The Sensitivity of Cash Savings to the Cost of Capital*

Viral V. Acharya† Soku Byoun‡ Zhaoxia Xu§

Abstract

We theoretically and empirically show that in the presence of a time-varying cost of capital (COC), firms save cash from external capital when the firm-specific COC is low to hedge against the risk of underinvestment in the *future* from a higher COC. This hedging motive drives the sensitivity of cash savings to the COC in both financially constrained and currently unconstrained firms. This sensitivity is especially pronounced among firms with a stronger correlation between their COC and financing needs for future investments. These results cannot be fully explained by the alternative motives for cash documented in the literature.

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†C.V. Starr Professor of Economics, Department of Finance, New York University, 44 West Fourth Street, New York, NY, 10012. Email: vacharya@stern.nyu.edu. Phone: (212) 998-0354. Fax: (212) 995-4256.

‡Professor and Carr P. Collins Endowed Chair of Finance, Hankamer School of Business, Baylor University, One Bear Place, #98004, Waco, TX 76798-8004, USA. Email: Soku_Byoun@Baylor.edu. Phone: (254) 710–7849. Fax: (710) 710-1092.

§School of Banking and Finance, UNSW Business School, Sydney, NSW 2052, Australia. Email: zhaoxia.xu@unsw.edu.au. Phone: +61 (2) 9385-6013.

1. Introduction

The extensive literature on the determinants of cash holdings suggests that firms mitigate external financing constraints caused by capital market frictions through cash saved from internal cash flows.[1] However, we document that firms in the United States save 28 cents from each dollar of equity capital raised compared to 15 cents from each dollar of internal cash flows. Moreover, external equity issuance alone explains 9.4% of the variation in corporate cash savings, while internal cash flows explain only 1.3%. In spite of this importance of external capital issuance for cash savings, the link between cash savings and external capital is not well understood.

In the traditional models (e.g., Almeida et al. (2004)), financially constrained firms save from cash flows by comparing profitability of current and future investments, while the cash saving policies of unconstrained firms are indeterminate. We add another dimension to the traditional model setting and consider the time-varying costs of external capital. It turns out that the variation in the firm-level cost of external capital over time is the key to understanding why firms save from external capital.[2] Since external capital is an important source of financing for future investment, firms should consider building cash reserves in a manner that lowers the *overall* cost of capital (COC) – averaged over time – for their investment opportunities. We show theoretically that when facing time-varying and convex costs of external finance, firms save cash from external capital issuance when the COC is relatively low to hedge against financing future investments at a higher cost and thereby reduce the overall COC (hedging motive). The need to hedge against raising external capital at a higher cost for future investments is most pronounced in firms that tend to face a higher COC when having greater external capital needs. Under uncertainty, this hedging motive drives the savings decisions of *both*

[1] See 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) among others.

[2] Although cash savings from external capital have been noted in previous studies (McLean (2011) and Darmouni and Siani (2021)), a formal analysis of the direct link between cash savings and the time-varying firm-level COC is absent in the literature.

financially constrained and (currently) unconstrained firms. Saving cash by raising external capital is costly. Nonetheless, given the time-varying costs of external capital, firms choose their optimal savings to balance the current COC and the expected COC for future investments. In summary, firms save more when (i) the current COC is low, and (ii) they face a strong correlation between the COC and external financing needs.

To empirically test our model's predictions, we estimate a firm's COC by its weighted average cost of capital based on its debt to equity ratio and the costs of equity and debt. The cost of equity (COE) is estimated by the implied internal rate of return obtained by equating the stock price to the present value of future cash flow forecasts. The cost of debt (COD) is estimated as the actual yield on the debt carried by the firm.[3] We first show that the average cash holdings of firms are negatively associated with their average COC over the 39-year sample period (Figure 2). Such opposite movements of cash and the COC are found in all industries. Moreover, firms, especially those with high hedging motives, save significantly more when the COC is lower relative to its historical average (Figure 3) and when their future investments are greater (Figure 4). Additionally, the cost of capital exhibits mean-reversion towards the long-run average COC.

We measure a firm's hedging motive as the regression coefficient of the firm's external finance needs on the COC based on the standard proxies used in the literature for such needs. A high value of the coefficient indicates that the firm faces a higher COC when it needs more external capital, i.e., a high hedging motive. Since firms' cash savings decisions can be influenced by economic conditions (McLean (2011)), we control for the macroeconomic effects and investigate the sensitivity of cash saving to the firm-specific cost of capital. Examining the firm-level COC enables us to better understand the cross-sectional variation in the impacts of financing costs on firms' cash saving decisions based on

[3] Claus and Thomas (2001) and Fama and French (2002) use the implied cost of capital (ICC) to measure the equity premium; Li, Ng, and Swaminathan (2013) and Lee, So, and Wang (2020) use the ICC to predict stock market return; and Burgstahler, Hail, and Leuz (2006), Botosan and Plumlee (2005), Hughes, Liu, and Liu (2009) Frank and Shen (2016), Xu (2020), and Byoun and Wu (2020) use the ICC to estimate the COE. Frank and Shen (2016) show that the ICC can better reflect the time-varying required return on capital than the CAPM measure as a proxy for the cost of capital. The COD is estimated using the same measure applied in Frank and Shen (2016) and Xu (2020).

their hedging needs. Consistent with our model, we find that firms' cash savings from external capital are more sensitive to the COC when their hedging needs are greater; such firms issue significantly more external capital in excess of their current financial needs when the COC is relatively low. These findings support our novel perspective on corporate hedging, i.e., firms save cash to hedge their future investments against a high cost of capital.

When comparing the relative importance of equity and debt as sources of external capital, we find that firms save significantly more cash from equity issues (28 cents from each dollar of equity raised) than from debt issues (6 cents from each dollar of debt raised). Moreover, firms' cash savings are much more sensitive to the COE than to the COD.

To address the endogeneity concern that cash savings may themselves affect the COC, we adopt an identification strategy that uses the Regulation Fair Disclosure (Reg FD) in 2000 as a plausibly exogenous shock to the COC and conduct a generalized triple difference analysis. Reg FD reduced the COC by leveling the information playing field, especially among firms that are more prone to selective disclosure prior to the regulation, as shown in Chen et al. (2010). By exploiting the cross-sectional variation in the impact of Reg FD on the firm-level COC, we show that firms experiencing a greater decline in the COC exhibit an increased sensitivity of cash savings to external capital compared to firms with a lesser decline in the COC after Reg FD. We also verify that pre-existing divergent trends cannot explain our results and conduct placebo tests to minimize the possibility that our results are driven by omitted factors rather than by changes in the COC. Our results are also robust to alternative COC measures, adjustments for potential measurement errors, and different sample periods.

Furthermore, we find that financially constrained and (currently) unconstrained firms *both* save more in response to a low COC. Almeida et al. (2004) suggest that financially constrained firms save from internal cash flows to mitigate underinvestment due to financial constraints. Our findings suggest that firms save from not only internal cash flows to mitigate the effect of financial constraints, but also from external capital to hedge against higher financing costs for future investments, as saving from external capital when the COC is relatively low reduces underinvestment due to a higher future COC.

We also explore alternative motives that might explain the sensitivity of cash savings to the COC. One 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)). To test this alternative motive, we examine whether firms with high market timing motives are more likely to save cash and issue excess external capital when the COC is low than firms with low market timing motives. Using three market timing measures, we find that our results are not driven by such motives.

Second, Keynes (1936) suggests that the purpose of precautionary cash savings is to insulate firms from external finance by saving from internal cash flows. This precautionary motive 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 a firm's precautionary motive explains its cash savings from equity issue proceeds. Accordingly, we examine whether firms with greater precautionary motives save more from external capital when the COC is relatively low. Although the precautionary motive has an overall positive effect on cash savings, it does not fully explain the sensitivity of cash savings from external capital to the firm-specific COC. The time-varying COC affects cash savings from external capital for firms with high hedging motives even after controlling for the effect of precautionary motives.

We also examine whether our results can be explained by the model proposed by Bolton et al. (2013) who show that the dynamics of cash and financing decisions are related to the *relative* importance of the market timing and precautionary savings motives, which vary with the firm's cash holdings. Their model predicts that firms with low cash holdings will time favorable market conditions to shield against crises, while firms with high cash holdings do not time the market. However, we find that our results of saving cash from external capital at a low COC are not driven by the difference in the level of firms' cash holdings. Finally, we also rule out the possibility that our results are driven by credit or agency risks that affects firms' cash holdings as documented in previous studies (Acharya et al. (2012) and Jensen (1986)). Overall, our analyses show that the sensitivity of cash savings to the COC is best explained by firms' hedging needs stemming from the time variation in the firm-specific COC and its correlation with their future financing needs for investments.

2. Related Literature

The literature has offered several explanations for firms' cash holdings, including agency conflicts (Jensen (1986), Dittmar et al. (2003); Dittmar and Mahrt-Smith (2007), Harford et al. (2008), Gao et al. (2013), and Nikoloo and Whited (2014)), tax considerations (Foley et al. (2007), and Harford et al. (2017), Faulkender et al. (2019)), product market competition (Fresard (2010)), refinancing risk (Harford et al. (2014)), and leverage (DeAngelo et al. (2021)). Our study focuses on explaining firms' cash saving behavior in the presence of time-varying cost of capital and contributes to the literature by demonstrating the importance of a hedging motive for corporate cash savings from external capital.

In the related empirical literature, DeAngelo, DeAngelo, and Stulz (2010) raise questions concerning the economic significance of the existing theories for cash savings from equity issuance: the market timing motive (Kim and Weisbach (2008)) and precautionary motive (McLean (2011)). The authors find that most firms with attractive market timing opportunities fail to issue stocks and that many mature firms issue stocks without apparent financial difficulties. Moreover, Dittmar et al. (2019) maintain that the existing theories fail to explain most within-firm variation in cash savings and that the precautionary savings theory does not explain the cash holdings of cash-rich firms. Contributing to this literature, we show that firms save to reduce the overall COC by transferring financial resources to future states with a higher COC. Accordingly, the market timing (to take advantage of overvalued stocks) and the precautionary (to prepare for uncertain contingencies) motives 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 a low COC.

We also extend the literature on the effects of financial constraints on cash savings. Almeida et al. (2004) suggest that the cash flow sensitivity of cash captures the effect of financial constraints. Riddick and Whited (2009) challenge this interpretation by showing that financially constrained 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 internal cash flows. In our model, firms trade off between not only current and future investments but also the current COC and future COC in accessing external capital so as to hedge against higher financing costs for future investments. This hedging motive drives the sensitivity of cash savings to the COC in *both* financially constrained and (currently) unconstrained firms. Our empirical results show that the cash savings of *both* financially constrained and unconstrained firms increase as the COC decreases.

The continuous-time model developed in Bolton et al. (2013) shows that firms respond to fluctuations in financing conditions such as the probability of a crisis by adjusting cash, payout and investment decisions, and by timing the market to raise funds, even without immediate funding needs. Our model is complementary to their model and focuses on identifying the cash-saving motive of individual firms to reduce the overall external financing cost in consideration of future investment needs. In particular, we introduce a novel hedging motive for cash-saving decisions that is reflected in the correlation between the firm's cost of capital and funding needs. Moreover, we provide empirical evidence supporting the theoretically implied sensitivity of cash savings to the firm-specific COC and the impact of hedging needs in driving this sensitivity.

Acharya, Almeida, and Campello (2007) show that financially constrained firms' preference for cash savings from internal funds over preserving debt capacity depends on their need to hedge investment opportunities against income shortfalls. Our hedging motive is distinct from that in their study because we consider cash savings from *both* internal cash flows and external capital (especially equity) in response to the COC. More importantly, *both* financially constrained and unconstrained firms save from external capital obtained with a relatively low COC to hedge against a higher COC for future investment.

Finally, our study is also related to Azar, Kagy, and Schmalz (2016) who suggest that the cost of carry for cash holdings, which depends on the risk-free interest rate, is an important factor explaining the trend in corporate cash holdings over time. However, Gao, Whited, and Zhang (2021) find a hump-shaped relationship between cash holdings and interest rates. They rationalize this relationship in a model in which firms' precautionary cash demand is nonmonotonically correlated with interest rates. They suggest that interest rates are unlikely to explain the recent rise in corporate cash holdings.[4] McLean (2011) finds that the variation of equity issuance costs due to business cycle fluctuations affects firms' equity issues and cash savings. Our study extends the inquiry to the firm-specific cost of capital and explore the cross-sectional variation in the impact of the COC on firms' cash saving decisions in a consideration of hedging needs. We contribute to the literature by showing that corporate cash savings are closely related to the time-varying COC and, particularly the COE, which fluctuates over time due to changes in the risk premium in addition to the level of the risk-free interest rate and macroeconomic conditions.

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

3. Hypothesis Development

3.1 A Base Model Setting

To show the crux of how the time-varying COC affect cash savings, we start with a base model wherein a firm endowed with cash W_0 faces two-period financing and investment decisions with a zero discount rate. At $t = 0$, the firm invests I_0 which returns $\pi(I_0)$ at $t = 2$ along with an investment opportunity to expand its operation at $t = 1$.[5] The firm also chooses external finance X_0 and save $C_0 = W_0 + X_0 - I_0$ for its investment opportunity at $t = 1$. At $t = 1$, the firm raises additional capital X_1 to invest I_1 which produces $\pi(I_1)$ at $t = 2$. We assume $\pi_I > 0$ and $\pi_{II} < 0$.[6]

The firm maximizes its value as given by

$$V_0(W_0) = \max_{(X_0, C_0, I_0, X_1, I_1)} \pi(I_0) + \pi(I_1) - X_0 - X_1 - \lambda(\delta_0, X_0) - \lambda(\delta_1, X_1) \tag{1}$$
$$\text{subject to} \quad I_1 = C_0 + X_1 \quad \text{and} \quad I_0 = X_0 + W_0 - C_0.$$

where the external finance cost is represented by $\lambda(\delta_t, X_t) = \frac{1}{2}\delta_t X_t^2$ with $\delta_t > 0$, for $X_t > 0$ and $t = 0, 1$. When $X_t \leq 0$ (no external capital or payout), external finance costs are zero. The convex external finance cost function implies that the marginal external finance cost increases with the amount of external capital raised. The external finance cost is also an increasing function of δ_t ($\lambda_\delta(\delta_t, X_t) > 0$), which is the time-varying component of the external financing cost related to market frictions such as agency problems, limited intermediation, investor preferences that drive fluctuation in the risk premium, and/or market sentiment.[7] We assume that δ_t is deterministic in the base model and relax this assumption in Section 3.2.

[5] This assumption is adopted for simplicity and intuitive appeal. In the previous version of the present paper, we assume that $\pi(I_0)$ is realized at $t = 0$ and used for investment at $t = 1$ and obtain similar results.

[6] f_x and f_{xx} denote the first and second partial derivatives, respectively, of $f(x, y)$ with respect to x.

[7] The convex external finance cost function is obtained under the costly-state-verification approach used by Froot et al. (1993). According to Baker (2009), limited intermediation refers to intermediaries' inability to reinforce fundamental value due to the lack of competition or efficiency.

