The role of derivative usage in influencing corporate financing and investment decisions

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Keywords: Cost of equity, cost of debt, derivatives, cost of capital, agency conflicts, investments

JEL Classification: *G12, G30, H21*

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Abstract

We show that derivative usage by Indian firms reduces the weighted average cost of capital and cost of debt. However, it does not affect the cost of equity. The negative impact of derivative usage on cost of debt is stronger for firms facing high financial constraints. Moreover, we find that the advantage of lower cost of capital does not necessarily lead to increased capital expenditure and acquisitions. However, derivative usage leads to higher R&D spending by corporates. We show evidence that usage of derivatives significantly lowers over-investment but does not affect under-investment. Our findings shed light on the benefits of using derivatives in minimizing the cost of capital and investing more in high-risk growth opportunities. Therefore, derivative usage has implications for the capital structure and investment decisions that managers make.

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1. Introduction

Cost of capital plays a fundamental role in a variety of financial decisions undertaken by the corporate managers. These include the determination of minimum rate of return to be earned on investment projects as well as the composition of firm's capital structure. Optimal capital structure leads to firm value maximization through lowering of the cost of capital (Modigliani and Miller, 1958). In this study, we examine whether derivative usage influences a firm's cost of capital. Hedging is positively associated with investment and firm value (Allayannis and Weston, 2001; Carter et al., 2006; Campello et al., 2011; Chaudhry and Gupta, 2023). Consequently, it is likely to be valued positively by external capital providers and reduce the cost of capital, the rate at which future cash flows are discounted.

The firms operating in countries with more effective regulations and stronger disclosure requirements have lower cost of capital (Hail and Leuz, 2006). This is because the degree of disclosure quality exerts a negative impact on capital costs (Botosan, 1997; Francis et al., 2005). Corporate governance mechanisms play an important role in influencing the cost of debt in countries with less transparent information environment and poor investor protection regime (Zhu, 2014). Due to the existence of poor-quality disclosures, more agency conflicts, and high firm riskiness (La Porta et al., 2000), investors in emerging markets are likely to demand a higher premium for providing funds. It increases the cost of raising funds in these markets. Due to these specific features of emerging economies, the inferences drawn based on the developed markets cannot be extended to the emerging capital markets. This prompts the need to analyze the impact of hedging decisions on the cost of capital of firms operating in emerging economies such as India.

Standardized trading in derivative contracts started in India in the year 2000-2001, much later than the advanced economies such as the US and even China where derivatives were introduced in 1990s (Chaudhry and Gupta, 2024). However, the volume of trade in the

Indian derivative markets has been growing at an exponential pace since the year 2021, with the index options market comprising 30-40% of the derivatives turnover.[1] The notional value of derivatives traded on exchanges has surpassed global standards and is witnessing increasing participation of the retail investors.[2] The turnover in the equity derivatives segment increased by 128% in 2023-2024 from the previous year 2022-2023 and in the commodity segment, trading volume rose by 87% as compared to the previous year.[3] However, the currency derivatives segment experienced a decline of 15% compared to last year. The substantial increase in derivatives trading and growth in equity markets relative to the global counterparts makes Indian capital markets a suitable prospect for this study.[4] While this funneling of growth by the retail participants is drawing heavy attention of the market regulator [5], it can also be indicative of maturing capital markets.

Derivative usage alleviates variations in earnings, making them more informative and reflective about manager's performance and abilities (DeMarzo and Duffie, 1995; Lin et al., 2009). Kim et al. (2022) show that by increasing corporate disclosures and improving the transparency of firm's operations, derivative usage restricts managers from hoarding bad news and the risk of stock price crash goes down. Furthermore, derivative usage can reduce the cost of debt by resolving agency problems between the debtholders and shareholders (Smith and Stulz, 1985; Campbell and Kracaw, 1990). Derivative usage can lower the cost of equity by resolving agency conflicts between the managers and investors (Haugen and Senbet, 1981; Morellec and Smith, 2007). By allaying the effect of information asymmetry and agency

[1] https://www.financialexpress.com/market/cafeinvest-the-rise-and-risks-of-indias-derivatives-market-3634211/
[2] https://www.fia.org/marketvoice/articles/explainer-meteoric-rise-indias-equity-derivatives-volume
[3] https://www.sebi.gov.in/reports-and-statistics/publications/aug-2024/annual-report-2022-23_74990.html
[4] https://static.pib.gov.in/WriteReadData/userfiles/file/EconomicSurvey2023Q44O.pdf
[5] https://www.livemint.com/market/stock-market-news/india-to-tighten-derivatives-rules-despite-investor-pushback-sources-say-11725606564103.html

conflicts, use of derivatives can result in minimization of cost of capital and creation of firm value (Chen and King, 2014).

We postulate that using derivatives improves the quality of information environment and resolves the agency conflicts among different capital providers. It eventually lowers the cost of raising external capital. We test whether firms that use derivatives (derivative-user firms) can raise funds at lower cost in the capital markets, relative to firms that do not use derivatives (non-derivative-user firms). Particularly, we examine whether the overall cost of capital, cost of debt, and cost of equity are lower for derivative-user firms as compared to the non-derivative-user firms. Our sample consists of publicly listed companies in India. The sample period ranges from 2016 to 2023.

In this study, we analyze the effect of using derivatives in influencing the financing and investment decisions undertaken by the firms. We find that the weighted average cost of capital is significantly lower for derivative-user firms as compared to the non-derivative-user firms. The impact of derivative usage on the cost of debt is negative and statistically significant. Our findings highlight the beneficial role that derivative instruments play in reducing the borrowing costs for a sample of Indian firms. However, we do not find derivative usage to affect the cost of equity. A potential explanation for our findings is that bank lending accounts for most of the borrowing by Indian firms.[6] Banks who typically are more informed and have access to better quality information (Bharath et al., 2008) are likely to understand the benefits of derivative usage in reducing firm riskiness.

The negative relation between derivative usage and cost of debt holds under various robustness checks. Since the impact of derivative usage on overall cost of capital is mainly driven by cost of debt, we perform further analyses using cost of debt as the key dependent

[6] Retrieved on January 14, 2025, from https://rbi.org.in/scripts/BS_ViewBulletin.aspx?Id=17995#

variable. The endogeneity tests address concerns related to self-selection bias, omitted variable bias, and potential reverse causality in our findings. In a subsample analysis, we find that derivative usage plays a stronger role in reducing cost of debt when firms are more financially-constrained. We do not observe any significant difference in capital expenditure and acquisition cost between the derivative-user and non-derivative-user firms. However, we find that derivative-user firms' spending on research and development (R&D) activities is considerably higher than the non-derivative-user firms. To check if derivative-user firms are over investing the excess cash in wasteful projects, we adopt the methodology followed by Biddle et al. (2009). The empirical results show that derivative usage reduces over-investment by firms.

