	0.2250***	0.3996***
	[0.0230]	[0.0364]	[0.0260]	[0.0301]	[0.0252]	[0.0294]
ICF	0.0972**	0.4190***	0.0202	0.4373***	0.2206***	0.2337***
	[0.0381]	[0.0579]	[0.0359]	[0.0619]	[0.0376]	[0.0472]
ExCapital×COC	-0.2593	-1.2515***	-0.3331	-1.0502***	-0.0616	-0.5948*
	[0.2137]	[0.3687]	[0.2365]	[0.3164]	[0.2351]	[0.3163]
ICF×COC	-0.0318	-0.1128	0.3196	0.0252	-0.2502	-0.0542
	[0.3092]	[0.5629]	[0.2928]	[0.5819]	[0.3702]	[0.3970]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,966	16,651	16,042	17,520	17,021	17,010
\$Adj.\$ \$R2̂\$	0.3421	0.3792	0.2935	0.3955	0.3172	0.3399

Panel B: Precautionary Motive								
	Dividend		R&D		CFSD		Precaution	
	High	Low	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COC	-0.1296***	-0.2281***	-0.1898***	-0.1328***	-0.1667***	-0.1125***	-0.1608***	-0.1479***
	[0.0222]	[0.0341]	[0.0293]	[0.0238]	[0.0333]	[0.0435]	[0.0337]	[0.0423]
ExCapital	0.2579***	0.3876***	0.3932***	0.2688***	0.4045***	0.2964***	0.3981***	0.2971***
	[0.0213]	[0.0202]	[0.0225]	[0.0199]	[0.0258]	[0.0294]	[0.0272]	[0.0306]
ICF	0.2312***	0.2897***	0.2416***	0.3087***	0.3390***	0.2939***	0.3532***	0.2827***
	[0.0301]	[0.0376]	[0.0371]	[0.0389]	[0.0354]	[0.0608]	[0.0328]	[0.0608]
ExCapital×COC	-0.5456***	-0.5720***	-0.4763**	-0.5133***	-0.5195**	-0.5752**	-0.4959**	-0.6242**
	[0.1898]	[0.2107]	[0.2333]	[0.1797]	[0.2451]	[0.2869]	[0.2515]	[0.2940]
ICF×COC	-0.1545	-0.6961**	-0.1377	-0.8652***	-0.6259*	-0.8060	-0.7711**	-0.5483
	[0.2689]	[0.3170]	[0.3135]	[0.3279]	[0.3274]	[0.5392]	[0.3002]	[0.5546]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	33,016	25,676	29,336	29,837	17,433	16,980	17,293	16,619
Adj. R^2	0.2173	0.3588	0.3692	0.2608	0.3616	0.3223	0.3472	0.3293

Panel C: Excess Issuance				
	Market Timing		Precautionary	
	High	Low	High	Low
	(1)	(2)	(3)	(4)
COC	-0.4578***	-0.5428***	-0.2746***	-0.3855***
	[0.0598]	[0.0710]	[0.0560]	[0.0704]
Controls	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Observations	15,966	16,651	17,293	16,619
Adj. R^2	0.2152	0.3626	0.2493	0.3049

Panel D: Future Investment				
	Market Timing		Precautionary	
	High	Low	High	Low
	(1)	(2)	(3)	(4)
FInvest	0.0297	0.1249***	0.0579**	0.0536
	[0.0249]	[0.0318]	[0.0247]	[0.0326]
FInvest× COC	-0.1944	-0.8801**	-0.2982	-0.1924
	[0.2633]	[0.3501]	[0.2579]	[0.3320]
COC	-0.2582***	-0.3851***	-0.2156***	-0.2462***
	[0.0503]	[0.0627]	[0.0480]	[0.0511]
Controls	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Observations	15,966	16,651	17,293	16,619
Adj. R^2	0.1901	0.2026	0.1364	0.188