The FOCs are given as follows:

$$\pi_I(I_0) - 1 - \delta_0 X_0 = 0; \tag{2}$$

$$\pi_I(I_1) - 1 - \delta_1 X_1 = 0; \tag{3}$$

$$-\pi_I(I_0) + \pi_I(I_1) = 0, \tag{4}$$

these imply the following: $\pi_I(I_0) = \pi_I(I_1) = 1+\delta_0 X_0 = 1+\delta_1 X_1$. These FOCs suggest that the firm's optimal investment decisions are made by trading off between current and future external finance costs. In particular, when $\delta_0 < \delta_1$ ($\delta_0 > \delta_1$), the firm will issue more (less) X_0 and save more (less) C_0, while reducing (increasing) X_1 to achieve the optimal investments. Thus, the optimal cash saving is achieved when the marginal benefit of cash saving is equal to the marginal cost of external finance $(1 + \delta_1 X_1)$.

We formalize this observation in the following results:

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

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

Proof: See Internet Appendix 1.

Result 1 suggests that the firm reduces (increases) cash savings and external capital raised at $t = 0$ when facing a higher (lower) financing cost (δ_0). If the firm is currently constrained ($W_0 < I_0^*$), where I_0^* is the first-best investment satisfying $\pi_I(I_0^*) = 1$, both external finance constraints at $t = 0$ and 1 are binding and the firm will increase external finance, cash savings and investment in response to a lower COC to satisfy the FOCs. If the firm is currently unconstrained but "overall" intertemporally constrained ($I_0^* \leq W_0 < I_0^* + I_1^*$), even though the current external finance constraint is not binding, the external finance constraint at $t = 1$ is still binding. Consequently, the firm will save the remaining W_0 and issue external capital and save for future investment. If δ_0 is lower, the firm will issue more external capital X_0 to save for I_1. Thus, both currently constrained and future constrained firms may save by issuing excess capital $(X_0 - I_0)$ when the COC is lower. Cash saved today reduces future external capital needs and the total costs of external capital.

When the firm is financially unconstrained overall ($W_0 \geq I_0^* + I_1^*$), neither of the external finance constraints is binding because the firm has enough cash for both investments at $t = 0$ and 1 and is insulated from external financing. Such firms will not save for future investment. In the next section, we extend the model to introduce uncertainty in the cost of capital and investment opportunities to show that a hedging motive arises when the firm wants to insulate its future value from the fluctuations in external financing costs.

3.2 Hedging Motive

In the discussion above, we assume that the time-varying cost component of external finance stemming from market frictions and investor preferences, δ, is nonstochastic, and thus independent of external capital needs. We now incorporate uncertainty in external finance costs and investment opportunities and show that the correlation between external finance costs and external capital needs induces an incentive to save more cash in response to the COC to hedge against costs for future external capital needs. We refer to this incentive as the "hedging motive" of cash savings.

We now introduce random cash flow shocks to assets in place at $t = 1$ and $t = 2$, denoted by z_1 and z_2, respectively. We assume that z is i.i.d., normal with a zero mean and a variance of σ^2.[8] To capture the external finance cost and investment opportunity correlated with cash flow shock z_1, we assume $\tilde{\delta_1} = \delta_1 + \alpha z_1$ and $\tilde{\pi} = \pi + \beta z_1$, where α and β measure the strength of the correlations between $\tilde{\delta_1}$ and z_1 and between $\tilde{\pi}$ and z_1, respectively.

[8] "*i.i.d*" stands for independent and identical distribution across firms and over time.

The firm maximizes current shareholder wealth as follows:

$$
\begin{aligned}
V_0 \quad &= \max_{(X_0, C_0, I_0)} E_0\{\pi(I_0) + z_1 - X_0 - \tilde{\lambda}(\delta_0, X_0) + V_1\} \qquad (5) \\
&\quad \text{subject to} \quad I_0 = W_0 + X_0 - C_0, \\
&\quad \text{where} \quad V_1 = \max_{X_1, I_1} E_1\{\tilde{\pi}(I_1) + z_2 - X_1 - \tilde{\lambda}(\tilde{\delta}_1, X_1)\}, \quad \text{and} \\
&\qquad\qquad I_1 = X_1 + z_1 + C_0,
\end{aligned}
$$

where $\tilde{\lambda}(\delta_0, X_0)$ and $\tilde{\lambda}(\tilde{\delta}_1, X_1)$ are the external finance cost function at $t = 0$ and $t = 1$, respectively.

The following time line illustrates the firm's cash flows and decisions.

t=0	1	2
Firm endowed with W_0	Cash flow: z_1	Cash flow: $\pi(I_0) + \tilde{\pi}(I_1) + z_2$
raise X_0, save C_0,	cash available: $W_1 = C_0 + z_1$	
invest $I_0 + C_0 = W_0 + X_0$	raise X_1	
	invest $I_1 = X_1 + W_1$	

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

$$\mu_1 = \tilde{\pi}_I(I_1) = 1 + \tilde{\lambda}_X(\tilde{\delta}_1, X_1). \qquad (6)$$

We can see the direct effects of z_1 on V_1 by considering

$$\frac{dV_1(W_1)}{dz_1} = \tilde{\pi}_I(I_1)\left[\frac{dX_1}{dz_1} + 1\right] - \frac{dX_1}{dz_1} - \tilde{\lambda}_X(\tilde{\delta}_1, X_1)\frac{dX_1}{dz_1} - \tilde{\lambda}_\delta(\tilde{\delta}_1, X_1)\frac{d\tilde{\delta}_1}{dz_1}, \qquad (7)$$

noting $\frac{dI_1}{dz_1} = \frac{dX_1}{dz_1} + 1$. The formulations of $\tilde{\delta}_1$ and $\tilde{\pi}$ imply $\frac{d\tilde{\delta}_1}{dz_1} = \alpha$ and $\frac{d\tilde{\pi}}{dz_1} = \beta$. The change in profit function $\tilde{\pi}$ due to z_1 also affects I_1 and X_1 by $\frac{dI_1}{dz_1} = \frac{\beta}{\bar{\pi}_I}$ and $\frac{dX_1}{dz_1} = \frac{\beta}{\bar{\pi}_I} - 1$, respectively.[9]

[9] We use the Rubinstein (1976) and Froot et al. (1993) result: $Cov(a(x), b(y)) = E[a_x]E[b_y]Cov(x, y)$, for x and y normally distributed. Specifically, we have $Cov(\tilde{\pi}, z_1) = \bar{\pi}_I Cov(I_1, z_1)$ and $Cov(I_1, z_1) = E\left[\frac{dI_1}{dz}\right]\sigma^2$, which implies $\frac{dI_1}{dz} = \frac{Cov(\tilde{\pi}, z_1)}{\bar{\pi}_I \sigma^2} = \frac{d\tilde{\pi}/dz_1}{\bar{\pi}_I} = \frac{\beta}{\bar{\pi}_I}$. The bar over a variable denotes its expected value.

Dividing both sizes by $\frac{dX_1}{dz_1}$ yields

$$\frac{dV_1(W_1)}{dX_1} = \tilde{\pi}_I(I_1)\left[1 + \frac{dz_1}{dX_1}\right] - 1 - \tilde{\lambda}_X(\tilde{\delta}_1, X_1) - \gamma\tilde{\lambda}_\delta(\tilde{\delta}_1, X_1) = \tilde{\pi}_I(I_1)\frac{dz_1}{dX_1} - \gamma\tilde{\lambda}_\delta(\tilde{\delta}_1, X_1), \quad (8)$$

where $\gamma = \frac{d\tilde{\delta}/dz_1}{dX/dz_1} = \frac{\alpha\bar{\pi}_I}{\beta - \tilde{\pi}_I}$ is a measure of the correlation between external finance cost and external capital needs resulting from the effects of z_1 on $\tilde{\delta}$ and $\tilde{\pi}$.[10] A higher γ imposes a higher cost on additional external financing when the firm faces a lower cash flow shock and greater external finance needs. Given the higher marginal cost of external finance and the convexity of the external finance cost function, the variability in cash flows becomes costly because it disturbs both investment and external finance. Thus, the hedging motive of cash savings arises as the firm wants to insulate the value of its intermediate asset position, $V_1(W_1)$, from fluctuations in X_1 due to z_1.

For simplicity, we consider $\tilde{\lambda}(\tilde{\delta}_1, X_1) = (1+\gamma)\lambda(\tilde{\delta}_1, X_1) = \frac{1}{2}(1+\gamma)\tilde{\delta}_1 X_1^2$ which captures the concurrent effects of z_1 on $\tilde{\pi}$ and $\tilde{\delta}_1$ through γ. We assume that the external finance cost function at $t = 0$ is also governed by γ. The specified external finance cost function implies $\mu_1 = 1 + (1+\gamma)\tilde{\delta}_1 X_1$. The first-best level of investment (I_1^*, satisfying $\tilde{\pi}_I(I_1^*) = 1$) can be achieved if the firm has sufficient cash at $t = 1$ ($I_1^* \leq W_1$) after realizing z_1. If W_1 cannot cover the investment, the firm must rely on external finance, that is, $X_1 > 0$ and its investment will be determined to satisfy $\tilde{\pi}_I(I_1) = \mu_1 > 1$. Thus, the firm invests below the first-best level ($I_1 < I_1^*$) given the external finance costs.

Based on the above observations, we obtain the following:

$$V_1(W_1) = \int_{I_1^*-C_0}^{\infty} \{\tilde{\pi}(I_1^*) - I_1^* + W_1\}\, g(z)dz + \int_{-\infty}^{I_1^*-C_0} \left\{\tilde{\pi}(I_1) - I_1 + W_1 - \frac{1}{2}(1+\gamma)\tilde{\delta}_1 X_1^2\right\} g(z)dz,$$

where $g(z)$ is the probability density function (PDF) of z_1.

Moving back to the first period, the firm maximizes V_0. In Internet Appendix 2, we derive the

[10] The effect of z_1 on $\tilde{\pi}$ comes through β and $I_1 = X_1 + C_0 + z_1$. Thus, even when the investment opportunity does not directly depend on the cash flow shock (i.e., $\beta = 0$), the investment is still affected by the cash flow shock. In this case, we have $\gamma = -\alpha$.

FOCs, which imply that optimal cash saving and investment decisions satisfy the following condition:

$$\pi_I(I_0) = G = 1 + (1+\gamma)\delta_0 X_0, \tag{9}$$

where $G = 1 + \int\limits_{-\infty}^{I_1^* - C_0} \left\{ \tilde{\pi}_I(I_1) - 1 + (1+\gamma)\tilde{\delta}_1 X_1 \right\} g(z)dz$ is the marginal benefit of cash savings. Thus, the expected marginal benefit of cash due to the cost of external finance at $t = 1$ is an important consideration for investment and cash saving decisions at $t = 0$. When the firm is currently unconstrained with sufficient initial endowment to make the first-best initial investment ($I_0^* \leq W_0$), it may currently make the optimal investment without incurring external finance costs and pay out the remaining to shareholders (negative X_0) if it does not consider future financing needs. However, when facing uncertainty in future financing costs due to z_1, the firm will not payout but increase X_0 to save cash until its marginal benefit is equal to the marginal cost.

When the firm is constrained ($I_0^* > W_0$), it will choose the optimal cash savings by issuing excess external capital until the marginal benefit of cash savings, G, is equal to the marginal cost of external finance, $1 + (1+\gamma)\delta_0 X_0$. Thus, cash savings associated with the COC for the hedging motive comes from both internal funds (W_0) and external capital for both currently constrained and future constrained firms.

In Internet Appendix 2, we obtain the same results under uncertainty as in Result 1: the firm reduces (increases) external finance, cash saving, and investment when facing a higher (lower) cost of external capital. Given that the effect of uncertain external finance is greater for a higher γ, firms with high γ will have stronger incentives to save when the COC is relatively low. In Internet Appendix 3, we formally show that the optimal decisions at $t = 0$ have the following properties with respect to γ:

Result 2 *The correlation between the external capital needs and external finance costs, γ, increases the sensitivities of optimal external finance, $\hat{X}_0$, cash savings, $\hat{C}_0$, and investment, $\hat{I}_0$ to the COC,*

δ_0;

$$\frac{\partial^2 \hat{X}_0}{\partial \delta_0 \partial \gamma} < 0, \quad \frac{\partial^2 \hat{C}_0}{\partial \delta_0 \partial \gamma} < 0 \quad \text{and} \quad \frac{\partial^2 \hat{I}_0}{\partial \delta_0 \partial \gamma} < 0.$$

Proof: See Internet Appendix 3.

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

Given the above results, we propose the following hedging motive hypotheses:

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

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

Hypothesis 1c Both constrained and unconstrained firms save more from external finance and internal funds, when the COC is relatively low.

4. Data and Variables

4.1 Sample

The initial sample includes all U.S. firms from the annual Compustat files for the 1981–2019 period. We require that firms have a value of assets greater than $5 million and positive values for equity, cash holdings and net sales. Financial firms (SIC codes 6000-6799) and regulated utilities (SIC codes 4900-4999) are excluded from the sample. Observations with missing net income and stock issuance proceeds are also excluded. Stock price information is obtained from the Center for Research in Security Prices (CRSP), nominal GDP growth rates are obtained from the Bureau of Economic Analysis, and interest rates are collected from the Federal Reserve Bank of St. Louis.

To estimate the COE, we obtain analysts' earnings and growth forecasts from the Institutional Brokers Estimate System (I/B/E/S). We require non-missing data for the prior year's book value, earnings, and dividends. When explicit forecasts are unavailable, we obtain forecasts by applying the long-term growth rate to the prior year's earnings forecast.

4.2 Cost of Capital

It is challenging to estimate individual firms' cost of capital because the cost of equity and the cost of debt are not directly observable. We measure the COE using the implied cost of capital approach, which estimates the *ex ante* expected return implied by market prices. Specifically, the ICC is the discount rate that equates a stock's present value of expected cash flows to its current price. According to the discounted cash flow model, the stock price of a firm at time t is given by

$$P_t = \sum_{k=1}^{\infty} \frac{E_t(FE_{t+k})}{(1 + ICC_t)^k}, \tag{10}$$

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

To estimate the cost of equity, we use three different models proposed by Gebhardt, Lee, and Swaminathan (2001), Claus and Thomas (2001), and Li, Ng, and Swaminathan (2013). The consensus analyst forecasts from the I/B/E/S are used to predict future earnings per share. Given that firms are required to file their financial statements within 90 days of the fiscal year end, we estimate the COE using the earliest forecasts available after three months of the prior fiscal year end. As these models rely on analyst forecasts to estimate future free cash flow to equity, the estimated ICC is only available for firms covered by analysts and with positive earnings forecast. To circumvent this disadvantage, we use the approach developed in Li and Mohanram (2014) to forecast future earnings from cross-sectional residual income models. Since this approach does not use analyst forecasts and allows for negative earnings, it helps mitigate the concerns about potential biases in analyst forecasts (Hoberg and Philips (2010)), omitting firms with negative earnings, and no analyst coverage. The specific estimation procedures are provided in Internet Appendix 5. The reported results are based on the Gebhardt, Lee, and Swaminathan (2001) approach. The results are robust to the alternative COE estimation methods.