Our study makes important contributions to the corporate finance literature. We add to the scant literature examining the impact of derivative usage on cost of capital (for example, Gay et al., 2011; Coutinho et., 2012; Chen and King, 2014). We show that the overall cost of capital is lower for derivative-user firms relative to the non-derivative-user firms. Coutinho et al. (2012) note that in emerging markets, investors consider derivative usage by firms to be risky and penalize them by demanding a higher return on their capital. In contrast, our study shows that the overall cost of capital is significantly lower for firms that use derivatives. This is because derivative usage helps in mitigating information asymmetry and agency problems between different stakeholders (Campbell and Kracaw, 1990; DeMarzo and Duffie, 1995; Morellec and Smith, 2007; Chen and King, 2014), which eventually lowers the cost of raising funds. Gay et al. (2011) examine the impact of derivative usage on cost of equity for a sample of US firms and find that derivative-user firms have lower cost of equity due to lower systematic risk. Ahmed et al. (2018) find that investors demand lower risk premium from derivative-user firms because these firms have low market risk and financial distress risk.

Unlike these studies, we do not find any significant difference between derivative-user firms and non-derivative-user firms with respect to the cost of equity.

Chen and King (2014) observe that use of derivatives lowers information asymmetry, agency cost, and risk of financial distress, which causes reduction in the cost of debt. In line with their findings, we also find that derivative-user firms borrow funds at cheaper costs than non-derivative-user firms. Contrary to the empirical studies which investigate the impact of derivative usage on standalone measures of cost of capital (for example, Gay et al., 2011; Coutinho et al., 2012; Chen and King, 2014), in this study, we determine the impact of derivative usage on all these measures of cost of capital. By doing so, we provide comprehensive evidence regarding the differential effect of hedging on different types of financing costs. Based on our findings, we can infer that in emerging markets, debt is a popular source of financing which can be raised at low costs, as compared to equity. This reinforces the findings of Mitton (2008), Shailer and Wang (2015), and Chaudhry and Kumari (2024), who note the importance of corporate debt financing in emerging markets such as China and India.

Unlike Chen and King (2014), we do not find any evidence which suggests that reduction in cost of funds leads to more capital expenditures or acquisitions. Instead, we observe that derivative-user firms invest more in R&D activities than non-derivative-user firms. Investment in R&D activities plays an important role in achieving operational efficiency and sustainable growth in the long run (García-Manjón and Romero-Merino, 2012). By demonstrating that derivative-user firms spend more on innovation-related activities such as R&D, we support the findings of Blanco and Wehrheim (2017). The authors emphasize upon the risk mitigation role of derivatives which enables firms to increase their investments in innovation-based long-term projects which entail high potential risk.

We show that the negative relation between derivative usage and cost of debt becomes stronger when financial constraints are high. This is consistent with Smith and Stulz (1985) and Chen and King (2014) who demonstrate that the use of derivatives alleviates the risk of financial distress and bankruptcy and lowers the cost of debt. This is the cash flow generating role of derivatives which suggests that hedging reduces the variability in cash flows and makes them a readily available source of corporate financing (Jankensgård and Moursli, 2020). We also find that derivative usage reduces over-investment but does not under-investment. Our finding of reduction in over-investment by derivative-user firms contrasts with the findings of Lobo et al. (2022) who show that hedging increases over-investment and information asymmetry moderates this relationship. These results do not indicate the presence of over-investment of free cash flow problem as highlighted by Jensen (1986).

The remainder of the paper is organized as follows. Section 2 presents the related literature and develops hypotheses. Section 3 explains the sample data and research methodology. In Section 4, we discuss empirical results. Section 5 concludes the study.

2. Related literature and hypotheses development

Cost of capital is influenced by several factors including the existence of conflicts among different stakeholders, lack of transparent information environment, and presence of financial constraints.

Funds provided by equity investors may be misappropriated by managers as they are likely to indulge in opportunistic behavior by prioritizing their own interests at the expense of shareholders (Jensen and Meckling, 1976; Masulis et al., 2009). These may include excessive perquisite consumption and wasting firm’s resources by investing in negative NPV projects. Due to the self-maximizing behavior of corporate managers, shareholders are likely to charge higher premium, which translates into higher cost of equity. When the quality of accounting information disclosures improves, uncertainty and riskiness associated with future cash flows decrease and this reduces the cost of capital (Francis et al., 2005; Lambert et al., 2007). For stocks that have more private information associated with them, the informativeness of stock prices reduces and it generates high risk for the uninformed investors (Easley and O'Hara, 2004). As a result, investors charge higher return from these stocks, thus increasing the cost of equity. Myers and Majluf (1984) posit that high information asymmetry between managers and potential investors makes the externally raised funds less favorable than internally generated funds. This is because lack of information disclosures aggravates agency problems which increases the risk for outsiders and makes external financing expensive. Francis et al. (2005) document cross-country evidence that voluntary disclosures undertaken by the firms reduce information asymmetry, which enables firms to raise external funds at low costs. Gao and Zhu (2015) find that high information asymmetry increases both cost of debt and cost of equity. This is because more information disclosures enable investors to estimate the assets returns better and this in turn lowers their expected return on these assets.

Derivative disclosures enhance the quality of accounting information and reduce the degree of information asymmetry in the financial markets (DeMarzo and Duffie, 1995; Lin et al., 2009). Trading in derivatives promotes dissemination of high-quality information in the financial markets and leads to reduction in the cost of equity (Naiker et al., 2013). The improved flow of information in the market ensures better price discovery, higher market liquidity, and lower perceived risk. Altogether, these mechanisms enable investors to better assess the firm's risk and value, thereby lowering the cost of equity capital. Morellec and Smith (2007) argue that when firm cash flows are high, but growth opportunities are lower, firm managers may invest the excess funds in value-destroying projects. However, when firms undertake hedging, the cash flows become more stable and predictable. This restricts the availability of excess cash with the managers and the agency problem between managers and shareholders gets resolved, resulting in lower cost of equity.

Myers (1977) posits that in the presence of debtholders, shareholders may not be incentivized to create firm value by undertaking value-creating projects. This is especially true when firms are financially distressed because then the benefits that may arise from corporate investments will be shared with the debtholders. In such a case, equity holders are more likely to underinvest. Managers acting on behalf of the shareholders may waste firm resources by investing in high-risk projects with negative net present value (Myers, 1977; Myers and Majluf, 1984). Doing so helps the shareholders increase their payoffs when the volatility of a firm increases. The debtholders, however, are at risk because of their fixed claim in the business. Risky investments can increase the likelihood of a firm's insolvency and thus debtholders are likely to lose their claims. Furthermore, when more growth opportunities are available, shareholders are less likely to hedge risk after the issuance of debt as it redistributes wealth from shareholders to the bondholders (Fok et al., 1997). The bondholders anticipate this possibility and charge higher interest rates as compensation for bearing the risk. The divergence of interests between the shareholders and bondholders results in increased cost of raising debt funds. Lambert et al. (2007) observe that disclosure of accounting information affects investors' perception about future cash flows and assessed covariances between future cash flows and other firms' cash flows. These effects together lead to lower cost of capital when the quality of disclosures is superior. Derrien et al. (2016) find that loss of analyst coverage increases the cost of debt and credit default events. When analysts following a firm disappear, lack of information about the firm's financial prospects increases uncertainty among the debt holders, which raises the cost of debt. Further, high asymmetry and uncertainty impairs the creditors' ability to assess the credit risk of firm which increases the possibility of the firm facing negative credit events in the future.