Appendix 1: The first-order conditions

For $X_t > 0$, the Lagrangian for the maximization problem (2) at t can be written as follows:

$$
\begin{aligned}
L_t(I_t, C_t, X_t) &= [W_t - C_t - I_t - \lambda_t(X_t)] + \mu_t[X_t - I_t - \lambda_t(X_t) - C_t + W_t] + \psi_t C_t \\
&+ \int_{I^*_{t+1} - C_t - \pi(I_t)}^{\infty} \left\{\pi(I^*_{t+1}) + \pi(I_t) + z + C_t - I^*_{t+1}\right\} g(z)dz \\
&+ \int_{\hat{I}_{t+1} - C_t - \pi(I_t)}^{I^*_{t+1} - C_t - \pi(I_t)} \left\{\pi(C_t + \pi(I_t) + z)\right\} g(z)dz. \\
&+ \int_{-\infty}^{\hat{I}_{t+1} - C_t - \pi(I_t)} \left\{\pi(\hat{I}_{t+1}) - \lambda_{t+1}(X_{t+1})\right\} g(z)dz.
\end{aligned}
$$

where μ_t and ψ are Lagrange multipliers for the constraints in (2). Applying Leibnitz integral rule, the first order conditions for I_t, C_t, X_t, and μ_t, respectively, are

$$
\begin{aligned}
\frac{\partial L_t}{\partial I_t} &= -1 - \mu_t + \pi_I(I_t)\left(\int_{I^*_{t+1} - C_t - \pi(I_t)}^{\infty} g(z)dz + \pi(I^*_{t+1})\right) \\
&\quad + \pi_I(I_t)\left(\int_{\hat{I}_{t+1} - C_t - \pi(I_t)}^{I^*_{t+1} - C_t - \pi(I_t)} \left\{\pi_I(C_t + \pi(I_t) + z)\right\} g(z)dz - \pi(I^*_{t+1}) + \pi(\hat{I}_{t+1})\right) \\
&\quad + \pi_I(I_t)\left(\int_{-\infty}^{\hat{I}_{t+1} - C_t - \pi(I_t)} \pi_I(\hat{I}_{t+1}) g(z)dz - \left\{\pi(\hat{I}_{t+1}) - \mathbb{1}_{(X_{t+1}>0)}\lambda_{t+1}(X_{t+1}))\right\}\right) \\
&= -1 - \mu_t + \pi_I(I_t)\left(1 + \int_{\hat{I}_{t+1} - C_t - \pi(I_t)}^{I^*_{t+1} - C_t - \pi(I_t)} \left\{\pi_I(C_t + \pi(I_t) + z) - 1\right\} g(z)dz \right.\\
&\quad \left. + \int_{-\infty}^{\hat{I}_{t+1} - C_t - \pi(I_t)} \left\{\pi_I(\hat{I}_{t+1}) + \lambda_{t+1}(X_{t+1}) - 1\right\} g(z)dz \right) \\
&= [1 + H]\pi_I(I_t) - 1 - \mu_t = 0
\end{aligned}
\tag{A.1}
$$

$$\begin{aligned}
\frac{\partial L_t}{\partial C_t} &= H - \mu_t - \psi_t = 0 \\
\frac{\partial L_t}{\partial X_t} &= -\lambda_t'(X_t) + \mu_t[1 - \lambda_t'(X_t)] = 0 \\
\frac{\partial L_t}{\partial \mu_t} &= X_t - I_t - \lambda_t(X_t) - C_t + W_t = 0
\end{aligned}$$

If the firm is financially unconstrained with sufficient initial endowment to make the initial investment and cash saving decisions ($W_t \geq C_t + I_t$ or $X_t \leq 0$), we have $\lambda_t(X_t) = 0$ and the Lagrangian for the maximization problem (2) at t can be written as follows:

$$\begin{aligned}
L_t(I_t, C_t, X_t) &= [W_t - C_t - I_t] + \mu_t[X_t - I_t - C_t + W_t] \\
&+ \int_{I^*_{t+1} - C_t - \pi(I_t)}^{\infty} \left\{\pi(I^*_{t+1}) + \pi(I_t) + z + C_t - I^*_{t+1}\right\} g(z)dz \\
&+ \int_{\hat{I}_{t+1} - C_t - \pi(I_t)}^{I^*_{t+1} - C_t - \pi(I_t)} \{\pi(C_t + \pi(I_t) + z)\} g(z)dz. \\
&+ \int_{-\infty}^{\hat{I}_{t+1} - C_t - \pi(I_t)} \left\{\pi(\hat{I}_{t+1}) - \lambda_{t+1}(X_{t+1})\right\} g(z)dz.
\end{aligned}$$

and the first order conditions for I_t, C_t, X_t, and μ_t, respectively, are

$$\begin{aligned}
\frac{\partial L_t}{\partial I_t} &= [1 + H]\pi_I(I_t) - 1 = 0 \\
\frac{\partial L_t}{\partial C_t} &= H - \psi_t = 0 \\
\frac{\partial L_t}{\partial X_t} &= \mu_t = 0 \\
\frac{\partial L_t}{\partial \mu_t} &= X_t - I_t - C_t + W_t = 0
\end{aligned}$$