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

4.3 Hedging Motive Measures

We measure the hedging motive by the regression coefficient of external capital needs on the COC.[11] The following three proxies are used to capture firms' needs for external capital: external finance dependence, the financial deficit, and the KZ index. Following Rajan and Zingales (1998), external finance is measured as follows:

$$External = (CapEx - OCF)/CapEx, \tag{12}$$

where $CapEx$ is capital expenditures; and OCF is the operating income before depreciation and amortization (oibdp). We also follow Shyam-Sunder and Myers (1999), Frank and Goyal (2003), and

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

Byoun (2008) and define the financial deficit as follows:

$$Deficit = (Div + Acq + Inv - ICF1)/TA, \tag{13}$$

where Div is the cash dividend; Acq is acquisitions; Inv is net investments; $ICF1$ is income before extraordinary (ibc) items plus depreciation and amortization (dpc) and TA is total assets at the beginning of the period. Following Baker, Stein, and Wurgler (2003), we also use the revised KZ index to measure external finance dependence as follows:

$$KZ = -1.002CF - 39.368DIV - 1.315CASH + 3.139LEV, \tag{14}$$

where CF is the operating income before depreciation and amortization (oibdp) 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.

We use the industry median $External$ based on the 2-digit SIC code and the firm-level $Deficit$ and KZ as proxies for external capital needs. To measure hedging needs, we obtain annual external capital need measures and compute their regression coefficients on individual firms' COCs over the sample period. Figure 1 presents the distributions of three hedging motive measures. The mean values of the three measures are 0.003, 0.009, and 0.0005, respectively. The distributions are slightly right skewed. Based on the three hedging motive measures, 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 and remove the middle 40 percent.

5. Empirical Analysis

5.1 Univariate Analysis

The summary statistics of the firm characteristic variables and the COC are reported in Table 1 Panel A. The average cash holding is 11% of total assets and the cash savings rate is approximately

1.18% of total assets. The average COC is 8.49%, with an average COE of 9.62% and an average COD of 7.01%. Panel B shows the decomposition of the standard deviation of the COC across firms and over time. As expected, the COD exhibits less variation than the COE cross-sectionally and over time.

Our theoretical model implies that the COC will revert to the long-run mean. To examine whether the cost of capital is mean reverting, we estimate the following simple AR(1) model for each firm:

$$COC_{it} = \alpha + \beta COC_{it-1} + \varepsilon_{it}, \tag{15}$$

where the long-run mean COC is estimated by $\alpha/(1-\beta)$. We perform firm-by-firm time series tests on mean reversion for firms with minimum 5-year observations. The mean of the estimated α and β is 0.05 and 0.38, respectively. The estimated long-run mean COC is 8%. The results indicate that the COC exhibits mean-reverting behavior. The COC is expected to rise in the future when the current COC is low.

Figure 2 Panel A plots the average annual cash holdings relative to the average COC for all sample firms over the sample period. The striking symmetry of the two series suggests that firms increase (decrease) cash when the COC is low (high). Thus, the COC appears to be an important driver of corporate cash holding behavior over time. Notably, the COC declined significantly until the early 2000s, which may help explain the increase in cash holdings over the same period documented by Bates et al. (2009). Previous studies posit that an increasing number of firms in high-tech industries with significant intangible assets and negative cash flows since 1980s has driven an increase in average cash holdings (Graham and Leary (2018), Begenau and Palazzo (2021), and Denis and McKeon (2021)). To investigate whether the evolution of cash and the COC is affected by industry compositions, we classify firms into Fama-French 5 industries. As shown in Figure 2 Panels B–F, an increase in cash holdings when the COC decreases are observed in all industries. The opposite movements of cash and the COC is the most notable in high-tech industries (Panel D).

To further examine how a relatively low COC drives corporate cash savings, we obtain a firm's COC minus its historical average for firms with a minimum of 3 years of data. Figure 3 Panel A plots cash savings across deciles of the deviation of COC from the historical average for the sample period of 1981-2019 and the subsample periods of 1981-1999 and 2000-2019. The downward-sloping graphs indicate that firms save more when the COC is lower relative to the historical average.

Figure 4 plots the current year cash savings across future investment (subsequent three-year average) deciles. The figure shows that firms with greater future investment save more cash in the current year, which is consistent with the hedging motive view that firms save cash for future investments.

5.2 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 estimate the following regression:

$$\Delta Cash_{it} = \lambda_0 + \lambda_1 ExCapital_{it} + \lambda_2 ICF_{it} + \lambda_3 X_{it-1} + f_i + \gamma_t + \varepsilon_{it} \tag{16}$$

where $\Delta Cash_{it}$ is the change in cash and equivalents of firm i in year t; ICF_{it} is internal cash flow; and $ExCapital_{it}$ is the sum of the 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 denotes firm fixed effects. γ_t represents year fixed effects which control for the macroeconomic effects. Following Opler et al. (1999) and Bates et al. (2009), we include the following control variables: M/B_{it-1}, the market-to-book asset ratio; $Cash_{it-1}$, the lagged cash-to-asset ratio; Vol, cash flow volatility; $Leverage_{it-1}$, the leverage ratio;[12] $Size_{it-1}$, 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

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

assets at $t-1$; $Acquisitions_{it}$, acquisitions divided by total assets at $t-1$; and $Divdend_{it}$, cash dividend divided by total assets at $t-1$. We winsorize all variables at the 2 and 98 percentiles to mitigate the effects of outliers.

We first estimate the model without firm and year fixed effects. The results are reported in Table 2. The coefficient estimate of external capital ($ExCapital$) is 0.2822 and significant, whereas that of internal cash flows (ICF) is 0.2299 and significant. To evaluate the relative importance of external capital to internal cash flows, we estimate the standardized beta coefficients. Column 5 of Table 2 shows that the standardized beta coefficient of external capital is much larger than that of internal cash flow (0.6691 versus 0.1806), indicating that external capital is a major source of firms' cash savings. When we include firm fixed effects (Column 2), year fixed effects (Column 3), and firm and year fixed effects (Column 4), the coefficient estimates of the cash sources remain positive and significant. The coefficients on M/B are positive, indicating that firms with more investment opportunities save more cash. The estimates also show that cash flow volatility positively affects cash savings, while lagged cash, dividend, leverage, firm size, net working capital, capital expenditures, and acquisitions have negative effects.

5.3 Cost of Capital and Cash Savings

To test whether firms' cash savings are sensitive to the COC, we include the COC and its interactions with external capital ($ExCapital$) and internal cash flows (ICF) in equation (16). The estimation results are reported in Table 3. For brevity, we do not report the estimates of control variables. The negative and significant coefficient estimates of the COC suggest that firms save more when the COC is low. The economic magnitude of the impact is also significant. A one percentage point decrease in the COC is associated with an approximately 16% increase in cash savings. The negative coefficient estimates of its interaction with external capital indicate that firms save significantly more from external capital when the COC is lower.

6. Hedging Motive

Our model suggests that in the presence of the time-varying COC, firms with a high correlation between their COC and external financing needs (a high hedging motive) have more incentives to raise external capital and save cash at a relatively low COC. Figure 3 Panel B shows that firms with high hedging motives save more cash when their COC is lower than its historical mean and save less when their COC is higher than the historical mean. In Panel B, however, such a downward-sloping relationship is much weaker among firms with low hedging motives. In this section, we formally test the predictions of our models.

6.1 Hedging Needs and Cash Savings

To test hypothesis 1a that firms with high hedging motives save more when the COC is relatively low, we examine whether the sensitivity of cash savings to the COC is more pronounced among firms with high hedging needs. We divide 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 regression coefficients between the COC and each of the three measures of external capital needs ($External$, $Deficit$, and KZ).

The coefficient estimates of the interaction terms between external finance proceeds and the COC ($ExCapital \times COC$) are significant and negative only among high hedging needs firms, indicating that firms with greater hedging motives save more from external capital when the COC is relatively low. We further find that the difference in the impacts of the COC on cash savings from external capital between firms with high and low hedging needs is significant (Columns (3), (6), and (9)). These results are consistent with hypothesis 1a.

6.2 Hedging Needs and Excess Capital Issuance

Hypothesis 1b predicts that firms with greater hedging needs issue excess capital when the 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 saved as cash. We first examine whether firms with high hedging motives are more likely to raise excess capital when the COC is lower by estimating the Probit fixed effects model that accounts for the biases arising from the inclusion of firm fixed effects and year fixed effects and report the average marginal effects. As a robustness check, we also estimate the linear probability model and find similar results. Table 5 reports the results of firms with high and low hedging needs based on the three hedging motive measures. As shown in Panel A, the coefficients on *COC* are negative and significant for firms with high hedging motives, indicating that they are more likely to raise excess capital as the COC drops. A one percentage decrease in the COC is associated with approximately 8.14% higher probability of raising excess capital by firms with high hedging motives (Column (1)). However, we do not observe similar effects for firms with low hedging motives.

We next investigate whether the amount of excess capital raised by firms with high hedging motives is more sensitive to the COC. Panel B shows that the coefficient estimates of the COC are negative and significant only among 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.

6.3 Equity versus Debt

Thus far, our results show that firms save cash from external capital and that this saving behavior is affected by the COC. As equity and debt are the two main sources of external capital, we investigate their relative importance for firms' cash savings. We first perform a simple regression for each cash sources and report the results in Table 6 Panel A. The coefficient estimate of net equity issues ($EIssue$) is 0.2804 and significant, with an adjusted R^2 of 9.4%. The coefficient estimate of debt issues ($DIssue$) is a mere 0.0556, and the adjusted R^2 is 0.71%. The estimated coefficient of internal cash flows (ICF) is 0.1503 and statistically significant, with an adjusted R^2 of 1.3%. When we include all cash sources along with the control variables (Column 4) and firm fixed effects (column 5), the coefficient estimates of all cash sources remain positive and significant. Overall, equity is the most important source for cash savings.

We next examine the relative importance of the COE and COD for firms' cash savings by including the interaction terms between the COE (COD) and net equity issue proceeds (net debt issue proceeds) and internal cash flows in our regression model. As shown in Table 6 Panel B, the coefficient estimates of COE are negative and significant among firms with high hedging motives, 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 sensitive to the COE, whereas cash savings from internal cash flows show limited sensitivity to the COD.

When the sample is divided into low and high 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 among high hedging needs firms. Thus, COE appears to be an important consideration in making cash savings decisions for firms with high hedging needs.

6.4 Exogenous Shock to the Cost of Capital

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

Following Chen et al. (2010), we use the M/B ratio 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 the top and bottom 30% ranked by the M/B ratio or the top 50% ranked by the R&D-to-sales ratio among positive R&D and zero-R&D firms, respectively. The M/B ratio and R&D-to-sales ratio are measured as of the end of September 2000 before Reg FD. We set the *Post* dummy as one for 2000-2003 and zero for 1997-1999.

We first verify whether treatment firms experience a greater decline in their cost of equity than control firms following Reg FD as shown in Chen et al. (2010). Columns (1) and (2) in Table 7 Panel A report the results obtained from using the M/B- and R&D-based measures of selective disclosure, respectively. The coefficients of $Treated \times Post$ are negative and significant, which confirms that firms with selective disclosure before Reg FD have a larger drop in the cost of equity after Reg FD.

We next examine whether treatment firms save more from external capital than control firms in the post-Reg FD period. Table 7 Panel B Columns (1) and (2) show that the coefficient estimates of triple interaction term $Treated \times ExCapital \times Post$ are positive and significant, indicating that cash savings from external capital have significantly increased among firms with a larger reduction in the COC relative to firms with a smaller reduction in the COC following the legislation.

To ease concerns that the results may be driven by omitted variables that affect both the COC and cash savings, we also conduct placebo tests based on the fictitious event years of 1991 and 2013. The sample period is 6 years surrounding the fictitious event year. The results of the placebo tests reported in Panel A Columns (3)-(6) show that the coefficients of $Treated \times Post$ are insignificant. For tests of the impacts on cash savings, Columns (3)-(6) of Panel B show that none of the coefficient estimates of $Treated \times ExCapital \times Post$ are significant. Thus, the results appear to be unique to Reg FD and are less likely due to other confounding factors. These findings boost our confidence that the COC has a causal impact on corporate cash savings from external capital.

It is also possible that the above results simply capture pre-existing divergent trends or differences between the treatment and control groups that are unrelated to the shock to the COC. To explore this possibility, we investigate the dynamics of firms' cash savings from external capital surrounding the shock. If this alternative explanation holds true, we should observe more cash savings from external capital by the treatment firms prior to Reg FD. To test this possibility, we replace $Post$ with year indicator variables associated with the years surrounding Reg FD. Figure 5 presents the coefficient estimates of the triple interaction term $Treated \times ExCapital \times Year$ with the 90% confidence interval. As shown in Figure 5, the differences in the sensitivities of cash savings to external capital between the treated and control groups are close to zero before Reg FD. Firms experiencing a larger decline in the COC save significantly more cash from external capital than firms experiencing a smaller decline in the COC after Reg FD. Therefore, it is less likely that our results are driven by pre-existing divergent trends in the treated and control firms or reverse causality.

6.5 Robustness

Although we show that the COC has a significant impact on cash savings in a quasi-natural experimental setting, an endogeneity concern may exist due to measurement errors in the COC. As a remedy for measurement errors in the COC, we estimate the model using high-order cumulants as suggested by Erickson et al. (2014). Table A1 in Internet Appendix 6 reports the estimation results. The coefficient estimates of the interaction between external capital and the COC in Panel A Columns (1) and (2) are negative and significant for high hedging motive firms, whereas they are insignificant among lower hedging motive firms. These results are consistent with those reported in previous tables.

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

We also examine whether our results are robust to alternative measures of the COC by using the Claus and Thomas (2001) and Li, Ng, and Swaminathan (2013) approaches as specified in Internet Appendix 5. There may be concerns that these models rely on analyst forecasts for future earnings that are not available for all firms and that analyst forecasts may be biased. To mitigate these concerns, we adopt an alternative approach to forecast future earnings without relying on analyst forecasts. Li and Mohanram (2014) propose the use of two cross-sectional models to estimate future earnings: the earning persistence (EP) and residual income (RI) models. They show that the RI model outperforms the cross-sectional model developed by Hou et al. (2012) and EP models in forecasting future EPS. Therefore, we use the Li and Mohanram (2014) RI model approach to forecast future EPS and estimate the implied cost of equity using the Gebhardt et al. (2001) model. The results shown in Panel B Columns (1)-(6) illustrate that our findings are robust to these alternative

COC measures.

Additionally, we investigate the robustness of our results to different time periods. To this end, we partition our sample into two subperiods: 1981-1999 and 2000-2019 and perform the tests. As shown in Panels C and D, the coefficients on $ExCapital \times COC$ remain significant and negative for firms with high hedging motives, but insignificant for firms with low hedging motives. These results indicate that our finding that firms with high hedging motives save more cash from external capital when the COC is lower is not driven by a particular sample period.