Usage of derivatives is expected to affect the capital structure choices of a firm by alleviating the agency cost of issuing debt. For instance, risk-shifting problem occurs when after issuing debt, shareholders are incentivized to undertake risky projects that offer high potential returns but also increase the risk of firm default. Risk management such as hedging of cash flows reduces the project risk and the likelihood of default, thus resolving the risk-shifting problem (Campbell and Kracaw, 1990). This allays the risk for debtholders, who are likely to charge a lower return on their funds as the probability of firm default and high project risk goes down. Smith and Stulz (1985) argue that after the issuance of debt, shareholders undertake hedging due to reputational concerns and probable reduction in the number of debt covenants. Hedging alleviates the risk of financial distress and lowers the possibility that a firm will default, enhancing its reputation in the market. Also, by reducing the volatility in cash flows, hedging can reduce the restrictive covenants imposed by the debtholders and provide more operational flexibility to the shareholders. In anticipation, debtholders are likely to demand lower cost of debt. Chen and King (2014) show that derivative usage enhances disclosure quality and mitigates the problem of risk-shifting, which together lead to reduction in cost of debt. By alleviating the variability in cash flows and managing financial distress, derivatives reduce the severity of risk-shifting and lower the premium charged by the debtholders.

Thus, it can be inferred that derivative usage enhances disclosure quality and alleviates the agency problems that exist among shareholders, debtholders, and firm managers. This results in decrease in cost of equity, cost of debt, as well as the weighted average cost of capital.

Therefore, we postulate that the weighted average cost of capital, cost of debt, and cost of equity is lower for the derivative-user firms than for the non-derivative-user firms.

3. Data and research methodology

We obtain financial information, stock returns, and market index returns data from the Prowess dx database, and data on government bond yields from the Reserve Bank of India website. The statutory tax rates are obtained from the Income Tax Department website (https://incometaxindia.gov.in/Pages/charts-and-tables.aspx). The final sample consists of 2,257 unique firms and 10,505 firm-year observations. The sample period ranges from 2016 to 2023.

We define derivative-user firms following Chaudhry and Gupta (2023), as those firms which report derivatives either as an asset or as a liability in their balance sheet, or make provisions for the probable losses from their position in derivative contracts in the balance sheet. Firms that recognize gains or losses from their positions in the derivative contracts in the income statement are also defined as derivative-user firms. The variable *DERUSER* is one if a firm uses derivatives and is zero otherwise.

The overall cost of capital (*WACC*) is calculated as the weighted average of cost of debt and cost of equity. The computation of this measure is shown in Equation (1) below.

$$WACC = \left[k_e \times \frac{EQUITY}{EQUITY + DEBT}\right] + \left[k_d \times (1 - T) \times \frac{DEBT}{EQUITY + DEBT}\right] \quad \ldots (1)$$

where, $WACC$ is the weighted average cost of capital, k_e is the cost of equity, $EQUITY$ is paid-up equity share capital, $DEBT$ is total debt of a firm, k_d is the cost of debt, and T represents corporate statutory tax rates.

Following Sengupta (1998), Pittman and Fortin (2004), and Lorca et al. (2011), we calculate cost of debt as the interest expense paid divided by total borrowings held by a firm.

We calculate cost of equity (k_e) using the Capital Asset Pricing Model (CAPM) as shown in Equation (2) below.

$$k_e = R_f + \beta_i\left(R_m - R_f\right) \quad \ldots (2)$$

where, k_e is the cost of equity, R_f is the yield on the one-year government bond, R_m is the return on *BSE SENSEX* index (our proxy for market portfolio), and β_i represents the sensitivity of stock returns to market returns. We calculate a five-year rolling market beta for each stock and for each year in our sample. We do so by regressing daily excess stock returns on daily excess market returns. Expected market return is calculated using average of past ten years of market returns data. Excess returns are calculated using the risk-free rate proxied by the yield on the one-year government bond.

To examine the effect of *DERUSER* on *WACC*, Model (3) is estimated using pooled OLS regression.

$$\begin{aligned} WACC_{i,t} = {} & \beta_0 + \beta_1 DERUSER_{i,t} + \beta_2 FIRMSIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 LNMB_{i,t} \\ & + \beta_5 TANG_{i,t} + \beta_6 CF_{i,t} + \beta_7 CF\_VOL_{i,t} + \beta_8 BETA_{i,t} + \beta_9 TURNOVER_{i,t} \\ & + \beta_{10} STKVOL_{i,t} + Credit\ rating\ dummies + Industry\ Dummies \\ & + Year\ Dummies + \varepsilon_{it} \end{aligned} \quad \ldots (3)$$

where, for firm *i* and year *t*, $WACC$ is the weighted average cost of capital and *DERUSER* indicates whether the sample firms use derivative instruments. Following Botosan and Plumlee (2002), Anderson and Reeb (2003), Dhaliwal et al. (2008), Boubakri and Ghouma (2010), Gay et al. (2011), and Chen et al. (2016), we control for firm size (*FIRMSIZE* natural logarithm of the book value of total assets), financial leverage (*LEV* total debt divided by total assets), growth opportunities (*LNMB* natural logarithm of the market-to-book ratio), asset tangibility (*TANG* net fixed assets scaled by total assets), operating cash flows (*CF* cash flow from operating activities scaled by total assets), cash flow volatility (*CF_VOL* standard deviation of *CF* for the trailing three years), stock turnover (*TURNOVER* average weekly stock turnover), market beta (*BETA* sensitivity of stock returns to market returns), which is same as β_i, estimated by using Equation (2), and total stock return volatility (*STKVOL* annualized standard deviation of stock returns).

The impact of using derivatives on the cost of debt is estimated using Model (4).

$$k_{d_{i,t}} = \beta_0 + \beta_1 DERUSER_{i,t} + \beta_2 FIRMSIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 LNMB_{i,t} + \beta_5 TANG_{i,t} + \beta_6 CF_{i,t} + \beta_7 CF\_VOL_{i,t} + \beta_8 STKVOL_{i,t} + Credit\ rating\ dummies + Industry\ dummies + Year\ dummies + \varepsilon_{it} \quad \ldots (4)$$

where, k_d is the cost of debt computed as the ratio of interest expense to total borrowings, *DERUSER* indicates whether the firm uses derivatives or not. The other control variables include *FIRMSIZE*, *LEV*, *LNMB*, *TANG*, *CF*, *CF_VOL*, and *STKVOL*. We also control for credit ratings in Model (4). As credit ratings measure the creditworthiness of the borrower with respect to its debt obligations, they are likely to influence firm' cost of borrowing (Lin et al., 2011).