Appendix 2: Proof of Proposition 1

From the first order conditions of the optimization problem at t for $X_t > 0$ satisfying $\hat{X}_t = \hat{I}_t + \lambda_t(\hat{X}_t) + \hat{C}_t - W_t$, we differentiate each condition with respect to λ_{t+1}.

$$\begin{aligned}
\{H_I\pi_I(\hat{I}_t) + (1+H)\pi_{II}(\hat{I}_t)\}\frac{\partial \hat{I}_t}{\partial \lambda_{t+1}} + H_C\pi_I(\hat{I}_t)\frac{\partial \hat{C}_t}{\partial \lambda_{t+1}} + H_{\lambda_{t+1}}\pi_I(\hat{I}_t) &= 0 \\
H_I\frac{\partial \hat{I}_t}{\partial \lambda_{t+1}} + H_C\frac{\partial \hat{C}_t}{\partial \lambda_{t+1}} + H_{\lambda_{t+1}} &= 0 \\
-\frac{\partial \hat{I}_t}{\partial \lambda_{t+1}} - \frac{\partial \hat{C}_t}{\partial \lambda_{t+1}} + [1 - \lambda_t^{'}(X_t)]\frac{\partial \hat{X}_t}{\partial \lambda_{t+1}} &= 0
\end{aligned}$$

where

$$\begin{aligned}
H_C &= \int_{\hat{I}_{t+1}-\hat{C}_t-\pi(\hat{I}_t)}^{I^*_{t+1}-\hat{C}_t-\pi(I_t)} \pi_{II}(\hat{C}_t + \pi(\hat{I}_t) + z)g(z)dz < 0, \quad \text{and} \\
H_I &= \pi_I(\hat{I}_t)H_C < 0, \\
H_{\lambda_{t+1}} &= \frac{\partial \lambda_{t+1}(\hat{X}_{t+1})}{\partial \lambda_{t+1}} \int_{-\infty}^{\hat{I}_{t+1}-\hat{C}_t-\pi(\hat{I}_t)} g(z)dz > 0.
\end{aligned}$$

H_I and H_C represent the marginal reduction in underinvestment at $t+1$ due to increased investment and cash saving at time t, respectively, whereas $H_{\lambda_{t+1}}$ represents the effects of external finance cost on underinvestment, *ceteris paribus.*

The determinant of the Jacobian matrix of the derivatives is

$$\begin{aligned}
D &= \begin{vmatrix} H_I\pi_I(\hat{I}_t) + (1+H)\pi_{II}(\hat{I}_t) & H_C\pi_I(\hat{I}_t) & 0 \\ H_I & H_C & 0 \\ -1 & -1 & 1 - \lambda_t^{'}(X_t) \end{vmatrix} \\
&= [1 - \lambda^{'}(X_t)]H_C(1+H)\pi_{II}(\hat{I}_t),
\end{aligned}$$

By the implicit function theorem and Crammer's rule we get

$$\frac{\partial \hat{I}_t}{\partial \lambda_{t+1}} = \frac{\begin{vmatrix} -H_{\lambda_{t+1}}\pi_I(\hat{I}_t) & H_C\pi_I(\hat{I}_t) & 0 \\ -H_{\lambda_{t+1}} & H_C & 0 \\ 0 & -1 & 1 - \lambda_t^{'}(X_t) \end{vmatrix}}{D} = 0,$$

$$\frac{\partial \hat{C}_t}{\partial \lambda_{t+1}} = \frac{\begin{vmatrix} H_I\pi_I(\hat{I}_t) + (1+H)\pi_{II}(\hat{I}_t) & -H_{\lambda_{t+1}}\pi_I(\hat{I}_t) & 0 \\ H_I & -H_{\lambda_{t+1}} & 0 \\ -1 & 0 & 1-\lambda_t'(X_t) \end{vmatrix}}{D} = \frac{-H_{\lambda_{t+1}}}{H_C} > 0,$$