7. Financial Constraints and Alternative Hedging Measure

7.1 Financial Constraints

Since financial constraints are an important consideration for firms' cash savings decisions (Almeida et al. (2004)), it is possible that our results simply reflect financial constraints. If financial constraints drive our results, we should expect financially constrained firms to save more at a lower COC, while financially unconstrained firms have less incentives to do so. Diverging from this view, our theoretical model predicts that both financially constrained and unconstrained firms will save when the COC is low (hypothesis 1c). To investigate whether financial constraints explain the cash savings behavior observed in Table 4, we follow previous studies and use credit ratings, the WW (Whited and Wu (2006)) index, and the HP (Hadlock and Pierce (2010)) index to define financially constrained and unconstrained firms.[13] Financially constrained (unconstrained) firms are defined as firms without (with) credit ratings or firms in the top (bottom) 30 percent of the WW index or HP index.

The results presented in Table 8 Panel A show that both financially constrained and unconstrained firms save more when the COC is relatively low. Regarding economic magnitude, a one standard deviation decrease in the COC is associated with an approximately 4.52% (6.11%) increase in cash

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

savings among unconstrained (constrained) firms based on the HP index. The estimated coefficients of $ExCapital \times COC$ are negative and significant among both constrained and unconstrained firms. Firms' cash savings from external capital in response to the COC are also economically significant in both financially constrained and unconstrained firms. When $ExCapital \times COC$ decreases by one standard deviation, the cash savings of financially unconstrained (constrained) firms increase by 21% (10%) based on the HP index. The estimated coefficients of $ICF \times COC$ are also negative and significant among both constrained and financially constrained firms. These results are consistent with hypothesis 1c.

We further test whether financial constraints help explain firms' excess capital issuance in response to a low COC. To this 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 the COC is relatively low.[14] Overall, these results suggest that financial constraints cannot fully explain the sensitivity of cash savings to the 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 flows 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 the COC.

We conduct tests based on our hedging motive and AAC hedging needs measures for financially constrained and unconstrained firms. We report the results of high hedging motive firms based on these measures in Panel B of Table 8. The coefficient estimates of $ExCapital \times COC$ are negative and

[14] The tables are available upon request.

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

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

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

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

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

To test market timing hypothesis 2a, we estimate regression models for firms with high or low market timing motives based on the three market timing measures. As shown in Table 9 Panel A, the coefficient estimates of $ExCapital \times COC$ are negative and significant for both firms with high and low market timing motives. The results are inconsistent with market timing hypothesis 2a that firms with greater market timing motives save more from external capital when the COC is relatively low.

In Panel D, we test market timing hypothesis 2b regarding excess external capital. The results show that the coefficient estimates of the COC are negative and significant for both low and high market timing motive firms, which is inconsistent with the hypothesis that excess capital issues are mainly driven by the market timing motive. Both low and high market timing motive firms issue excess external capital to save when the COC is lower.

8.2 Precautionary Motive

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

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

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

To test these hypotheses, we follow previous studies and use R&D spending, cash flow volatility, and nondividend payout as measures of precautionary motives that represent unforeseen opportunities and contingencies requiring sudden expenditures. Cash flow volatility is the 10-year standard deviation of the average industry cash flow based on the 2-digit SIC code. We pay particular attention to the precautionary measure used by McLean (2011) based on the first principal component of R&D spending and cash flow volatility. For R&D spending, cash flow volatility and their first principal component, we define the top 30% of firms as high precautionary firms and the bottom

30% as low precautionary firms. We also treat nondividend-paying firms as high precautionary firms and dividend-paying firms as low precautionary firms.

Table 9 Panel B shows that the estimated coefficients of $ExCapital \times COC$ are mostly negative and significant for both low and high precautionary firms. These results are not consistent with precautionary hypothesis 3a, which states that firms with greater precautionary motives save more at a lower COC. In Panel C, we test precautionary hypothesis 3b regarding excess external capital and find that the coefficient estimates of the COC are negative and significant for both low and high precautionary motive firms. These results are inconsistent with hypothesis 3b, which states that firms with higher precautionary motives issue more capital in excess of the current financial needs than firms with lower precautionary motives when the COC is relatively low. Additionally, we include the precautionary motive measure to our baseline estimations and find that our results in Table 4 still hold after controlling for the precautionary motive effect.[15] These results reinforce our conclusion that firms' cash savings from external capital in response to the time-varying COC cannot be fully explained by precautionary motive.

8.3 Market Timing and Precautionary Motives

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

[15] The table is available upon request.

hypotheses:

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

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

To test these hypotheses, we define firms with high (low) cash holdings as firms in the top (bottom) 30 percent based on their lagged cash ratio or cash balance. As shown in Table 9 Panel C, the coefficient of $ExCapital \times COC$ is negative and significant among firms with high cash ratios, while it is positive among firms with low cash ratios. The coefficients are insignificant among firms with high cash balances and firms with low cash balances. These results are inconsistent with hypothesis 4a, which states that firms with low cash holdings tend to time favorable market conditions to save cash more than firms with high cash holdings. These results indicate that our finding that firms with high hedging motives save more from external capital when the COC is relatively low is not explained by the model developed by Bolton et al. (2013).

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

8.4 Credit Risk

As shown by Acharya et al. (2012), cash reserves are positively related to credit risk. Riskier firms choose to hold more cash as a buffer against a possible cash flow shortfall in the future. Accordingly, firms' cash saving decisions might be driven by their credit risk. We explore this possibility by investigating whether high-risk and low-risk firms behave differently in their cash savings decisions. We use two measures to capture a firm's credit risk: the Altman Z-score and leverage. Since the results are similar when using these two approaches, we report the results based on the Altman Z-score. Firms with the Altman Z-score above (below) the industry median value are classified as low (high) risk firms. Table 9 Panel E show that the coefficients on $ExCapital \times COC$ are negative and significant for firms with high hedging motives (Columns (1) and (3)) and insignificant for firms with low hedging motives (Columns (2) and (4)). Such difference in cash savings exists among firms with high credit risk and firms with low credit risk. These results indicate that credit risk does not fully explain the sensitivity of cash savings to the COC.

8.5 Agency Risk

Jensen (1986) develops the agency costs of free cash flow hypothesis, which suggests that entrenched managers prefer to retain cash. This hypothesis is supported by studies showing that firms with greater agency problems hold more cash in both within-country and cross-country analyses (Dittmar et al. (2003), Dittmar and Mahrt-Smith (2007), Harford et al. (2008)). To investigate whether agency problems of free cash flow may explain the observed cash saving behavior, we examine the differences in the impacts of the COC on firms' cash savings from external capital between firms with high free cash flows and firms with low free cash flows. We measure free cash flow following Lehn and Poulsen (1989) and classify firms with high (low) free cash flows as those with free cash flows above (below) the median level. As shown in Table 9 Panel F, the coefficients on $ExCapital \times COC$ are negative and significant for firms with high hedging motives (Columns (1) and (3)) and insignificant for firms with low hedging motives (Columns (2) and (4)) for both high and low agency risk firms. Regardless of the level of free cash flows, high hedging motive firms are more likely to save from external capital as the COC declines. These results indicate that agency risk cannot fully explain firms' cash saving behavior.

9. Conclusions and Discussions

We develop a theoretical model showing that in the presence of a time-varying COC, firms channel funds into future states with a high COC by saving cash from external capital when the current COC is relatively low. 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 show greater sensitivity to the COC among firms with greater hedging needs.

Consistent with the theoretical predictions, we find that both financially constrained and unconstrained firms save more cash from external capital when the COC is relatively low. The 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 the COC is relatively low. Our findings cannot be fully explained by alternative explanations such as the precautionary motive, the market timing motive, credit risk, and agency risk.

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

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Figure 1: Distributions of Hedging Motive Measures

This figure plots the distributions of three hedging motive measures. Hedging Motive Measures 1 to 3 represent the correlation coefficients between the COC and each of the three measures of external capital needs (*External*, *Deficit*, and *KZ*)

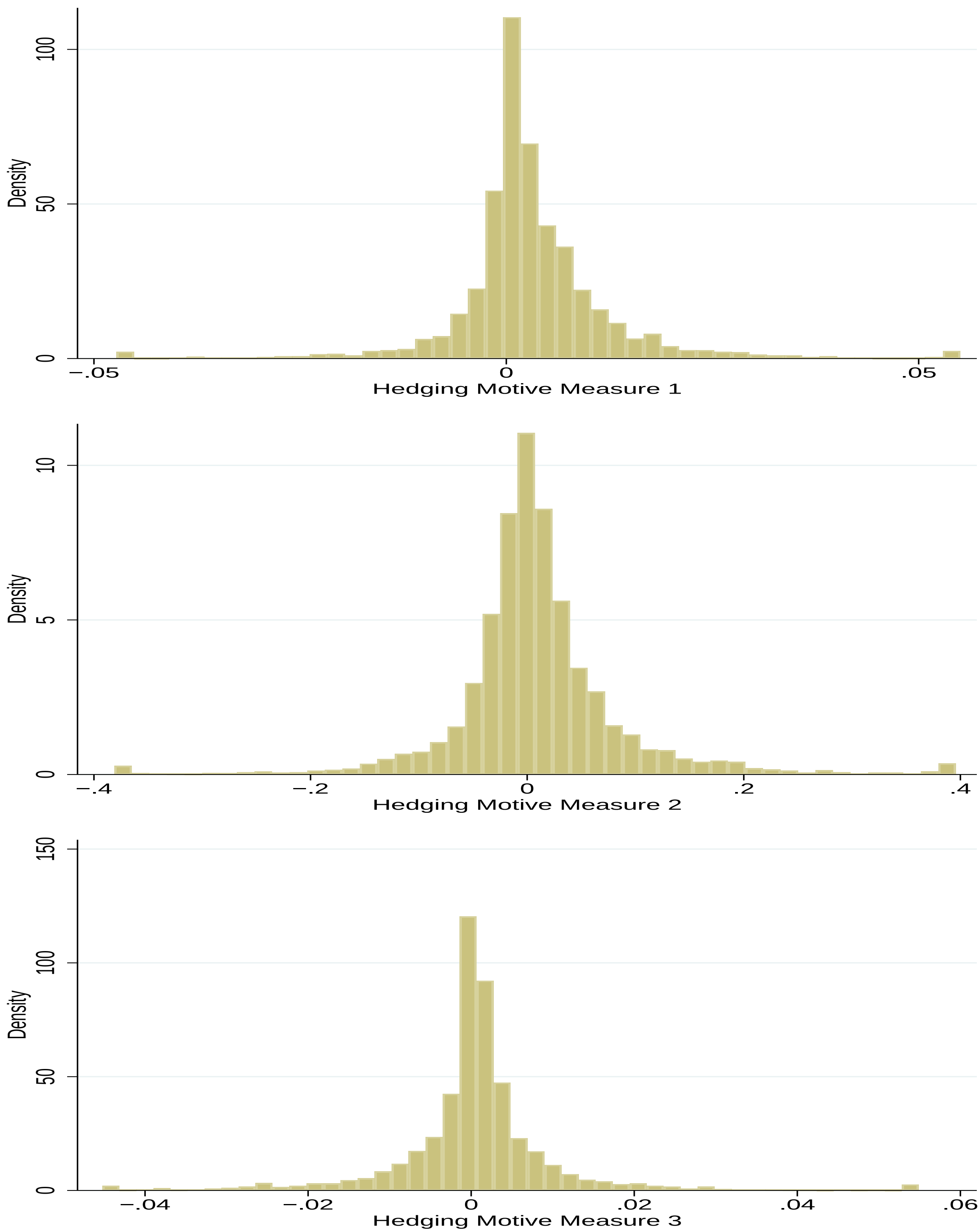

Figure 2: Cash Holdings versus Cost of Capital

This figure plots firms' average cash holdings relative to the level of the cost of capital for all firms and Fama-French 5 industries from 1981 to 2019. Cash is cash and equivalents divided by total assets.