Lastly, to examine the relationship between derivative usage and cost of equity, we estimate Model (3). We replace the dependent variable (*WACC*) by k_e which represents cost of equity, computed using Equation (2).

We winsorize all the continuous variables at the 1st and 99th percentiles except for the cost of debt (k_d), which is winsorized at the 1st and 95th percentiles. All the regression models discussed above are estimated using pooled ordinary least-squares method. We compute heteroscedasticity robust standard errors, which are clustered by firm. We also control for industry and year fixed effects.

4. Empirical results

4.1 Descriptive statistics

Panel A of Table 1 presents our sample data year-wise. For cost of debt, both the non-derivative-user firms as well as the derivative-user firms do not show much variation between 2016 to 2018. In case of non-derivative-user firms, cost of debt rises slightly from 2018 and then remains stable till 2021, after which it falls in 2022 and rises thereafter. However, for the derivative-user firms, cost of debt rises sharply from 2018 to 2019, drops suddenly in 2020, again increases in 2021 and drops in 2022. It shows an increase in 2023. The average cost of equity exhibits similar pattern for both the derivative-user and non-derivative-user firms. Till 2017, cost of equity decreases and between 2017 and 2019, it becomes stable. Then, in 2020, there is a sudden increase in cost of equity, followed by a sharp fall in 2021. From 2021 onwards, it shows a steep increase for both the sub-groups. Panel B shows the distribution of our sample on an industry-wise basis. Majority of firms (both derivative-user and non-derivative-user firms) belong to the manufacturing industry. This accounts for about 67% of the total sample.

[Insert Table 1 here]

Panel C shows the summary statistics. The sample mean (median) cost of debt (k_d), cost of equity (k_e), and weighted average cost of capital (*WACC*) are 11% (9.4%), 10.9% (9.9%), and 7.6% (7.1%) respectively. In Panel D, we report the Pearson and Spearman correlation coefficients at the 5% level of significance. The overall cost of capital is positively correlated with cost of debt and cost of equity. Derivative usage is negatively correlated with cost of debt and overall cost of capital. However, it is positively correlated with cost of equity. Next, in Panel E, we notice that as compared to the non-derivative-user firms, derivative-user firms have lower k_d and *WACC*, but higher k_e. Overall, the results from the univariate analyses are consistent with our hypothesis that derivative-user firms have lower cost of capital than the non-derivative-user firms.

4.2 Effect of derivative usage on overall cost of capital, cost of debt, and cost of equity

We first examine the impact of derivative usage on the overall cost of capital. In Column (1) of Table 2, we report results obtained from the estimation of Model (3). The coefficient on *DERUSER* is -0.006, which is statistically significant at the 1% level. It suggests that the weighted average cost of capital for the derivative-user firms is 60 basis points lower as compared to those firms which do not use derivatives. This finding is consistent with our conjecture that cost of capital is lower for firms that use derivatives. To further validate our results, we perform a series of robustness tests and present those results in Columns (2)-(5).

First, we control for industry-specific shocks by including an interaction term between the industry dummies and year dummies. Second, we address the concerns related to correlation of errors across firms and years by clustering the standard errors in both the dimensions. We note that in both Columns (2) and (3), the coefficients on *DERUSER* are negative and statistically significant (at the 1% level). Third, in Column (4), we report results obtained from the estimation of Fama and Macbeth (1973) model. Again, we observe a negative and statistically significant coefficient on *DERUSER* (at the 1% level). These results refute our concerns related to autocorrelation in errors across time (Petersen, 2009). In Column (5), we estimate median regression to remove the effect of outliers. The coefficient on *DERUSER* is negative and statistically significant at the 1% level. Across all these columns, the coefficient on *DERUSER* is -0.006, which is the same as that reported in Column (1).

[Insert Table 2 here]

In the next set of analyses, we define weighted average cost of capital using alternate market proxies and report those results in Columns (6)-(10). In our baseline regression model, the overall cost of capital is computed using *BSE SENSEX* as the market proxy. We replace this market index proxy by other indices such as, *NIFTY 50*, *NIFTY 100*, *NIFTY 200*, *NIFTY 500*, and *NIFTY TOTAL*. We notice that after using these different market proxies for the computation of overall cost of capital, the coefficient on our key independent variable *DERUSER* is negative and remains significant at the 1% level. This reinforces the baseline finding that derivative usage reduces firm's cost of capital. Unlike Coutinho et al. (2012), in this study, we find robust evidence to show that in emerging markets like India, investors charge lower cost of capital from firms using derivatives.

Next, we investigate the effect of using derivatives on cost of debt. For this purpose, we estimate Model (4) and report the results obtained in Column (1) of Table 3. The coefficient on *DERUSER* is -0.009 which is statistically significant at the 1% level. This result shows that firms that use derivatives have lower cost of debt than those firms which do not use derivatives. To validate this finding, we control for industry-by-year fixed effects in Column (2), cluster standard errors by both firm and year in Column (3), estimate the Fama-Macbeth (1973) regression in Column (4), and perform median regression in Column (5). Reassuringly, we find that derivative usage reduces the cost of debt across all model specifications. The coefficients reported in Columns (2)-(5) are statistically significant at the 1% level and are similar in magnitude when compared to the coefficient reported in Column (1). Our findings are important because debt is a major source of financing for firms in emerging markets (see, Mitton, 2008; Chaudhry and Kumari, 2024). These are in line with those of Campello et al. (2011) and Chen and King (2014) who find evidence that hedging decreases the cost of debt through channels of reduced information asymmetry and lower financial distress. Notably, the coefficient on *DERUSER* reported in Column (1) of Table 3, is larger in magnitude, as compared to the coefficient reported in Column (1) of Table 2 (0.009 versus 0.006).

[Insert Table 3 here]

Further, we investigate the impact derivative usage has on cost of equity. To test this relation, we re-estimate Model (3) by replacing the dependent variable as cost of equity. The result from this analysis is presented in Column (6). The coefficient on *DERUSER* is statistically insignificant. This implies that derivative usage by firms does not have any impact on their cost of equity. We get similar results when we perform this estimation under different model specifications. Across Columns (6)-(10), the coefficients on *DERUSER* are insignificant. Unlike Gay et al. (2011), we do not observe derivative-user firms to experience reduction in their cost of equity. A plausible reason for the difference in our findings and those of Gay et al. (2011) could be the different research settings. In contrast to the developed markets, Indian derivative market is relatively nascent and less developed, where derivative usage may not play any significant role in reducing systematic risk (Chaudhry and Gupta, 2023). Consequently, using derivatives does not impact cost of equity for a sample of Indian firms.