and

$$\frac{\partial \hat{X}_t}{\partial \lambda_{t+1}} = \frac{\begin{vmatrix} H_I\pi_I(\hat{I}_t) + (1+H)\pi_{II}(\hat{I}_t) & H_C\pi_I(\hat{I}_t) & -H_{\lambda_{t+1}}\pi_I(\hat{I}_t) \\ H_I & H_C & -H_{\lambda_{t+1}} \\ -1 & -1 & 0 \end{vmatrix}}{D} = \frac{-H_{\lambda_{t+1}}}{[1-\lambda_t'(X_t)]H_C} > 0,$$

For $X_t \leq 0$, $\hat{X}_t = \hat{I}_t + \hat{C}_t - W_t$ and differentiating each FOC with respect to λ_{t+1} yields

$$\begin{aligned} \{H_I\pi_I(\hat{I}_t) + (1+H)\pi_{II}(\hat{I}_t)\}\frac{\partial \hat{I}_t}{\partial \lambda_{t+1}} + H_C\pi_I(\hat{I}_t)\frac{\partial \hat{C}_t}{\partial \lambda_{t+1}} + H_{\lambda_{t+1}}\pi_I(\hat{I}_t) &= 0 \\ H_I\frac{\partial \hat{I}_t}{\partial \lambda_{t+1}} + H_C\frac{\partial \hat{C}_t}{\partial \lambda_{t+1}} + H_{\lambda_{t+1}} &= 0 \\ -\frac{\partial \hat{I}_t}{\partial \lambda_{t+1}} - \frac{\partial \hat{C}_t}{\partial \lambda_{t+1}} + \frac{\partial \hat{X}_t}{\partial \lambda_{t+1}} &= 0 \end{aligned}$$

The determinant of the Jacobian matrix of the derivatives is

$$\begin{aligned} D &= \begin{vmatrix} H_I\pi_I(\hat{I}_t) + (1+H)\pi_{II}(\hat{I}_t) & H_C\pi_I(\hat{I}_t) & 0 \\ H_I & H_C & 0 \\ -1 & -1 & 1 \end{vmatrix} \\ &= H_C(1+H)\pi_{II}(\hat{I}_t), \end{aligned}$$

By the implicit function theorem and Crammer's rule we get

$$\frac{\partial \hat{I}_t}{\partial \lambda_{t+1}} = \frac{\begin{vmatrix} -H_{\lambda_{t+1}}\pi_I(\hat{I}_t) & H_C\pi_I(\hat{I}_t) & 0 \\ -H_{\lambda_{t+1}} & H_C & 0 \\ 0 & -1 & 1 \end{vmatrix}}{D} = 0,$$

$$\frac{\partial \hat{C}_t}{\partial \lambda_{t+1}} = \frac{\begin{vmatrix} H_I\pi_I(\hat{I}_t) + (1+H)\pi_{II}(\hat{I}_t) & -H_{\lambda_{t+1}}\pi_I(\hat{I}_t) & 0 \\ H_I & -H_{\lambda_{t+1}} & 0 \\ -1 & 0 & 1 \end{vmatrix}}{D} = \frac{-H_{\lambda_{t+1}}}{H_C} > 0,$$

and

$$\frac{\partial \hat{X}_t}{\partial \lambda_{t+1}} = \frac{\begin{vmatrix} H_I\pi_I(\hat{I}_t) + (1+H)\pi_{II}(\hat{I}_t) & H_C\pi_I(\hat{I}_t) & -H_{\lambda_{t+1}}\pi_I(\hat{I}_t) \\ H_I & H_C & -H_{\lambda_{t+1}} \\ -1 & -1 & 0 \end{vmatrix}}{D} = \frac{-H_{\lambda_{t+1}}}{H_C} > 0.$$