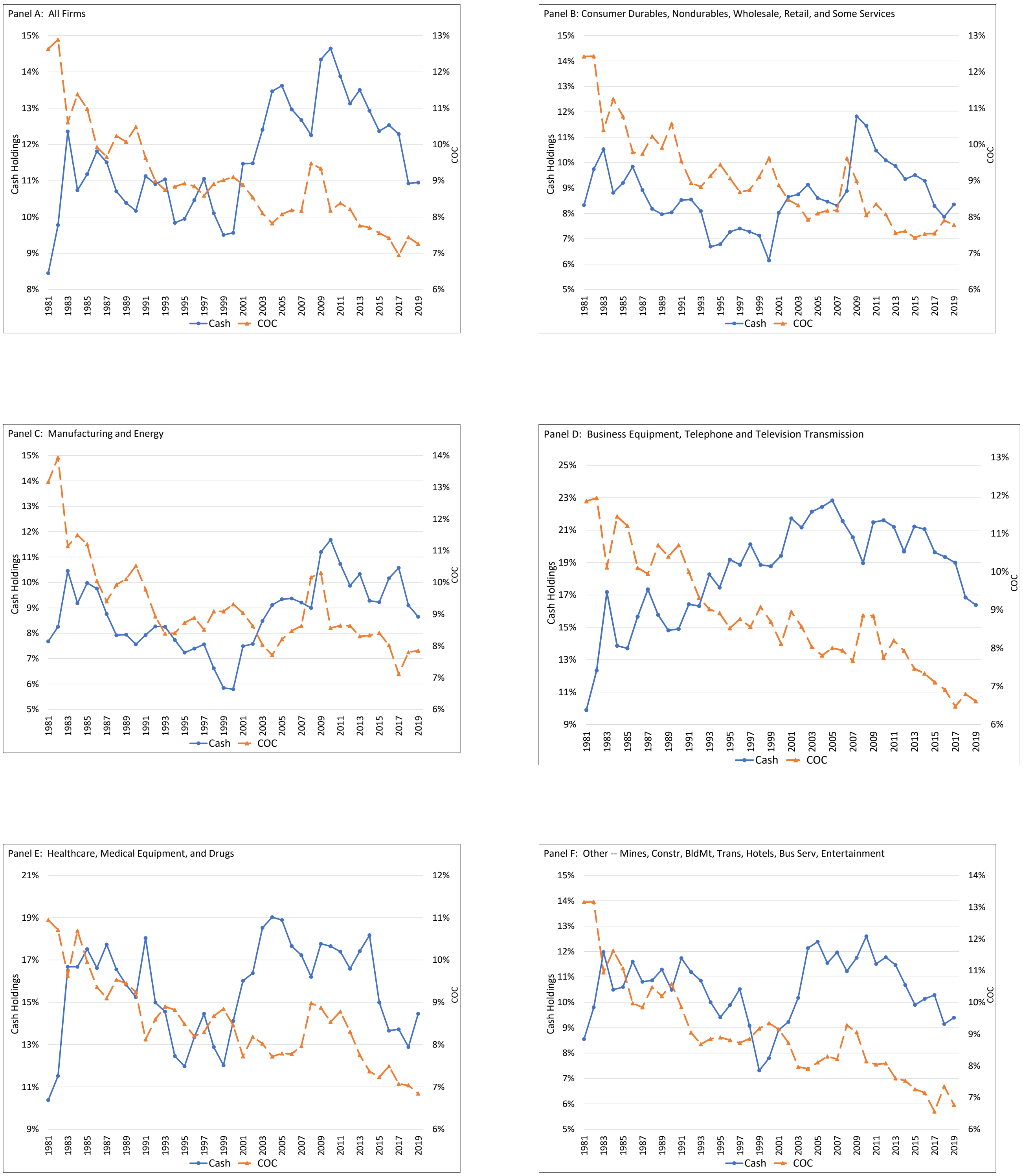

Figure 3: Cost of Capital and Cash Savings

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

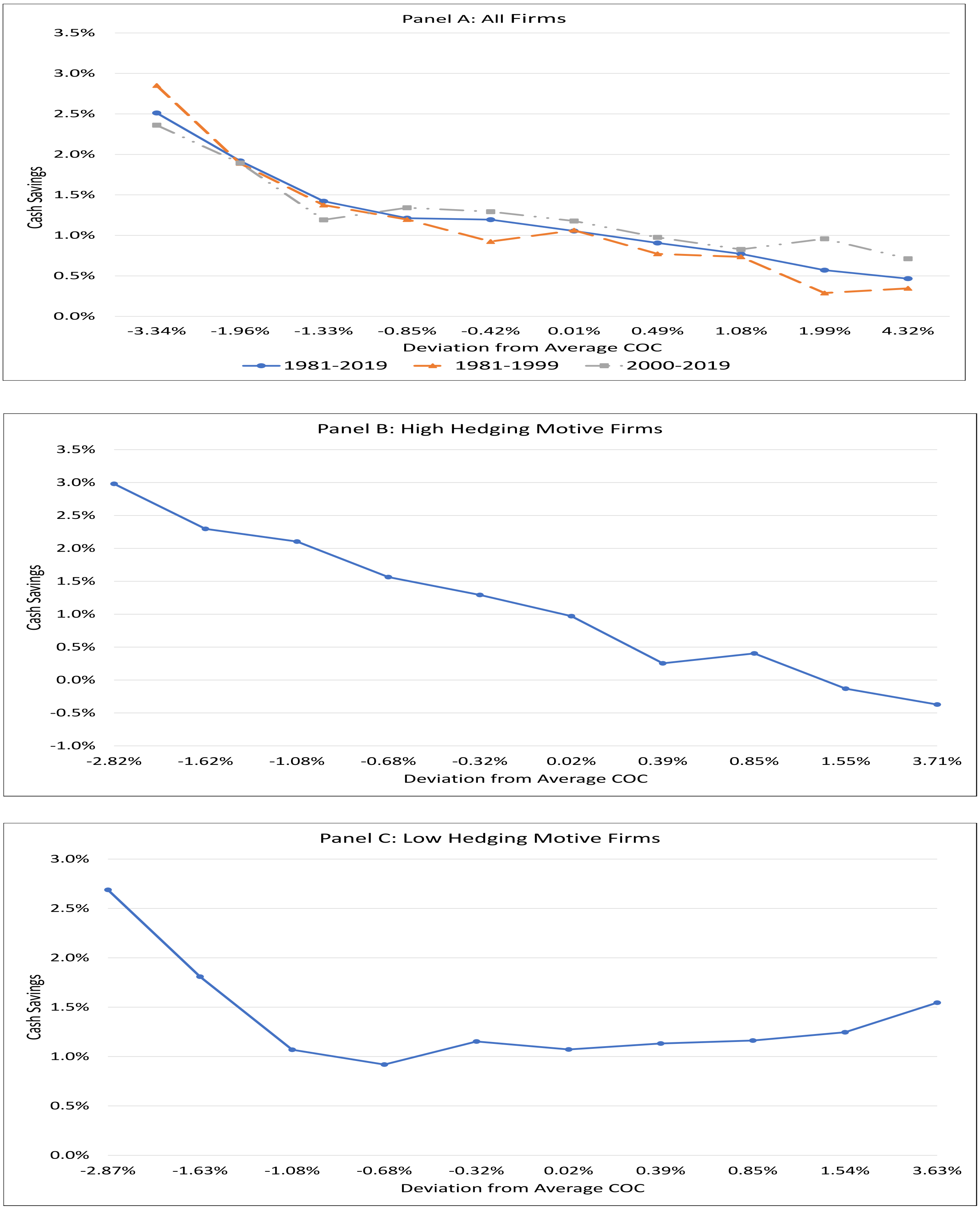

Figure 4: Cash Savings versus Future Investment

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

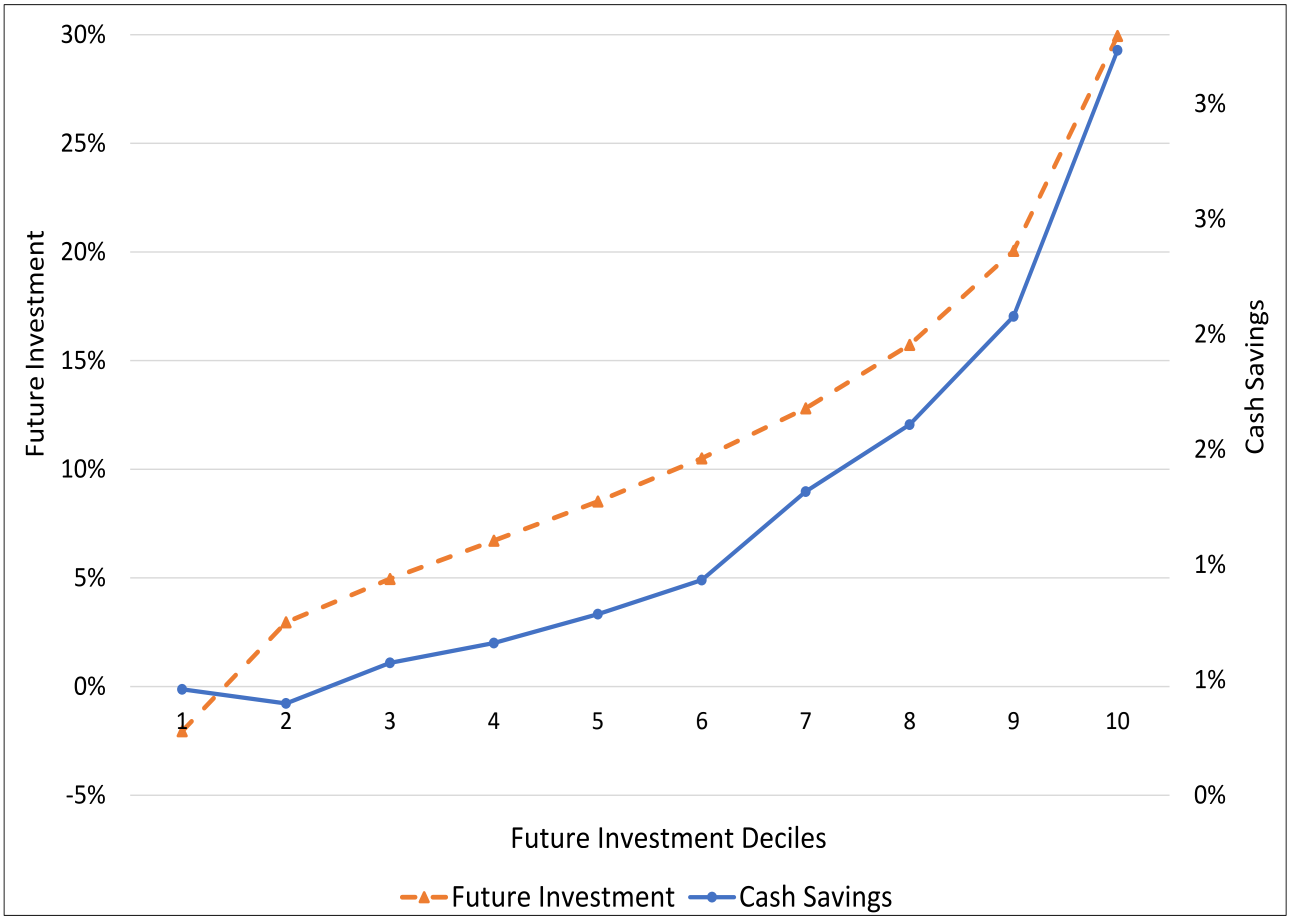

Figure 5: Dynamics of the Effects

This figure plots the differences in the sensitivities of cash savings to external capital around the adoption of Reg FD in October 2000 between the treated and control firms. The treatment firms are the top 50% of R&D-to-Sales ratio among positive R&D firms and the control firms are zero-R&D firms. The partition variables are measured as of the end of September 2000 before Reg FD.

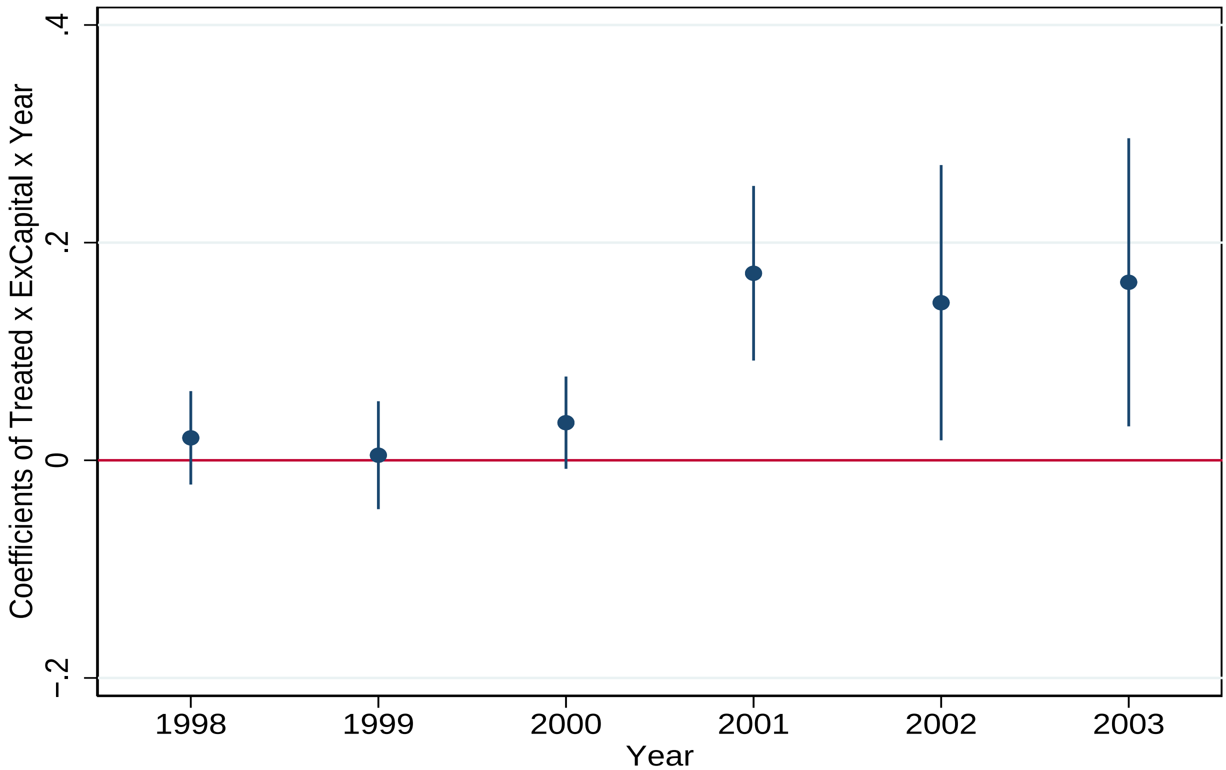

Table 1: Summary Statistics

This table reports the summary statistics of firm characteristics (Panel A) and standard deviation of the 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 the market-to-book asset ratio. *Vol* is cash flow volatility. *CapEx* denotes capital expenditures. *COE* denotes cost of equity. *COD* denotes cost of debt. *COC* is the weighted average of cost of capital. The detailed variable definitions are provided in Internet Appendix 4.

Panel A: Summary Statistics			
	Mean	Median	Standard Deviation
ΔCash	0.0118	0.0020	0.0808
Cash	0.1106	0.0644	0.1214
ExCapital	0.0330	-0.0109	0.1943
ICF	0.0221	0.0257	0.0613
Size	6.7279	6.6094	1.9510
M/B	1.7310	1.4398	0.9405
Vol	0.0108	0.0075	0.0102
Dividend	0.0141	0.0058	0.0200
Leverage	0.2456	0.2323	0.1625
NWC	0.1042	0.0866	0.1709
CapEx	0.0854	0.0602	0.1070
Acquisitions	0.0449	0.0000	0.1079
R&D	0.0258	0.0000	0.0479
COE	0.0962	0.0920	0.0328
COD	0.0701	0.0671	0.0292
COC	0.0849	0.0822	0.0249

Panel B: Decomposition of Standard Deviation		
	Cross-section	Time-series
COE	0.0256	0.0239
COD	0.0255	0.0200
COC	0.0199	0.0180

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*, the leverage ratio; *Size*; *NWC*, net working capital excluding cash and equivalents; *M/B*, the market-to-book asset ratio; *Vol*, cash flow volatility, *CapEx*, capital expenditures; *Acquisitions*; *Divdend*; *lagged Cash*. Firm fixed effects are included in Column (2). Year fixed effects are included in Column (3). Firm and year fixed effects are included in Column (4). Standardized beta coefficients are reported in Column (5). The specific variable definitions are provided in Internet Appendix 4. 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)
ExCapital	0.2822***	0.2999***	0.2826***	0.2962***	0.6691
	[0.0060]	[0.0065]	[0.0059]	[0.0065]	
ICF	0.2299***	0.2212***	0.2356***	0.2189***	0.1806
	[0.0071]	[0.0079]	[0.0072]	[0.0080]	
Cash	-0.0894***	-0.2324***	-0.0897***	-0.2395***	-0.1419
	[0.0043]	[0.0068]	[0.0043]	[0.0070]	
M/B	0.0111***	0.0102***	0.0127***	0.0116***	0.14
	[0.0005]	[0.0007]	[0.0005]	[0.0007]	
Vol	0.1469***	0.3378***	0.1890***	0.1064**	0.0192
	[0.0319]	[0.0508]	[0.0338]	[0.0518]	
Dividend	-0.0038	0.0417	-0.0513***	0.03	-0.001
	[0.0192]	[0.0332]	[0.0196]	[0.0338]	
Leverage	-0.0348***	-0.0314***	-0.0338***	-0.0267***	-0.0718
	[0.0021]	[0.0038]	[0.0021]	[0.0038]	
Size	-0.0023***	-0.0100***	-0.0017***	-0.0139***	-0.0565
	[0.0002]	[0.0006]	[0.0002]	[0.0009]	
NWC	-0.0330***	0.0310***	-0.0373***	0.0310***	-0.0689
	[0.0025]	[0.0054]	[0.0025]	[0.0054]	
CapEx	-0.2756***	-0.3607***	-0.2882***	-0.3616***	-0.3626
	[0.0070]	[0.0086]	[0.0071]	[0.0087]	
Acquisitions	-0.3401***	-0.3528***	-0.3359***	-0.3475***	-0.4607
	[0.0079]	[0.0086]	[0.0079]	[0.0086]	
R&D	0.0925***	-0.1667***	0.0870***	-0.1637***	0.0564
	[0.0091]	[0.0324]	[0.0092]	[0.0322]	
Firm FEs	No	Yes	No	Yes	No
Year FEs	No	No	Yes	Yes	No
Observations	59,564	59,507	59,564	59,507	59,564
Adj. R^2	0.2685	0.3474	0.2826	0.3599	0.2685