Overall, the evidence supports the hypothesis that firms that use derivatives are able to raise funds at lower cost than firms which do not use derivatives. This relation is economically significant and holds across various model specifications. Derivative-user firms have an advantage over the non-derivative-user firms in terms of being able to borrow funds at lower interest rates. However, derivative usage is not significantly related to cost of equity. The equity investors may not fully understand the nascent Indian derivative markets and therefore do not incorporate this aspect in the expected return on their funds. Corporate debt providers in India, who mainly comprise of banks, better comprehend the derivative markets and perceive derivative-user firms to be less risky. As a result, they demand lower return on their funds from firms that use derivatives. We perform subsequent analyses using cost of debt as the key dependent variable of our study.

4.3 Endogeneity

The choice of using derivatives can be endogenous in nature (Hentschel and Kothari, 2001; Bartram et al., 2011; Chaudhry and Gupta, 2024). Also, there may be variables that possibly have not been controlled for in Model (4). It can result in biased OLS estimates and our empirical inferences may be impaired. We address endogeneity concerns using multiple methods and report these results in Table 4.

[Insert Table 4 here]

4.3.1 Treatment-effects model

In the first step of the treatment-effects model, we perform maximum likelihood estimation. This estimation enables us to obtain the likelihood that a firm will use derivatives. For this purpose, we follow Chaudhry and Gupta (2023) and regress *DERUSER* on firm size (*FIRMSIZE*), sales (*SALES*), financial distress (*ZSCORE*), spending on R&D (*RND*), whether a firm reports foreign sales (*FRGNSALES*), whether a firm pays dividend (*DIV_DUMMY*), whether a firm borrows from the foreign markets (*FRGNDEBT*), leverage (*LEV*), and asset tangibility (*TANG*). In the second step, we regress k_d on the estimates obtained from the first step. Standard errors are computed based on the bootstrapping method, which accounts for the probable correlation among residuals across firm and year dimensions. The results obtained from the two steps of the treatment-effects model are presented in Columns (1) and (2).

The results presented in Column (1) of Table 3 shows that a firm's likelihood to use derivatives increases with firm size, financial distress, and R&D spending. Further, those firms with foreign sales and those with foreign debt are more likely to be identified as derivative-user firms. Column (2) shows that the coefficient on *DERUSER* is negative and statistically significant at the 1% level. This result is consistent with our regression results reported in Column (1) of Table 3.

4.3.2 Two-stage least squares model

While using 2SLS method for addressing endogeneity, we first identify two instrument variables that are significantly correlated with our key independent variable (*DERUSER*) but do not directly affect the dependent variable (k_d).

The first instrument (IV_1) that we use is the export earnings of a firm scaled by total assets. Firms with high export earnings are likely to be more exposed to fluctuations in exchange rates (He and Ng, 1998). It increases the foreign exchange rate risk faced by a firm. Therefore, we expect such firms to use derivatives to hedge their foreign exchange rate risk (Goldberg et al., 1998). The second instrument (IV_2) is defined as a binary variable, that takes value of one if foreign institutional investor/s are present and is zero otherwise. Foreign institutional investors are knowledgeable investors who understand the complexities associated with risk management (Wen-liang and He, 2014). So, we theorize that firms with foreign institutional investors are more likely to use derivatives in managing their risk exposures.

The results (untabulated) obtained from the diagnostic tests confirm the validity of the two chosen instrument variables. Robust regression *F*-statistics of 36.239 rejects the null hypothesis that the *DERUSER* variable is exogenous at the 1% level of statistical significance. Furthermore, results from the first-stage regression estimation indicate that the adjusted-R^2 and partial-R^2 are 0.265 and 0.047, respectively. The Robust *F*-statistics is statistically significant at the 1% level, indicating that the instruments are strongly correlated with the endogenous variable. Score $\chi 2(1)$ statistics of 0.556 is statistically insignificant, confirming that the model is not overidentified.

In the first stage, we regress *DERUSER* on the two instruments and exogenous controls, which are specified in Model (1), and present these results in Column (3). The coefficients on both the instrument variables are positive and statistically significant at the 1% and 5% levels, respectively. Thus, the two instruments are strongly correlated with *DERUSER*, confirming that firms with high export earnings and those with foreign institutional investors are more likely to use derivatives. In the second stage, we use fitted values of *DERUSER*, which are obtained from the first stage, to estimate Model (1) and report these results in Column (4). The coefficient on *DERUSER* is negative and statistically significant at the 1% level, which is consistent with our main results.

The results obtained from the 2SLS model further confirm that our main finding of a negative effect of derivative usage on cost of debt is robust to endogeneity that may result from the omitted variable bias.

4.3.3 Difference-in-difference analysis

In the difference-in-difference analysis, we examine the impact of introduction of new currency derivatives on the relationship between derivative usage and the cost of debt. We expect this exogenous event to affect firms' propensity to use derivatives. In India before 2018, currency futures and options were available only on US dollars. In 2018, derivative products on three other foreign currencies (euro, British pound, and Japanese yen) were introduced. We argue that after the introduction of new currency derivatives, usage of derivatives by corporates will increase. Firms are now in a better position to manage their foreign exchange rate exposure because of the availability of more derivative products in the market. Therefore, this event (introduction of new currency derivatives) would positively affect firms' propensity to use derivatives but will not have any direct effect on the cost of debt. Any effect on the cost of debt is expected to be through the firm's use of derivatives. We anticipate that in the post-2018 period, cost of debt will decline more for derivative-user firms relative to the non-derivative-user firms in the sample.

We compare derivative usage and cost of debt for the year 2020 against the base year of 2017. Treatment firms are defined as those firms which use derivatives and control firms are those firms which do not use derivatives. We use logit regression to estimate the likelihood that a firm uses derivatives. So, we regress *DERUSER* on firm characteristics including sales, size of firm, financial distress, capital expenditure, R&D spending, foreign sales, leverage, dividend growth rate, sales growth, foreign debt, and industry dummies (Bartram et al., 2011; Chaudhry and Gupta, 2023). Propensity score matching using nearest-neighbor method, within a caliper of 20% and without replacement is employed to match the treatment and control firms, within the same industry. We keep only those pairs of treatment and control firms, which are present in both 2017 and 2020. This method yields 78 matched pairs of treatment and control firms.

In untabulated tests, we note that treatment firms are not significantly different from control firms. The mean cost of debt drops from 8.69% to 7.81% for derivative-user firms whereas it increases from 8.91% to 9.63% for non-derivative-user firms. A similar pattern is observed in the median values of the cost of debt (8.16% to 7.54% for derivative-user firms and 7.99% to 9.55% for non-derivative-user firms). This evidence supports our conjecture that derivative-user firms enjoy lower cost of capital compared to non-derivative-user firms in the period following the introduction of new derivative products.

The results from the difference-in-difference analysis are shown in Column (5). We estimate Model (1) after replacing *DERUSER* with *POST* and *DERUSER*×*POST*, where *POST* indicates post-regulation period (2020). The coefficient on the interaction term is negative and statistically significant at the 5% level. It indicates that after the introduction of new range of derivatives, cost of debt has fallen significantly for the derivative-user firms as compared to the non-derivative-user firms. These results support our argument that after the introduction of new derivative instruments, the reduction in cost of debt is more evident for derivative-user firms relative to the non-derivative-user firms in our sample.