Appendix 3: Proof of Proposition 2

For $X_t > 0$, with $\lambda_{t+1}(\hat{X}_{t+1})$ replaced by $\lambda_{t+1}(\hat{X}_{t+1}, \gamma)$ and using the results from Appendix 2, we have the following:

$$\begin{aligned} \frac{\partial^2 \hat{I}_t}{\partial \lambda_{t+1}\partial\gamma} &= 0, \\ \frac{\partial^2 \hat{C}_t}{\partial \lambda_{t+1}\partial\gamma} &= -\frac{H_{\gamma\lambda_{t+1}}}{H_C} > 0 \\ \frac{\partial^2 \hat{X}_t}{\partial \lambda_{t+1}\partial\gamma} &= -\frac{-H_{\gamma\lambda_{t+1}}[1-\lambda_t'(X_t,\gamma)] - H_{\lambda_{t+1}}\lambda_{\gamma t}'(X_t,\gamma)}{[1-\lambda_t'(X_t,\gamma)]^2 H_C} > 0, \end{aligned}$$

where

$$\begin{aligned} H_{\gamma\lambda_{t+1}} &= \frac{\partial^2 \lambda_{t+1}(\hat{X}_{t+1},\gamma)}{\partial\lambda_{t+1}\partial\gamma} \int_{-\infty}^{\hat{I}_{t+1}-\hat{C}_t-\pi(\hat{I}_t)} g(z)dz > 0, \quad \text{and} \\ \lambda_{\gamma t}'(X_t) &= \frac{\partial^2 \lambda_{t+1}(\hat{X}_{t+1},\gamma)}{\partial X_{t+1}\partial\gamma} > 0. \end{aligned}$$

Appendix 4: A Dynamic Model

We build upon the models of Whited (1992), Whited and Wu (2006) and Gomes et al. (2006) to consider the effects of time-varying cost of external capital on cash savings in a dynamic setting. The firm maximizes the expected discounted value of future cash flows:

$$V_t = \max_{(I_t, K_{t+j}, C_{t+j})_{j=0}^{\infty}} E_t \sum_{j=0}^{\infty} M_{t,t+j} \left\{ d_{t+j} - \lambda_t(X_t, \gamma) \right\}, \tag{A.2}$$

where E_t is the expectation operator conditional on information at time t, $M_{t,t+j}$ is the discount factor at time t for cash flows at $t+j$, and d_{t+j} is cash flow at time $t+j$ given as:

$$d_t = \pi(K_t, S_t) - \phi(K_t, I_t) - I_t + X_t + C_t - C_{t+1}, \tag{A.3}$$

where K_t is the capital stock at time t; I_t is investment between t and $t+1$; X_t is the amount of external finance at t; $\pi(K_t, S_t)$ is the cash flow at time t from production with the first partial derivative with regard to K given as $\pi_K > 0$; S_t is an exogenous state variable; $\phi(K_t, I_t)$ is the cost of adjustment, with the partial derivatives satisfying $\phi_I > 0, \phi_{II} > 0$ and $\phi_K < 0$;[8] C_t is the liquid asset called "cash" at time t. Thus, the model allows firms to invest in two distinctive assets with possibly different returns: capital stock K_t and cash C_t. The external finance cost function, $\lambda_t(X_t, \gamma)$, is time-varying, which may arise from market frictions such as asymmetric information. γ is a measure of the strength of the correlation between the external capital needs and the cost of external capital. We also assume $\lambda_t(X_t) > 0$ and $\lambda_t'(X_t) > 0$ for $X_t > 0$ whereas $\lambda_t(X_t) = 0$ for $X_t \leq 0$, which implies that the marginal external financing cost increases with the amount of external capital raised (see Gomes (2001)).

Capital accumulation follows the rule:

$$K_{t+1} = (1 - \delta)K_t + I_t, \tag{A.4}$$

where δ is the depreciation rate, $\delta \in (0, 1)$. The dividend constraint is

$$d_t \geq d^*, \tag{A.5}$$

[8] These conditions imply a convex adjustment cost with economies of scale.

This constraint on d has the same effect as a restriction on external capital as in financial constraint models.