Table 3: The Cost of Capital and Cash Savings

This table reports the sensitivities of cash savings to the 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 the weighted average cost of capital. *ExCapital* and *ICF* are external capital and internal cash flow, respectively, divided by total assets at the beginning of the year. The detailed variable definitions are provided in Internet Appendix 4. 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	-0.0196	-0.0177	0.0005	-0.1742***	-0.1685***	-0.1551***
	[0.0152]	[0.0156]	[0.0151]	[0.0218]	[0.0224]	[0.0219]
ExCapital	0.3299***	0.2826***	0.3339***	0.3380***	0.2960***	0.3409***
	[0.0128]	[0.0060]	[0.0130]	[0.0136]	[0.0065]	[0.0137]
ICF	0.2289***	0.3080***	0.3265***	0.2125***	0.2997***	0.3121***
	[0.0072]	[0.0249]	[0.0252]	[0.0080]	[0.0263]	[0.0264]
ExCapital×COC	-0.5985***		-0.6399***	-0.5314***		-0.5605***
	[0.1356]		[0.1371]	[0.1432]		[0.1440]
ICF×COC		-0.8380***	-1.0227***		-0.9151***	-1.0344***
		[0.2376]	[0.2400]		[0.2509]	[0.2515]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	No	No	No	Yes	Yes	Yes
Year FEs	No	No	No	Yes	Yes	Yes
Observations	59,564	59,564	59,564	59,507	59,507	59,507
Adj. R^2	0.2697	0.2689	0.2702	0.3620	0.3615	0.3625

Table 4: Hedging Motive

This table compares the impacts of the cost of capital on the sensitivities of cash savings to external capital between firms with high and low hedging motives (hypothesis 1a). 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 the COC (Hedging Motive 1), the correlation between financial deficit and the COC (Hedging Motive 2), and the correlation between the KZ index and the COC (Hedging Motive 3). The detailed variable definitions are provided in Internet Appendix 4. Firm and year fixed effects are controlled. The coefficient estimates of the control variables are not reported for brevity. $Diff$ report differences in coefficients between firms with high hedging motives and firms with low hedging motives. 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	Diff	High	Low	Diff	High	Low	Diff
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
COC	-0.1905***	-0.0733*	-0.1172**	-0.3746***	0.1614***	-0.5360***	-0.3583***	0.1211***	-0.4794***
	[0.0389]	[0.0405]	[0.0561]	[0.0363]	[0.0380]	[0.0525]	[0.0381]	[0.0341]	[0.0511]
ExCapital	0.3409***	0.3137***	0.0272	0.4783***	0.3104***	0.1679***	0.3806***	0.2392***	0.1414***
	[0.0260]	[0.0222]	[0.0341]	[0.0314]	[0.0246]	[0.0399]	[0.0247]	[0.0237]	[0.0342]
ICF	0.2941***	0.2884***	0.0057	0.3994***	0.1932***	0.2062***	0.3538***	0.1670***	0.1869***
	[0.0453]	[0.0502]	[0.0676]	[0.0405]	[0.0492]	[0.0637]	[0.0413]	[0.0435]	[0.0600]
ExCapital×COC	-0.9302***	-0.2760	-0.6542*	-1.7274***	0.0857	-1.8132***	-1.1970***	-0.2543	-0.9427***
	[0.2609]	[0.2439]	[0.3571]	[0.2872]	[0.2812]	[0.4019]	[0.2491]	[0.2412]	[0.3467]
ICF×COC	-1.0880***	-0.7474	-0.3406	-1.7938***	-0.0104	-1.7834***	-1.6359***	0.2709	-1.9068***
	[0.4000]	[0.5212]	[0.6569]	[0.3573]	[0.4624]	[0.5843]	[0.3727]	[0.4489]	[0.5834]
Controls	Yes	Yes		Yes	Yes		Yes	Yes	
Firm FEs	Yes	Yes		Yes	Yes		Yes	Yes	
Year FEs	Yes	Yes		Yes	Yes		Yes	Yes	
Observations	17,770	17,633		17,795	17,660		17,710	17,945	
Adj. R^2	0.3561	0.3748		0.3736	0.3816		0.3691	0.3015	

Table 5: Excess Capital Issuance and Cash Savings

This table compares the probability of raising excess capital (Panel A) and the sensitivities of excess capital issuance to the cost of capital (Panel B) among firms with high and low hedging motives (hypothesis 1b). In Panel A, the dependent variable is a dummy variable equal to one if positive access capital issues and zero otherwise. The model is estimated using probit fixed effects estimator that accounts for the biases arising from the inclusion of firm fixed effects and year fixed effects. The average marginal effects are reported. In Panel B, the dependent variable is excess capital issues. The COC is the weighted average cost of capital. 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 the COC (Hedging Motive 1), the correlation between the financial deficit and the COC (Hedging Motive 2), and the correlation between the KZ index and the COC (Hedging Motive 3). Firm and year fixed effects are controlled. The detailed variable definitions are provided in Internet Appendix 4. 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: Probability of Issuance					
	Hedging Motive 1		Hedging Motive 2		Hedging Motive 3	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-8.1372***	4.2650***	-3.2660***	-1.04	-4.3294***	0.5477
	[0.7419]	[0.6881]	[0.7201]	[0.7196]	[0.7501]	[0.7134]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,482	16,424	16,616	16,318	16,311	16,802

	Panel B: Excess Issuance					
	Hedging Motive 1		Hedging Motive 2		Hedging Motive 3	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-1.0103***	0.4535***	-0.4472***	-0.084	-0.5884***	0.0526
	[0.0583]	[0.0598]	[0.0632]	[0.0665]	[0.0622]	[0.0597]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,795	17,660	17,770	17,633	17,710	17,945
Adj. R^2	0.2653	0.2185	0.2147	0.2143	0.1997	0.2038

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 the 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 the COC (Hedging Motive 1), the correlation between the financial deficit and the COC (Hedging Motive 2), and the correlation between the KZ index and the COC (Hedging Motive 3). The detailed variable definitions are provided in Internet Appendix 4. 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	0.2804***			0.4741***	0.5001***
	[0.0069]			[0.0090]	[0.0099]
Dissue		0.0556***		0.2658***	0.2953***
		[0.0043]		[0.0077]	[0.0083]
ICF			0.1503***	0.2291***	0.2122***
			[0.0061]	[0.0072]	[0.0081]
Controls	No	No	No	Yes	Yes
Firm FEs	No	No	No	No	Yes
Year FEs	No	No	No	No	Yes
Observations	65,398	65,398	65,398	59,564	59,507
Adj. R^2	0.0940	0.0071	0.0130	0.2663	0.359

	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	0.011	-0.1238***	0.0142	-0.1998***	0.1204***	-0.1905***	0.0793***
	[0.0148]	[0.0278]	[0.0299]	[0.0271]	[0.0278]	[0.0264]	[0.0247]
COD	-0.1427***	0.0591	-0.0009	-0.0514	0.0709	-0.0483	0.0493
	[0.0245]	[0.0794]	[0.0842]	[0.0784]	[0.0805]	[0.0790]	[0.0672]
Eissue	0.5601***	0.5488***	0.5143***	0.6164***	0.5688***	0.5863***	0.3284***
	[0.0245]	[0.0474]	[0.0432]	[0.0446]	[0.0415]	[0.0424]	[0.0489]
Dissue	0.3621***	0.3131***	0.3590***	0.3611***	0.3705***	0.3542***	0.2961***
	[0.0147]	[0.0258]	[0.0261]	[0.0279]	[0.0294]	[0.0272]	[0.0223]
ICF	0.3866***	0.2888***	0.3291***	0.4264***	0.2575***	0.3684***	0.1971***
	[0.0275]	[0.0469]	[0.0505]	[0.0457]	[0.0501]	[0.0420]	[0.0438]
Eissue×COE	-0.6070**	-1.1583**	-0.4279	-0.9207**	-0.6645	-1.6044***	0.2512
	[0.2591]	[0.4766]	[0.4619]	[0.4620]	[0.4355]	[0.4446]	[0.4997]
Dissue×COD	-0.9277***	-0.7475**	-0.9972***	-1.1978***	-1.0199***	-0.9228***	-0.7881***
	[0.1614]	[0.2925]	[0.3010]	[0.3182]	[0.3484]	[0.3014]	[0.2311]
ICF×COE	-1.5180***	-1.2391***	-1.3521***	-1.9480***	-0.5869*	-1.7244***	-0.3131
	[0.1795]	[0.2837]	[0.3363]	[0.2677]	[0.3249]	[0.2607]	[0.2981]
ICF×COD	-0.1019	0.5764	0.4394	0.3588	-0.1956	0.325	0.4758
	[0.2445]	[0.4340]	[0.4808]	[0.4237]	[0.4346]	[0.3566]	[0.4250]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	59,507	17,770	17,633	17,795	17,660	17,710	17,945
Adj. R^2	0.3518	0.3616	0.3568	0.3756	0.3677	0.373	0.3021

Table 7: The Effect of Exogenous Shocks to the Cost of Capital on Cash Savings
This table reports the effects of exogenous shocks to the cost of capital on cash savings. We use Regulation Fair Disclosure of 2000 (Reg FD) (Columns 1 and 2) as a shock to the cost of capital. We set the *Post* dummy as zero for 1997-1999 and one for 2000-2003. The remaining columns report the results of placebo tests based on fictitious event years 1991 (Columns 3 and 4) and 2013 (Columns 5 and 6). In Columns 1, 3, and 5, the treated firms are the top 50% of R&D-to-Sales ratio among positive R&D firms and control firms are zero-R&D firms. In Columns 2, 4, and 6, the treatment and control firms are defined as top and bottom 30% of M/B ratio, respectively. All partition variables are measured as of the end of September 2000 before Reg FD. The dependent variable is the cost of equity in Panel A and the change in cash and equivalents divided by total assets at the beginning of the year in Panel B. Firm and year fixed effects are controlled. The detailed variable definitions are provided in Internet Appendix 4. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: The Impact on The COE

	Reg FD		Placebo 1		Placebo 2	
	(1)	(2)	(3)	(4)	(5)	(6)
Treated×Post	-0.0148***	-0.0030***	0.0000	0.0002	-0.0008	0.0006
	[0.0012]	[0.0011]	[0.0014]	[0.0011]	[0.0015]	[0.0012]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,324	11,260	5,624	7,652	5,692	7,708
Adj. R^2	0.6669	0.6374	0.7018	0.6550	0.6955	0.6340

Panel B: The Impact on Cash Savings

	Reg FD		Placebo 1		Placebo 2	
	(1)	(2)	(3)	(4)	(5)	(6)
Treated×Post	0.0001	0.0083**	-0.0033	0.0034	0.0026	-0.0037
	[0.0068]	[0.0040]	[0.0052]	[0.0035]	[0.0050]	[0.0031]
ExCapital×Post	0.0593***	0.0676**	0.1577***	0.0965***	-0.0074	0.0262
	[0.0177]	[0.0272]	[0.0315]	[0.0235]	[0.0290]	[0.0175]
ICF×Post	0.0022	0.0722	-0.0697	-0.0088	-0.0154	-0.0432
	[0.0408]	[0.0542]	[0.0566]	[0.0675]	[0.0292]	[0.0345]
Treated×ExCapital×Post	0.0927**	0.0988**	-0.0350	0.0277	-0.0031	-0.0314
	[0.0457]	[0.0408]	[0.0404]	[0.0338]	[0.0456]	[0.0315]
Treated×ICF×Post	0.2244*	-0.0041	0.2792***	0.0451	0.0190	0.0694
	[0.1289]	[0.0943]	[0.1078]	[0.0824]	[0.0813]	[0.0633]
Treated×ExCapital	-0.0663*	0.0104	-0.0119	-0.0256	0.0459	0.0614**
	[0.0352]	[0.0134]	[0.0285]	[0.0216]	[0.0393]	[0.0272]
Treated×ICF	0.0624	0.1252**	-0.0097	-0.0197	0.1256*	-0.0182
	[0.1187]	[0.0542]	[0.0882]	[0.0664]	[0.0684]	[0.0562]
ExCapital	0.2805***	0.0952***	0.1697***	0.1693***	0.3618***	0.3492***
	[0.0151]	[0.0104]	[0.0355]	[0.0290]	[0.0333]	[0.0273]
ICF	0.2054***	0.1163***	0.2034***	0.1959***	0.1052***	0.1912***
	[0.0314]	[0.0287]	[0.0431]	[0.0577]	[0.0238]	[0.0305]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,324	11,260	5,624	7,652	5,837	7,708
Adj. R^2	0.3989	0.2438	0.3907	0.3565	0.4853	0.4421

Table 8: Constrained versus Unconstrained Firms
This table compares the sensitivities of cash savings to the cost of capital and sources of cash between financially constrained and unconstrained firms (Panel A) (hypothesis 1c). 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), firms at the top and bottom 30% of the WW index (Whited and Wu (2006)) (Columns 3 and 4), and firms at the top and bottom 30% of the 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 savings from external capital and internal capital for financially constrained and unconstrained firms with a high hedging motive using our hedging measure and using the measure described in Acharya et al. (2007). The reported results are based on the WW index and Hedging Motive 1 measure. Firm and year fixed effects are controlled. The detailed variable definitions are provided in Internet Appendix 4. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel A: Cash Savings and the Cost of Capital						
	Rating		WW Index		HP Index	
	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained	Constrained
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.0729***	-0.2982***	-0.1645***	-0.3488***	-0.1194***	-0.2116***
	[0.0243]	[0.0461]	[0.0378]	[0.0521]	[0.0431]	[0.0496]
ExCapital	0.3149***	0.3722***	0.3590***	0.3709***	0.3641***	0.3505***
	[0.0181]	[0.0223]	[0.0280]	[0.0232]	[0.0364]	[0.0246]
ICF	0.2910***	0.3750***	0.2988***	0.3697***	0.3852***	0.3569***
	[0.0311]	[0.0485]	[0.0553]	[0.0457]	[0.0579]	[0.0485]
ExCapital×COC	-0.4020**	-0.6819***	-0.8258***	-0.4541*	-1.0842***	-0.5147**
	[0.1911]	[0.2405]	[0.2891]	[0.2520]	[0.3394]	[0.2554]
ICF×COC	-1.1879***	-1.2552***	-1.1266**	-1.3089***	-1.9377***	-1.4170***
	[0.3005]	[0.4571]	[0.5168]	[0.4397]	[0.5536]	[0.4550]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37,889	20,197	17,418	17,746	11,755	17,564
Adj. R^2	0.3342	0.419	0.3431	0.4331	0.3043	0.4001