In sum, the introduction of new currency derivatives increases firms' propensity to use derivatives and that in turn reduces the cost of debt. This evidence addresses our concerns regarding reverse causality and helps us to establish the direction of causality. It can be concluded that derivative usage causes cost of debt to decline for firms.

4.3.4 Matched-sample analysis

In this subsection, we match sample of derivative-user firms with the non-derivative-user firms and perform regression analysis on the matched-sample thus obtained. By doing this exercise, we address the concern that firms that use derivatives are systematically different from those which do not use derivatives. For each year and each industry, we estimate a logit regression in which we model the variable *DERUSER* as a function of *FIRMSIZE*, *SALES*, *TANG*, *ZSCORE*, *CAPEX*, *RND*, *FRGNSALES*, *LEV*, *DIV_DUMMY*, *SGRTH*, and *FRGNDEBT* (Chaudhry and Gupta, 2023). We use propensity score matching (nearest-neighbor method), without replacement and within a caliper of 10%. This gives us 1,938 matched pairs of derivative-user and non-derivative-user firms. In unreported tests, we note that the derivative-user firms and non-derivative-user firms have similar firm characteristics.

We re-estimate Model (4) using the matched-sample of derivative-user and non-derivative-user firms. As shown in Column (6), the coefficient on *DERUSER* is -0.007, which is statistically significant at the 10% level. The sign and magnitude of this coefficient is similar and comparable to the coefficient reported in Column (1) of Table 3 for our baseline model.

The results obtained from the analysis of the matched sample of treatment and control firms confirm that the impact of derivative usage in reducing the cost of debt is not driven by distinct firm characteristics, which also motivate these firms to use derivatives.

4.4 Financial constraints

Financially-constrained firms are those which find it difficult to raise additional capital. For such firms, the marginal value of cash is higher as each additional dollar of funds generated internally, enables a constrained firm to avoid costly external finance (Faulkender and Wang, 2006). Hedging helps firms generate funds internally by managing the volatility in cash flows and avoiding costly external finance (Froot et al., 1993). Firms use derivatives to hedge negative cash flows that minimize financial distress costs (Smith and Stulz, 1985). Therefore, derivative usage enables firms which are more financially-constrained to generate cash flows internally as well as raise funds at lower costs.

To determine whether financial constraints play any role in influencing the *DERUSER*-k_d relation, we perform subsample analyses. We divide our full sample into subsamples based on industry median values of various measures of financial constraints. These measures include short-term liquidity ratio, cash holdings of a firm, Kaplan and Zingales (1997) index of financial constraints, and Altman (1968) z-score. Financially-constrained firms are those with low short-term liquidity, low cash holdings, above median values of Kaplan and Zingales (1997) index, and below median values of Altman (1968) z-score.[7] In Columns (2), (4), (6) and (8), firms are categorized as more financially-constrained and in Columns (1), (3), (5) and (7),

[7] A lower Altman (1968) z-score is related with a high probability of default. Such firms find it difficult to borrow additional funds in the market and are financially-constrained.

firms are less financially-constrained. After dividing the full sample into two, we estimate regression Model (4) for each of these subsamples and report our findings in Table 5.

[Insert Table 5 here]

Columns (1) and (2) show results when short-term liquidity ratio is used as proxy for financial constraints faced by a firm. When short-term liquidity is high, firm is less financially-constrained and is more constrained when short-term liquidity is low. The coefficient on derivative usage is significant (at the 1% level) in Column (2) only, where the firms are more financially-constrained. This implies that the effect of derivative usage in reducing the cost of debt is stronger when firm is more constrained. When we use the other proxies, we note similar results. The coefficients on *DERUSER* are statistically significant (at the 5% level or better) only across the even-numbered columns where firms are more financially-constrained. In the odd-numbered columns, the coefficients on *DERUSER* are insignificant. In other words, derivative usage plays an important role in alleviating firm's cost of debt especially when financial constraints are high (Chen and King, 2014).

In sum, the results from this subsection suggest that firms using derivatives experience a stronger reduction in their cost of raising debt when they are more financially-constrained. This highlights the cash flow generating role played by derivatives. Derivatives enable constrained firms to reduce variations in their cash flows and obtain funds at low cost.

4.5 Firm investment and efficiency

Firm value is the present value of all expected future cash flows accruing to a firm. Prior studies document evidence to support the firm value creating role of derivatives (Allayannis and Weston, 2001; Carter et al., 2006; Bartram et al., 2011; Chaudhry and Gupta, 2023). While some of these studies emphasize on the cash flow volatility reduction channel (see, for example, Bartram et al., 2011), others argue that reduction in discount rate leads to an increase in firm value (see, for instance, Chaudhry and Gupta, 2023). When the cost of raising external finance is high, hedging strategies adopted by a firm helps in generating cash flows which provides a source of financing the investment projects (Froot et al., 1993). When firms hedge their risk, cost of capital reduces, availability of funds increases and consequently, capital expenditure increases which is instrumental in maximizing firm value. This proposition is supported by the findings of Carter et al. (2006) who show that hedgers have high firm value than non-hedgers and the positive relation between corporate value and hedging becomes stronger with increase in capital spending. The firms are likely to benefit from the increased investments due to hedging. For instance, Nguyen (2018) establishes that as hedging reduces risk exposure, lowers financial distress, and resolves the issue of underinvestment, using derivatives to hedge risk can increase the capital investment by a firm. Jankensgård and Moursli (2020) document positive relation between derivative cash flows and firm investment. They argue that derivatives reduce the volatility of operating cash flows and help in generating funds internally to meet the investment requirements, especially when obtaining external funding is difficult and expensive.

Our results, so far, suggest that derivative usage reduces the overall cost of capital and cost of debt and therefore firms may find it easier to raise funds externally. Further, we also show that derivative usage helps in mitigating the financial constraints, which reduces the cost of borrowing. So, we postulate that using derivatives helps firms in bringing down their cost of raising funds which enables them to undertake more investments. We examine whether the corporate investments of firms using derivatives is higher than those of firms which do not use derivatives. To test this proposition, we regress investment variables on *DERUSER* and other variables controlled for in Model (4). Table 6 presents these results.

[Insert Table 6 here]

First, we define *CAPEX* as the capital expenditure on fixed assets, scaled by the lagged book value of total assets. The coefficient on *DERUSER* is negative but statistically insignificant, as shown in Column (1). This finding suggests that derivative usage does not affect capital expenditure. Next, in Column (2), we define firm investment alternatively. Corporate investment is measured in terms of acquisition expenditure incurred by a firm scaled by the lagged book value of total assets (*ACQ*). The coefficient on *DERUSER* is again insignificant, suggesting that derivative usage does not influence the acquisition expenditure.