The Lagrangian function conditional on the information set at time t is

$$V_t = \max_{(I_{t+j}, K_{t+j}, C_{t+j}, X_{t+j})_{j=0}^{\infty}} E_t \sum_{j=0}^{\infty} M_{t,t+j} \{(1+\mu_{t+j})d_{t+j} - \lambda_{t+j}(X_{t+j}, \gamma) \\ -q_{t+j}[K_{t+1+j} - (1-\delta)K_{t+j} - I_{t+j}]\} \tag{A.6}$$

where q_t and μ_t are Lagrange multipliers for constraints (A.4) and (A.5), respectively. The first-order conditions for maximizing the firm value at t with respect to I_t, K_{t+1}, C_{t+1}, and X_{t+1}, respectively, are given as follows:

$$\frac{\partial V_t}{\partial I_t} = -(1+\mu_t)[\phi_I(K_t, I_t) + 1] + q_t = 0; \tag{A.7}$$

$$\frac{\partial V_t}{\partial K_{t+1}} = E_t\left(M_{t,t+1}\left\{(1+\mu_{t+1})[\pi_K(K_{t+1}, S_{t+1}) - \phi_K(K_{t+1}, I_{t+1})] + (1-\delta)q_{t+1}\right\}\right) \\ -q_t = 0; \tag{A.8}$$

$$\frac{\partial V_t}{\partial C_{t+1}} = E_t\{M_{t,t+1}(1+\mu_{t+1})\} - (1+\mu_t) = 0; \quad \text{and} \tag{A.9}$$

$$\frac{\partial V_t}{\partial X_t} = 1 + \mu_t - \lambda_t'(X_t, \gamma) = 0. \tag{A.10}$$

Equation (A.7) suggests that a firm's optimal investment is determined where the product of the opportunity cost of external financing and the marginal cost of adjustment is equal to the marginal rate of return on investment at t. Clearly, the firm's investment in the presence of the external financing costs will be less than the optimal.

Without time-varying external financing costs ($\lambda_t' = \lambda_{t+1}'$), condition (A.9) also implies that saving cash today does not affect the firm value. In the presence of time-varying costs of external capital, however, the firm's investment and cash saving decisions depend on the relative (in an inter-temporal sense) costs of external capital. To see this, note that we obtain the following equations from equations (A.7) - (A.9):

$$\phi_I(K_t, I_t) + 1 = E_t\left\{ M_{t,t+1} \left(\frac{1+\lambda'_{t+1}(X_t,\gamma)}{1+\lambda'_t(X_t,\gamma)} \right) \left[1 + \pi_K(K_{t+1}, S_{t+1}) \right.\right. \tag{A.11}$$

$$\left.\left. -\phi_K(K_{t+1}, I_{t+1}) + (1-\delta)\big[\phi_I(K_{t+1}, I_{t+1}) + 1\big] \right] \right\}; \quad \text{and}$$

$$E_t\left\{ M_{t,t+1} \left(\frac{1+\lambda'_{t+1}(X_t,\gamma)}{1+\lambda'_t(X_t,\gamma)} \right) \right\} = 1. \tag{A.12}$$

The relative costs of external finance, $\Lambda_t(\gamma) = (1+\lambda'_{t+1}(X_t,\gamma))/(1+\lambda'_t(X_t,\gamma))$, in equations (A.11) and (A.12) represent the effect on investment and savings decisions of inter-temporal variation in costs of external finance and the correlation between the expected cost of external capital and the future capital needs.

Given Assumption 1 for the two-period model regarding the external finance cost function, it is straightforward to see that $\Lambda_t(\gamma)$ is an increasing function of γ for $\lambda'_t < \lambda'_{t+1}$: i.e., the effect of intertemporal costs of external capital is magnified for firms with a greater correlation between the expected cost of capital and future external capital needs.

Appendix 5: 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.

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

Cash Flow (CF) = operating income before depreciation (oibdp)/lagged plant and equipment (ppent)

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

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

$\Delta Cash$ = 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

Cost of Equity (ICC) = Implied Cost of capital

Credit Spread ($Spread$) = difference in yield between maturity matched Treasury yield and AAA-rated corporate bonds

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

$D90$ = 1 if fiscal year between 1991 and 2000; 0 otherwise

$D00$ = 1 if fiscal year after 2000; 0 otherwise

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

External Finance ($External$) = [capital expenditures (capx) - internal cash flow (ibc+dp)]/capx

External Finance Dependence (KZ) = $-1.002CF-39.368DIV-1.315CASH+3.139LEV$

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

Financial Deficit ($Deficit$) = [dividends + acquisitions + net investment - internal cash flow]/ lagged total assets (at)[9]

Future Investment ($FInvest$) = the average of two subsequent years of [capital expenditures (capx) + acquisitions (acq) + 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)

[9] We follow Rajan and Zingales (1998) to include the change in the non-financial components of net working capital as part of funds from operations in defining the financial deficit and external finance dependence.