	Panel B: Compare with AAC Measure			
	High Hedging Motive		High AAC Measure	
	Unconstrained	Constrained	Unconstrained	Constrained
	(1)	(2)	(3)	(4)
COC	-0.1862***	-0.4688***	-0.0814*	-0.3491***
	[0.0710]	[0.1123]	[0.0473]	[0.0655]
ExCapital	0.3692***	0.4344***	0.3026***	0.3541***
	[0.0454]	[0.0442]	[0.0336]	[0.0298]
ICF	0.3685***	0.4285***	0.2362***	0.3379***
	[0.0850]	[0.0988]	[0.0669]	[0.0590]
ExCapital×COC	-1.4010***	-1.2916***	-0.5579*	-0.3939
	[0.4499]	[0.4695]	[0.3282]	[0.3244]
ICF×COC	-1.6097**	-2.0681**	-0.6756	-1.0523*
	[0.7943]	[0.8692]	[0.6305]	[0.5711]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	4,850	3,808	10,693	10,909
Adj. R^2	0.3282	0.4540	0.3118	0.4106

Table 9: Alternative Motives

This table reports the test results of the following 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 the cost of capital on the sensitivities of cash savings to external capital between firms with high and low market timing motives. We measure market timing by the yearly timing (Timing 1), long-term timing (Timing 2) following Kayhan and Titman (2007), and mispricing proxy (Timing 3) developed by Stambaugh et al. (2015). For each measure, we define firms in the top 30 percent as firms with high market timing motive and those in the bottom 30 percent as firms with a low market timing motive while removing the middle 40 percent. Panel B compares the impacts of the cost of capital on the sensitivities of cash savings to external capital issues between firms with high and low precautionary motives. Firms with high (low) precautionary motives are defined as firms without (with) dividend payments, firms in the top 30 percent (bottom 30 percent) based on R&D expenditures, the industry-level median cash flow volatility (*CF Risk*), and a precautionary motive measure (*Precaution*), respectively. In Panel C, we test the predictions of model developed by Bolton et al. (2013) that considers both the market timing and precautionary motives. We compare the impacts of the cost of capital on the sensitivities of cash savings to external capital issues between firms with high and low cash holdings. Firms with high (low) cash holdings are classified as those in the top 30 percent (bottom 30 percent) based on cash ratios (che/at) or the cash balance (che). *ExCapital* and *ICF* are external capital and internal cash flow, respectively, divided by total assets at the beginning of the year. Panel D test whether the market timing or precautionary motive explains the sensitivities of excess capital issuance to the cost of capital. For brevity, the results based on the Timing 1 measure and *Precaution* are reported. Panel E reports differences between firms with high hedging motives (Columns (1) and (3)) and firms with low hedging motives (Columns (2) and (4)) for high credit risk firms and low credit risk firms. Panel F reports differences between firms with high hedging motives (Columns (1) and (3)) and firms with low hedging motives (Columns (2) and (4)) for high agency risk firms and low agney risk firms. Firm and year fixed effects are controlled. The detailed variable definitions are provided in Internet Appendix 4. 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					
	Timing 1		Timing 2		Timing 3	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.2591***	-0.1276***	-0.2522***	-0.1680***	-0.0233	-0.2492***
	[0.0531]	[0.0477]	[0.0577]	[0.0516]	[0.0475]	[0.0585]
ExCapital	0.3782***	0.3695***	0.3612***	0.3296***	0.3355***	0.3965***
	[0.0374]	[0.0343]	[0.0335]	[0.0398]	[0.0278]	[0.0362]
ICF	0.3200***	0.3632***	0.3456***	0.1986***	0.2632***	0.2808***
	[0.0547]	[0.0655]	[0.0642]	[0.0614]	[0.0502]	[0.0939]
ExCapital×COC	-0.7202*	-1.0525***	-0.8110**	-0.7619*	-0.9927***	-0.8508**
	[0.4128]	[0.3497]	[0.3611]	[0.4125]	[0.2852]	[0.3773]
ICF$×COC	-1.3467***	-1.7534**	-1.8003***	-0.2250	-1.2984***	-0.1931
	[0.5103]	[0.6830]	[0.6551]	[0.5757]	[0.4981]	[0.8847]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,407	11,401	11,509	11,627	13,349	13,218
Adj. R^2	0.3539	0.3339	0.3494	0.2987	0.3810	0.3935

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	-0.1241***	-0.2778***	-0.2152***	-0.1186***	-0.1018***	-0.3678***	-0.0772**	-0.2655***
	[0.0252]	[0.0440]	[0.0357]	[0.0278]	[0.0374]	[0.0470]	[0.0393]	[0.0468]
ExCapital	0.2520***	0.3840***	0.4110***	0.2533***	0.3942***	0.3263***	0.3927***	0.3376***
	[0.0194]	[0.0192]	[0.0204]	[0.0188]	[0.0232]	[0.0270]	[0.0263]	[0.0265]
ICF	0.1302***	0.4224***	0.3946***	0.2082***	0.3530***	0.0356	0.4185***	0.2210***
	[0.0345]	[0.0406]	[0.0380]	[0.0358]	[0.0365]	[0.0747]	[0.0431]	[0.0603]
ExCapital×COC	-0.1966	-0.6165***	-0.6676***	-0.2602	-0.5542**	-0.6472**	-0.6750**	-0.6999***
	[0.1927]	[0.2100]	[0.2308]	[0.1905]	[0.2483]	[0.2694]	[0.2886]	[0.2677]
ICF×COC	0.1453	-1.8812***	-1.4409***	-0.4854	-1.3951***	1.2313*	-2.0530***	-0.3904
	[0.3304]	[0.3933]	[0.3642]	[0.3427]	[0.3729]	[0.6590]	[0.4382]	[0.5530]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,489	24,367	27,766	31,572	17,703	17,111	17,228	17,154
Adj. R^2	0.2862	0.4124	0.4280	0.2978	0.4322	0.3674	0.4015	0.3797

Panel C: Market Timing and Precautionary Motives				
	Cash Ratio		Cash Balance	
	High	Low	High	Low
	(1)	(2)	(3)	(4)
COC	0.0088	-0.2922***	-0.1217***	-0.0904**
	[0.0106]	[0.0520]	[0.0312]	[0.0392]
ExCapital	0.0408***	0.4002***	0.1318***	0.3270***
	[0.0079]	[0.0249]	[0.0190]	[0.0280]
ICF	0.0283**	0.4402***	0.1202***	0.3061***
	[0.0123]	[0.0489]	[0.0373]	[0.0569]
ExCapital×COC	-0.2336***	0.5528*	-0.2529	0.0028
	[0.0668]	[0.2873]	[0.1908]	[0.3211]
ICF×COC	-0.1558	-0.9357**	-0.2350	-0.7987
	[0.1242]	[0.4756]	[0.3577]	[0.5255]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	17,308	16,862	17,297	17,322
Adj. R^2	0.7595	0.5612	0.4463	0.4519

Panel D: Excess Issuance						
	Market Timing		Precautionary		Market Timing and Precautionary	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.5057***	-0.3341***	-0.3738***	-0.3482***	-0.1303**	-0.6246***
	[0.0986]	[0.0864]	[0.0673]	[0.0803]	[0.0633]	[0.0839]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,407	11,401	17,228	17,154	17,308	16,862
Adj. R^2	0.1750	0.2086	0.2094	0.2446	0.2666	0.2328

Panel E: Credit Risk				
	High Risk		Low Risk	
Hedging Motive	High	Low	High	Low
	(1)	(2)	(3)	(4)
COC	-0.2752***	0.1692***	-0.5300***	0.1585***
	[0.0461]	[0.0517]	[0.0619]	[0.0580]
ExCapital	0.4158***	0.2508***	0.5137***	0.3266***
	[0.0420]	[0.0376]	[0.0459]	[0.0331]
ICF	0.2666***	0.0908	0.4901***	0.2606***
	[0.0503]	[0.0582]	[0.0644]	[0.0760]
ExCapital×COC	-1.4855***	0.1721	-1.6990***	0.2755
	[0.3533]	[0.3993]	[0.4446]	[0.3979]
ICF×COC	-0.9583**	0.257	-2.0983***	-0.0247
	[0.4411]	[0.5373]	[0.5947]	[0.7349]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	9,631	7,590	8,130	10,031
Adj. R^2	0.3132	0.3272	0.4277	0.4149

Panel F: Agency Risk				
	High Agency Risk		Low Agency Risk	
Hedging Motive	High	Low	High	Low
	(1)	(2)	(3)	(4)
COC	-0.4169***	0.1617***	-0.3115***	0.1371**
	[0.0588]	[0.0547]	[0.0447]	[0.0562]
ExCapital	0.4926***	0.3455***	0.4559***	0.2680***
	[0.0470]	[0.0313]	[0.0414]	[0.0398]
ICF	0.3570***	0.2396***	0.4368***	0.0903
	[0.0559]	[0.0590]	[0.0564]	[0.0868]
ExCapital×COC	-1.5665***	-0.2107	-1.8209***	0.5054
	[0.4271]	[0.3607]	[0.3754]	[0.4548]
ICF×COC	-1.3223***	-0.3909	-2.3040***	1.1268
	[0.5032]	[0.5490]	[0.4816]	[0.8677]
Controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	8,125	9,810	9,670	7,850
Adj. R^2	0.4158	0.4066	0.3237	0.3449

Internet Appendix

Appendix 1: Proof of Result 1 (Comparative Statistics)

To prove Result 1 on how the optimal cash savings, $\hat{C}_0$ and external finance $\hat{X}_0$ are affected by the COC, we differentiate the FOCs with respect to δ_0 in equations (2) to (4) as follows:

$$
\begin{aligned}
\left[\pi_{II}(I_0) - \delta_0\right] \frac{dX_0}{d\delta_0} - \pi_{II}(I_0)\frac{dC_0}{d\delta_0} &= X_0 && \text{(A.1)}\\
\left[\pi_{II}(I_1) - \delta_1\right] \frac{dX_1}{d\delta_0} + \pi_{II}(I_1)\frac{dC_0}{d\delta_0} &= 0; && \text{(A.2)}\\
-\pi_{II}(I_0)\frac{dX_0}{d\delta_0} + \pi_{II}(I_1)\frac{dX_1}{d\delta_0} + \left[\pi_{II}(I_0) + \pi_{II}(I_1)\right]\frac{dC_0}{d\delta_0} &= 0. && \text{(A.3)}
\end{aligned}
$$

The determinant of the Jacobian matrix of the derivatives is as follows:

$$
\begin{aligned}
D &= \begin{vmatrix} \pi_{II}(I_0) - \delta_0 & 0 & -\pi_{II}(I_0) \\ 0 & \pi_{II}(I_1) - \delta_1 & \pi_{II}(I_1) \\ -\pi_{II}(I_0) & \pi_{II}(I_1) & \pi_{II}(I_0) + \pi_{II}(I_1) \end{vmatrix} && \text{(A.4)}\\
&= \delta_0\pi_{II}(I_0)\left[\delta_1 - \pi_{II}(I_1)\right] + \delta_1\pi_{II}(I_1)\left[\delta_0 - \pi_{II}(I_0)\right] < 0.
\end{aligned}
$$

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

$$
\begin{aligned}
\frac{\partial X_0}{\partial \delta_0} &= \frac{\begin{vmatrix} X_0 & 0 & -\pi_{II}(I_0) \\ 0 & \pi_{II}(I_1) - \delta_1 & \pi_{II}(I_1) \\ 0 & \pi_{II}(I_1) & \pi_{II}(I_0) + \pi_{II}(I_1) \end{vmatrix}}{D} && \text{(A.5)}\\
&= \frac{X_0\left\{\pi_{II}(I_0)\pi_{II}(I_1) - \delta_1[\pi_{II}(I_0) + \pi_{II}(I_1)]\right\}}{D} < 0;
\end{aligned}
$$

$$
\begin{aligned}
\frac{\partial X_1}{\partial \delta_0} &= \frac{\begin{vmatrix} \pi_{II}(I_0) - \delta_0 & X_0 & -\pi_{II}(I_0) \\ 0 & 0 & \pi_{II}(I_1) \\ -\pi_{II}(I_0) & 0 & \pi_{II}(I_0) + \pi_{II}(I_1) \end{vmatrix}}{D} && \text{(A.6)}\\
&= \frac{-X_0\pi_{II}(I_0)\pi_{II}(I_1)}{D} > 0;
\end{aligned}
$$

$$
\begin{aligned}
\frac{\partial C_0}{\partial \delta_0} &= \frac{\begin{vmatrix} \pi_{II}(I_0) - \delta_0 & 0 & X_0 \\ 0 & \pi_{II}(I_1) - \delta_1 & 0 \\ -\pi_{II}(I_0) & \pi_{II}(I_1) & 0 \end{vmatrix}}{D} && \text{(A.7)}\\
&= \frac{X_0\pi_{II}(I_0)[\pi_{II}(I_1) - \delta_1]}{D} < 0;
\end{aligned}
$$

$$\frac{\partial I_0}{\partial \delta_0} = \frac{\partial X_0}{\partial \delta_0} - \frac{\partial C_0}{\partial \delta_0} = \frac{-X_0 \delta_1 \pi_{II}(I_1)}{D} < 0. \tag{A.8}$$

These results suggest that the firm decreases external finance and cash savings, while increasing future external finance, when facing a higher external finance cost currently.

Appendix 2: First-order conditions

The Lagrangian for the maximization problem at $t = 0$ can be written as follows:

$$L = \max_{(X_0, I_0, C_0)} \pi(I_0) - X_0 - \frac{1}{2}(1+\gamma)\delta_0 X_0^2 + \mu[W_0 + X_0 - C_0 - I_0] + \int_{I_1^*-C_0}^{\infty} \{\tilde{\pi}(I_1^*) - I_1^* + W_1\} g(z)dz + \int_{-\infty}^{I_1^*-C_0} \left\{\tilde{\pi}(I_1) - I_1 + W_1 - \frac{1}{2}(1+\gamma)\tilde{\delta}_1 X_1^2\right\} g(z)dz,$$

where μ is a Lagrange multiplier for the constraint. Applying the Leibnitz integral rule, the FOCs are as follows:

$$\frac{\partial L_0}{\partial I_0} = \pi_I(I_0) - \mu = 0; \tag{A.9}$$

$$\frac{\partial L_0}{\partial X_0} = -1 - (1+\gamma)\delta_0 X_0 + \mu = 0; \tag{A.10}$$

$$\begin{aligned} \frac{\partial L_0}{\partial C_0} &= -\mu + 1 + [\tilde{\pi}(I_1^*) - I_1^*]\, g\,(I_1^* - C_0) \\ &\quad + \int_{-\infty}^{I_1^*-C_0} \left\{\tilde{\pi}_I(I_1) - 1 + (1+\gamma)\tilde{\delta}_1 X_1\right\} g(z)dz \\ &\quad - [\tilde{\pi}(I_1^*) - I_1^*]\, g\,(I_1^* - C_0) \\ &= -\mu + G = 0; \end{aligned} \tag{A.11}$$

$$\frac{\partial L_0}{\partial \mu} = W_0 + X_0 - C_0 - I_0 = 0, \tag{A.12}$$

where

$$G = 1 + \int_{-\infty}^{I_1^*-C_0} \left\{\tilde{\pi}_I(I_1) - 1 + (1+\gamma)\tilde{\delta}_1 X_1\right\} g(z)dz > 0.$$

To satisfy the second order conditions, we assume $\pi_{II} + (1+\gamma)\delta_0 < 0$ which is required for the Hessian matrix to be negative definite.