Another measure of investment is R&D spending. We define *RND* as the amount spent on R&D activities scaled by the lagged value of total assets. In Column (3), the coefficient on *DERUSER* is positive and statistically significant at the 1% level. Further, in Column (4), we scale R&D spending by the lagged value of total sales and find consistent results. The coefficient on *DERUSER* is positive and statistically significant at the 5% level. This indicates that derivative-user firms spend more on R&D activities in comparison to the non-derivative-user firms. In other words, managers prefer to invest more in R&D activities over capital expenditure or acquisitions (Aboody and Lev, 2000).

Derivative usage improves the quality of financial reporting and disclosures (Guay, 1999) and this reduces information asymmetry, which curbs corporate managers to waste funds in value destroying investments (Biddle et al., 2009). To corroborate this proposition, we investigate whether derivative usage by firms has any effect on their investment efficiency. Following the approach developed by Biddle et al. (2009), we regress capital spending (expected level of investment) on growth opportunities and obtain residuals from this regression model. These residuals reflect deviations from expected investment where the top (bottom) quartile represents over (under) investment. To proxy for firm's growth opportunities, we employ two measures, sales growth rate measured annually and Tobin's Q. In Table 7, we show these results.

[Insert Table 7 here]

Columns (1) and (2) present results when annual sales growth rate is used as a proxy for growth opportunities. The coefficient on *DERUSER* is negative and statistically significant (at the 1% level) only in Column (2) and insignificant in Column (1). This implies that use of derivatives brings down over-investment in a firm. We observe similar results when we use Tobin's Q as a proxy for growth opportunities. The coefficient on *DERUSER* is insignificant in Column (3). However, in Column (4), it is negative and significant at the 1% level. This confirms that the usage of derivatives tends to reduce over-investment, while it is not associated with under-investment by the firm. The empirical result that derivative usage discourages over-investment is in line with Morellec and Smith (2007) who theorize that firms undertake hedging to restrict the over-investment of free cash flows and resolve agency problems between shareholders and managers. However, our results for investment efficiency are in contrast with the findings of Lobo et al. (2022) who report that hedging promotes overinvestment of cash flows and leads to empire building by managers.

Taken together, we conclude that derivative usage does not influence capital expenditure or acquisition cost. However, we note that firms that use derivatives spend more on R&D than the non-derivative-user firms. Our results are in line with those of Blanco and Wehrheim (2017) who show that due to the risk management function of using derivatives, managers of firms which are involved in options trading, invest more in riskier activities like innovation and R&D. In contrast to the Jensen (1986) proposition, we do not find evidence to support that derivative-user firms engage in empire building or excessive perquisite consumption. Since derivative usage by firms reduces over-investment, this implies that managers do not waste cash by borrowing more funds at low costs and over investing those funds.

5. Conclusion

This study illustrates that firms that use derivatives have lower overall cost of capital and cost of debt than firms which do not use derivatives. We do not find any significant difference in the cost of equity of derivative-user and the non-derivative-user firms. Perhaps, because of the relatively new derivative markets in India, equity investors may not fully understand how derivatives influence riskiness of a firm and are less likely to price usage of derivatives in their expected returns. However, bank loans are the main source of funding by Indian companies, providing potential explanation for the observed negative effect of derivative usage on cost of debt (while no effect on cost of equity). Our finding that derivative usage lowers the cost of debt but does not have any significant effect on the cost of equity will be useful for the corporate managers in making capital structure decisions.

Another important finding of our study is that the negative relation between derivative usage and cost of debt strengthens when firms are financially-constrained. This demonstrates the cash flow generating role of derivatives, useful for both the firm managers and capital providers. Since using derivatives mitigates financial constraints and stabilizes cash flows, this assures investors about the financial health of a firm. In further analyses, we note that the usage of derivatives does not lead to more capital investments or acquisitions, but is associated with more spending on R&D activities, which are risky in nature. In addition, we do not find any evidence that derivative usage by companies leads to wastage of funds by over-investment.

To summarize, we document that other than the traditional risk management function, derivative usage by firms helps them raise debt at lower cost and invest in R&D intensive innovative projects which are riskier. From the investors' viewpoint, derivative usage resolves the issue of free cash flows being misappropriated by the managers as it prevents the over-investment of excess cash. The findings from our study can also be useful for the market regulator in formulating policies and rules pertaining to the trading of derivative securities in India.

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Table 1: Descriptive statistics

This table presents descriptive statistics. The cost of debt (k_d) is defined as interest expense paid divided by total borrowings held by a firm, cost of equity (k_e) is computed using Capital Asset Pricing Model, *WACC* is the weighted average cost of capital, *DERUSER* is one if a firm uses derivatives and zero otherwise, *FIRMSIZE* is the natural log of total assets, *LEV* is total debt divided by total assets, *LNMB* is natural log of the market-to-book ratio, *TANG* is net fixed assets scaled by total assets, *CF* is the cash flow from operating activities scaled by total assets and *CF_VOL* is the standard deviation of past three years of *CF*, *BETA* is a measure of systematic risk, *TURNOVER* is stock turnover, and *STKVOL* is total stock return volatility. All continuous variables except for k_d are winsorized at the 1st and 99th percentiles. k_d is winsorized at the 1st and 95th percentiles. For Panels A and B, Columns (1) and (4) report the number of observations for non-derivative-user firms and Columns (7) and (10) report number of observations for derivative-user firms. Columns (2) and (3) report mean and median k_d (in percent) of non-derivative-user firms, and Columns (8) and (9) report mean and median k_d (in percent) of derivative-user firms. Columns (5) and (6) report mean and median k_e (in percent) of non-derivative-user firms, and Columns (11) and (12) report mean and median k_e (in percent) of derivative-user firms. The sample period is from 2016 to 2023.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Non-derivative-user firms						Derivative-user firms					
	N	Mean k_d	Median k_d	N	Mean k_e	Median k_e	N	Mean k_d	Median k_d	N	Mean k_e	Median k_e
Panel A: This panel presents distribution of the sample by year.												
2016	1102	11.5	10.5	1079	15.3	15.3	181	9	8.1	178	16.1	16.1
2017	971	11.6	10.6	987	9.2	9.2	304	9.9	8.6	305	9.6	9.7
2018	943	11	9.8	957	9.2	9.2	286	9.4	7.9	286	9.5	9.6
2019	953	12.2	10.1	968	8.4	8.5	278	11.1	8.6	280	8.8	8.8
2020	989	11.7	10.1	940	15	15.3	315	9.3	8.3	302	16	16
2021	1156	11.9	9.9	1148	6.3	6.3	307	11.2	8.8	308	6.6	6.6
2022	1194	10.1	8.3	1212	10.4	10.5	316	9.4	7.3	317	11.1	11.3
2023	839	10.5	8.7	847	13.9	14	257	9.8	7.9	257	14.9	15.1
Panel B: This panel presents distribution of the sample by industry.												
Accommodation and Food service activities	141	11	10.2	143	10.3	9	15	11.1	10	15	9.3	8.5
Administrative and support service activities	30	12.8	10.2	30	9.9	9.8	10	13.9	11.7	10	10.9	10
Agriculture, Forestry and Fishing	85	11.1	8.8	86	11.4	9.8	44	7.4	6.7	44	11.7	10.3
Arts, entertainment, and recreation	23	15.3	13.9	23	9.7	8.8	-	-	-	-	-	-
Construction	659	12.3	11.7	655	11.6	10.3	76	12	12.2	72	12.6	11.3
Education	18	12.9	7.9	18	10.8	10.1	-	-	-	-	-	-
Electricity, gas, steam, and air conditioning supply	87	9.8	8.2	87	11.1	10.1	27	8.6	9.6	27	11.2	12.6
Human health and social work activities	97	9.4	9.4	101	9.6	9	15	7.7	7.2	15	8.1	8.8
Information and communication	481	12.7	10.5	480	10.9	9.9	179	11.3	9.5	179	9.3	10.4
Manufacturing	5291	10.9	9.4	5271	10.9	9.8	1688	9.8	7.8	1683	10.3	11.3
Mining and quarrying	100	9.5	8	100	10.7	9.7	11	5	3.2	10	11.9	12.8
Other service activities	4	8.8	8.2	4	13	12.6	-	-	-	-	-	-
Professional, scientific, and technical activities	75	11.6	9.9	78	10.7	9.5	15	9.6	8.6	15	9.7	10.8
Transportation and storage	151	11.6	9.8	152	11.1	9.8	41	7.6	7.2	41	9.3	10.3
Wholesale and retail trade; repair of motor vehicles and motorcycles	905	12.3	10	910	10.2	9.2	123	10.8	9.1	122	10.3	11.3