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))

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

Operating Cash Flow (*OCF*) = operating income before depreciation (oibdp)

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

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

Tbill = 3-month T-bill rate (annual average of monthly observations)

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

Yield Spread (*Spread*) = BBB-bond yield − AAA-bond yield (annual average of monthly observations)

Appendix 6: Estimation procedure for the COE

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

$$P_t = BE_t + \sum_{k=1}^{5} \frac{FE_{t+k} - ICC_t \times BE_{t+k-1}}{(1+ICC_t)^k} + \frac{(FE_{t+5} - ICC_t \times BE_{t+4})(1+g_t)}{(ICC_t - g_t)(1+ICC_t)^5} \quad \text{(A.13)}$$

where P_t is the current stock price and the growth rate after 5 years, g_t, is estimated by 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 forecasted earnings per share at $t+1$; and b_{t+1} is the retention ratio at $t+1$.

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

$$P_t = BE_t + \sum_{k=1}^{12} \frac{(ROE_{t+k} - ICC_t)BE_{t+k-1}}{(1+ICC_t)^k} + \frac{(ROE_{t+12} - ICC_t)BE_{t+11}}{ICC_t(1+ICC_t)^{12}} \quad \text{(A.14)}$$

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 $t+12$. The industry median ROE is for 48 Fama and French industries based on past 10-year data, excluding firms with losses. The book value of equity is estimated by $BE_{t+k} = BE_{t+k-1} + FE_{t+k} \times b_{t+k}$.

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

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

The model has two parts: 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 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 the 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 $g_t^g = \ln\left(\frac{g_t}{g_{t+2}}\right)/15$. For g_{t+3}, we use the median long-term growth rate forecast of analysts. If the long-term growth rate forecast is not available, we estimate it using the first two years' forecast earnings: $g_{t+3} = \frac{FE_{t+2}}{FE_{t+1}} - 1$. The steady-state earning growth rate (g_t) is assumed to be a rolling average of 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 terminal year, we estimate the terminal value of remaining cash flows using the Gordon growth model: $FE_{t+15} \times (1 - b_t)/(ICC_t - g_t)$.

Appendix 7: Robustness Check

Table A1: Hedging Motive: Robustness

This table reports the robustness of the impacts of cost of capital on the sensitivities of cash savings 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 30 percent and those in the bottom 30 percent, respectively based on the correlation between industry-level external finance and COC. We use high order linear cumulants (Erickson et al. (2014)) to account for measurement errors in the cost of capital measure (Columns 1 and 2). Claus and Thomas (2001) (Columns 3 and 4) and Gebhardt et al. (2001) (Columns 5 and 6) are used as alternative COE measures. Detailed variable definitions are provided in the Appendix. Firm 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.

	High-Order Cumulants		Gebhardt et al. (2001)		Claus and Thomas (2001)	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	0.0431	0.0536	-0.0284	-0.0293	0.0293	-0.0286
	[0.0766]	[0.0774]	[0.0398]	[0.0367]	[0.0263]	[0.0283]
ExCapital	0.3453***	0.2484***	0.2825***	0.2140***	0.2892***	0.2232***
	[0.0217]	[0.0211]	[0.0231]	[0.0229]	[0.0197]	[0.0181]
ICF	0.3834***	0.4321***	0.5026***	0.1743***	0.2478***	0.1810***
	[0.0351]	[0.0422]	[0.0388]	[0.0384]	[0.0299]	[0.0283]
ExCapital×COC	-0.3646*	0.1681	-0.9373***	-0.1174	-0.4317***	-0.1074
	[0.2042]	[0.1764]	[0.2467]	[0.2419]	[0.1609]	[0.1464]
ICF×COC	-1.1091***	-1.7002***	-2.4779***	0.8630**	-0.5021**	0.2562
	[0.2910]	[0.4078]	[0.3536]	[0.3759]	[0.2085]	[0.1869]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	No	No	Yes	Yes	Yes	Yes
Observations	17,766	17,803	14,240	14,468	17,236	17,529
Adj. R^2			0.2720	0.2476	0.2581	0.2453