Therefore, the FOCs imply

$$\pi_I(I_0) - 1 - (1+\gamma)\delta_0 X_0 = 0; \tag{A.13}$$

$$G - 1 - (1+\gamma)\delta_0 X_0 = 0; \tag{A.14}$$

$$W_0 + X_0 - C_0 - I_0 = 0. \tag{A.15}$$

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

$$\pi_{II}\frac{d\hat{I}_0}{d\delta_0} + 0\frac{d\hat{C}_0}{d\delta_0} - (1+\gamma)\delta_0\frac{d\hat{X}_0}{d\delta_0} - (1+\gamma)\hat{X}_0 = 0, \tag{A.16}$$

$$0\frac{d\hat{I}_0}{d\delta_0} + G_C\frac{d\hat{C}_0}{d\delta_0} - (1+\gamma)\delta_0\frac{d\hat{X}_0}{d\delta_0} - (1+\gamma)\hat{X}_0 = 0, \tag{A.17}$$

$$-\frac{d\hat{I}_0}{d\delta_0} - \frac{d\hat{C}_0}{d\delta_0} + \frac{d\hat{X}_0}{d\delta_0} = 0, \tag{A.18}$$

where

$$G_C = \int_{-\infty}^{I_1^*-C_0} \left\{\tilde{\pi}_{II}(X_1 + C_0 + z_1) - (1+\gamma)\tilde{\delta}_1 X_1\right\} g(z)dz < 0.$$

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

The determinant of the Jacobian matrix of the derivatives is given by[16]

$$\begin{aligned} D &= \begin{vmatrix} \pi_{II} & 0 & -(1+\gamma)\delta_0 \\ 0 & G_C & -(1+\gamma)\delta_0 \\ -1 & -1 & 1 \end{vmatrix} \\ &= \pi_{II}(\hat{I}_0)[G_C - (1+\gamma)\delta_0] - (1+\gamma)\delta_0 G_C > 0. \end{aligned} \tag{A.19}$$

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

$$\frac{\partial \hat{I}_0}{\partial \delta_0} = \frac{\begin{vmatrix} (1+\gamma)\hat{X}_0 & 0 & -(1+\gamma)\delta_0 \\ (1+\gamma)\hat{X}_0 & G_C & -(1+\gamma)\delta_0 \\ 0 & -1 & 1 \end{vmatrix}}{D} = \frac{(1+\gamma)\hat{X}_0 G_C}{D} < 0, \tag{A.20}$$

$$\frac{\partial \hat{C}_0}{\partial \delta_0} = \frac{\begin{vmatrix} \pi_{II} & (1+\gamma)\hat{X}_0 & -(1+\gamma)\delta_0 \\ 0 & (1+\gamma)\hat{X}_0 & -(1+\gamma)\delta_0 \\ -1 & 0 & 1 \end{vmatrix}}{D} = \frac{(1+\gamma)\hat{X}_0 \pi_{II}(\hat{I}_0)}{D} < 0, \tag{A.21}$$

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

$$\frac{\partial \hat{X}_0}{\partial \delta_0} = \frac{\begin{vmatrix} \pi_{II} & 0 & (1+\gamma)\hat{X}_0 \\ 0 & G_C & (1+\gamma)\hat{X}_0 \\ -1 & -1 & 0 \end{vmatrix}}{D} = \frac{(1+\gamma)\hat{X}_0[\pi_{II}(\hat{I}_0)+G_C]}{D} < 0. \quad \text{(A.22)}$$

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

Appendix 3: Hedging Motive(the effect of γ)

To see how γ affects optimal decisions at $t = 0$, we differentiate equations (A.20)-(A.22) w.r.t. γ as follows:

$$\begin{aligned} \frac{\partial^2 \hat{I}_0}{\partial \delta_0 d\gamma} &= \frac{\left[\hat{X}_0 G_C + (1+\gamma)\hat{X}_0 G_{C\gamma}\right] D - (1+\gamma)\hat{X}_0 G_C D'}{D^2} \quad \text{(A.23)} \\ &= \frac{\hat{X}_0 G_C D0 + (1+\gamma)\hat{X}_0 (G_{C\gamma} D - G_C D')}{D^2} = \frac{\hat{X}_0 \pi_{II}(\hat{I}_0)\left[G_C^2 - (1+\gamma)^2 \delta_0 G_{C\gamma}\right]}{D^2} < 0, \end{aligned}$$

where

$$\begin{aligned} D &= \pi_{II}(\hat{I}_0)[G_C - (1+\gamma)\delta_0] - (1+\gamma)\delta_0 G_C, \\ D' &= \pi_{II}(\hat{I}_0)\left[G_{C\gamma} - \delta_0\right] - \delta_0 G_C - (1+\gamma)\delta_0 G_{C\gamma}, \\ G_{C\gamma} &= -\int_{-\infty}^{I_1^* - C_0} \tilde{\delta}_1 g(z) dz < 0, \end{aligned}$$

$$\frac{\partial^2 \hat{C}_0}{\partial \delta_0 d\gamma} = \frac{\hat{X}_0 \pi_{II}(\hat{I}_0) D - (1+\gamma)\hat{X}_0 \pi_{II}(\hat{I}_0) D'}{D^2} = \frac{\hat{X}_0 \pi_{II}(\hat{I}_0)\left[D - (1+\gamma)D'\right]}{D^2} < 0, \quad \text{(A.24)}$$

by noting

$$\begin{aligned} [D - (1+\gamma)D'] &= \pi_{II}(\hat{I}_0)\left[G_C - (1+\gamma)G_{C\gamma}\right] + (1+\gamma)^2 \delta_0 G_{C\gamma} \\ &= \pi_{II}(\hat{I}_0) \int_{-\infty}^{I_1^* - C_0} \tilde{\pi}_{II}(I_1) g(z) dz - (1+\gamma)\delta_0 \int_{-\infty}^{I_1^* - C_0} (1+\gamma)\tilde{\delta}_1 g(z) dz > 0, \end{aligned}$$

given $G_C - (1+\gamma)G_{C\gamma} = \int_{-\infty}^{I_1^o - C_0} \tilde{\pi}_{II}(I_1) g(z) dz < 0$, $\pi_{II}(\hat{I}_0) + (1+\gamma)\delta_0 < 0$, and $\pi_{II}(\hat{I}_1) + (1+\gamma)\tilde{\delta}_1 < 0$ by the second order conditions, and

$$\frac{\partial^2 \hat{X}_0}{\partial \delta_0 d\gamma} = \frac{\hat{X}_0 \left\{\left[\pi_{II}(\hat{I}_0) + G_C\right] + (1+\gamma)G_{C\gamma}\right\} D - (1+\gamma)\hat{X}_0 \left[\pi_{II}(\hat{I}_0) + G_C\right] D'}{D^2} < 0, \quad \text{(A.25)}$$

which follows from (A.23) and (A.24). These results suggest that the sensitivities of investment, cash savings and external finance to external finance cost are greater for higher γ.

Appendix 4: Definitions of Variables

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

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

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

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

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

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

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

Cost of Equity (**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)

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

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

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

Excess 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)[17]

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

Future Investment ($FInvest$) = the average of three 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 plant and equipment (ppent)

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)

[17] 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.

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

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

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

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

Size = logarithm of total assets (at)

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

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

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

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

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

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

Appendix 5: Estimation procedure for the COE

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

$$P_t = \sum_{k=1}^{15} \frac{FE_{t+k} \times [1 - b_{t+1} + \frac{(b_{t+1} - \frac{g_t}{ICC_t})}{15} \times (k-1)]}{(1 + ICC_t)^k} + \frac{FE_{t+15} \times (1 - b_t)}{(ICC_t - g_t)(1 + ICC_t)^{15}}. \quad \text{(A.26)}$$

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

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

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

$$P_t = BE_t + \sum_{k=1}^{12} \frac{(ROE_{t+k} - ICC_t)BE_{t+k-1}}{(1 + ICC_t)^k} + \frac{(ROE_{t+12} - ICC_t)BE_{t+11}}{ICC_t(1 + ICC_t)^{12}} \tag{A.27}$$

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

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

$$P_t = BE_t + \sum_{k=1}^{5} \frac{FE_{t+k} - ICC_t \times BE_{t+k-1}}{(1 + ICC_t)^k} + \frac{(FE_{t+5} - ICC_t \times BE_{t+4})(1 + g_t)}{(ICC_t - g_t)(1 + ICC_t)^5} \tag{A.28}$$

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

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

$$E_{t+n} = \delta_0 + \delta_1 NegE_t + \delta_2 E_t + \delta_3 NegE_t \times E_t + \delta_r B_t + \delta_5 TACC_t + \varepsilon, \tag{A.29}$$

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

The model is estimated cross-sectionally using the previous ten years of data to ensure no look-ahead bias. Specifically, one-year-ahead earnings in year t (E_{t+1}) are estimated using data from year $t - 10$ to $t - 1$, two-year-ahead earnings (E_{t+2}) are estimated using data from year $t - 11$ to $t - 2$, and so on. The model is estimated for firms with non-missing independent variables in year t. For each firm in year t, the forecasted EPS for years $(t + 1)$–$(t + 5)$ (FE_{t+1}–FE_{t+5}) is estimated by using the estimated coefficients from regression (A.29) and variables at t. Using the forecasted EPS, we estimate the implied cost of equity from the model developed by Gebhardt et al. (2001).

Appendix 6: Additional Results

Table A1: Hedging Motive: Robustness

This table reports the robustness of the impacts of the 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 and bottom 30 percent, respectively based on the correlation between industry-level external finance and the COC. We use high order linear cumulants (Erickson et al. (2014)) to account for measurement errors in the cost of capital measure (Panel A Columns 1 and 2). Panel A Columns 3 and 4 present the results for firms raising a minimum of 3% excess capital. Panel B presents the results obtained when using Li et al. (2013) (Columns 3 and 4), Claus and Thomas (2001) (Columns 5 and 6), and Li and Mohanram (2014) as alternative COE measures. Panels C and D report the results for subperiods 1981-1999 and 2000-2019, respectively. The detailed variable definitions are provided in Internet Appendix 4. Firm and year fixed effects are controlled. The coefficient estimates of the control variables are not reported for brevity. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

	Panel A: Measurement Errors			
	High-Order Cumulants		Active Issuances	
Hedging Motive	High	Low	High	Low
	(1)	(2)	(3)	(4)
COC	-0.0605	0.2412***	-0.1442***	-0.1163**
	[0.0776]	[0.0925]	[0.0491]	[0.0500]
ExCapital	0.5079***	0.4404***	0.3195***	0.3021***
	[0.0400]	[0.0457]	[0.0264]	[0.0234]
ICF	0.5218***	0.3772***	0.1997***	0.2921***
	[0.1037]	[0.1271]	[0.0569]	[0.0635]
ExCapital×COC	-1.6390***	-0.2357	-0.9300***	-0.3656
	[0.4344]	[0.5328]	[0.2566]	[0.2499]
ICF×COC	-1.7179	0.1469	-0.3745	-0.9281
	[1.1031]	[1.4293]	[0.5036]	[0.6566]
Controls	Yes	Yes	Yes	Yes
Firm FEs	No	No	Yes	Yes
Year FEs	No	No	Yes	Yes
Observations	18,394	18,135	11,630	11,845
Adj. R^2			0.3746	0.3837

Panel B: Alternative COC Measures						
	Li et al. (2013)		Claus and Thomas (2001)		Li and Mohanram (2014)	
Hedging Motive	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.0517	-0.014	-0.0074	0.0229	-0.0550**	0.0291
	[0.0352]	[0.0389]	[0.0258]	[0.0352]	[0.0237]	[0.0265]
ExCapital	0.4415***	0.3675***	0.2771***	0.2621***	0.3373***	0.3554***
	[0.0256]	[0.0231]	[0.0154]	[0.0180]	[0.0250]	[0.0251]
ICF	0.4449***	0.2971***	0.2942***	0.2090***	0.2329***	0.1812***
	[0.0412]	[0.0499]	[0.0237]	[0.0292]	[0.0269]	[0.0276]
ExCapital×COC	-0.6815***	-0.1061	-0.2388**	-0.0713	-0.3410**	-0.177
	[0.2600]	[0.2459]	[0.1133]	[0.1288]	[0.1610]	[0.1703]
ICF×COC	-2.0530***	-0.0654	-0.7654***	-0.1023	-0.5904***	0.0461
	[0.4030]	[0.5616]	[0.1296]	[0.2407]	[0.1585]	[0.2151]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,926	14,094	17,206	17,294	17,741	17,698
Adj. R^2	0.4390	0.3917	0.3507	0.3525	0.3559	0.3767

Panel C: Subperiod 1981-1999						
	Hedging Motive 1		Hedging Motive 2		Hedging Motive 3	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.3001***	-0.1736***	-0.6002***	0.1057*	-0.5437***	0.0306
	[0.0518]	[0.0641]	[0.0528]	[0.0552]	[0.0573]	[0.0507]
ExCapital	0.3163***	0.2472***	0.4000***	0.2721***	0.3334***	0.1859***
	[0.0298]	[0.0304]	[0.0383]	[0.0351]	[0.0332]	[0.0302]
ICF	0.3279***	0.2854***	0.2849***	0.1535*	0.3340***	0.0502
	[0.0791]	[0.0827]	[0.0678]	[0.0875]	[0.0678]	[0.0698]
ExCapital×COC	-1.0967***	-0.0451	-1.5837***	0.0135	-1.0561***	-0.1827
	[0.3006]	[0.3320]	[0.3513]	[0.3915]	[0.3287]	[0.2934]
ICF×COC	-1.4857**	-1.5044*	-1.1202*	-0.3995	-1.7334***	0.9481
	[0.6889]	[0.8379]	[0.6146]	[0.7970]	[0.6027]	[0.6764]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,848	8,777	8,920	8,753	8,742	9,028
Adj. R^2	0.3577	0.3480	0.3470	0.3664	0.3551	0.2858

	Panel D Subperiod 2000-2019					
	Hedging Motive 1		Hedging Motive 2		Hedging Motive 3	
	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
COC	-0.1965***	-0.0227	-0.3473***	0.1849***	-0.2465***	0.0698
	[0.0438]	[0.0532]	[0.0424]	[0.0493]	[0.0472]	[0.0460]
ExCapital	0.3158***	0.2970***	0.4279***	0.2828***	0.3351***	0.2739***
	[0.0254]	[0.0265]	[0.0303]	[0.0269]	[0.0267]	[0.0276]
ICF	0.2911***	0.1778***	0.3033***	0.1716***	0.3026***	0.1559***
	[0.0452]	[0.0523]	[0.0389]	[0.0537]	[0.0446]	[0.0432]
ExCapital×COC	-0.7812***	-0.1674	-1.3982***	0.1432	-0.9833***	-0.3709
	[0.3002]	[0.3205]	[0.3243]	[0.3403]	[0.3089]	[0.3076]
ICF×COC	-1.7675***	-0.4987	-1.8200***	-0.2419	-1.9422***	-0.2659
	[0.4423]	[0.6081]	[0.3518]	[0.5641]	[0.4371]	[0.4743]
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,735	7,691	8,836	8,837	8,935	8,797
Adj. R^2	0.3595	0.3972	0.3827	0.3838	0.3801	0.3298