Panel C: This panel reports summary statistics for all variables.

	(1) Mean	(2) Median	(3) 25^{th} Percentile	(4) 75^{th} Percentile	(5) Std Dev
k_d *(in %)*	11	9.4	6.5	12.5	9.8
k_e *(in %)*	10.9	9.9	7.9	12.9	4.2
WACC (in %)	7.6	7.1	5.4	9.1	3.2
DERUSER	0.214	0	0	0	0.41
FIRMSIZE	8.391	8.245	7.068	9.597	1.772
LEV	0.227	0.207	0.083	0.342	0.165
LNMB	0.392	0.369	-0.315	1.09	1.008
TANG	0.283	0.27	0.132	0.413	0.182
CF	0.064	0.062	0.015	0.113	0.08
CF_VOL	0.058	0.046	0.026	0.075	0.045
BETA	1.034	1.05	0.672	1.409	0.545
TURNOVER	3.006	0.697	0.112	2.869	6.404
STKVOL	0.529	0.534	0.432	0.62	0.138

Panel D: This panel reports the Pearson (Spearman) correlation coefficients in the lower (upper) triangle. Statistical significance at the 5% level is indicated by *.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) k_d		-0.003	0.785*	-0.128*	-0.048*	-0.168*	-0.067*	-0.029*	0.121*	-0.039*	0.027*	-0.084*	0.109*
(2) k_e	-0.029*		0.289*	0.057*	0.197*	0.033*	-0.041*	0.029*	0.026*	-0.023*	0.54*	0.166*	-0.033*
(3) *WACC*	0.560*	0.325*		-0.171*	-0.134*	-0.334*	-0.071*	-0.112*	0.077*	-0.018	0.151*	-0.111*	0.143*
(4) *DERUSER*	-0.057*	0.044*	-0.136*		0.414*	-0.046*	0.185*	0.042*	0.124*	-0.053*	0.12*	0.314*	-0.306*
(5) *FIRMSIZE*	-0.043*	0.163*	-0.103*	0.411*		-0.049*	0.206*	0.046*	0.148*	-0.198*	0.304*	0.59*	-0.547*
(6) *LEV*	-0.243*	0.042*	-0.335*	-0.048*	-0.036*		-0.149*	0.236*	-0.093*	0.009	0.04*	-0.24*	0.234*
(7) *LNMB*	-0.008	-0.097*	-0.059*	0.181*	0.186*	-0.140*		-0.024*	0.188*	0.043*	-0.01	0.486*	-0.359*
(8) *TANG*	-0.065*	0.018	-0.100*	0.032*	0.039*	0.213*	-0.021*		0.292*	-0.114*	0.031*	0.006	-0.036*
(9) *CF*	0.092*	0.028*	0.084*	0.117*	0.141*	-0.107*	0.181*	0.260*		-0.034*	-0.003	0.196*	-0.153*
(10) *CF_VOL*	0.009	-0.028*	-0.006	-0.071*	-0.199*	0.000	0.039*	-0.133*	-0.066*		-0.038*	-0.068*	0.11*
(11) *BETA*	-0.014	0.524*	0.191*	0.120*	0.304*	0.026*	-0.018	0.026*	0.009	-0.055*		0.257*	-0.087*
(12) *TURNOVER*	0.003	0.017	-0.045*	0.201*	0.364*	-0.172*	0.323*	-0.007	0.138*	-0.053*	0.086*		-0.47*
(13) *STKVOL*	0.033*	0.028*	0.119*	-0.300*	-0.531*	0.229*	-0.355*	-0.029*	-0.142*	0.113*	-0.083*	-0.268*	

Panel E: This panel reports mean and median values of variables for non-derivative-user firms and derivative-user firms separately. It presents results from the tests of difference-in-means and difference-in-medians. Statistical significance at the 1, 5, and 10% level is indicated by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7) = (2) – (5)	(8) = (3) – (6)
	Non-derivative-user firms			Derivative-user firms			Difference-in-Means	Difference-in-Medians
	N	Mean	Median	N	Mean	Median		
k_d	8147	0.113	0.097	2244	0.099	0.082	0.014***	0.015***
k_e	8138	0.108	0.098	2233	0.113	0.103	-0.005***	-0.005***
WACC	8255	0.078	0.073	2250	0.067	0.062	0.011***	0.011***
FIRMSIZE	8255	8.011	7.844	2250	9.784	9.712	-1.773***	-1.868***
LEV	8255	0.231	0.212	2250	0.211	0.192	0.02***	0.02***
LNMB	8255	0.297	0.273	2250	0.74	0.734	-0.443***	-0.461***
TANG	8255	0.28	0.265	2250	0.294	0.287	-0.014**	-0.022***
CF	8255	0.059	0.056	2250	0.081	0.08	-0.022***	-0.024***
CF_VOL	8255	0.059	0.047	2250	0.052	0.042	0.007***	0.005***
BETA	8255	1	1.014	2250	1.159	1.175	-0.159***	-0.161***
TURNOVER	8255	2.333	0.449	2250	5.477	2.404	-3.144***	-1.955***
STKVOL	8255	0.551	0.557	2250	0.45	0.444	0.101***	0.113***

Table 2: Effect of derivative usage on overall cost of capital

This table presents OLS regression results in which the dependent variable (*Y*) is weighted average cost of capital (*WACC*), *DERUSER* is one if a firm uses derivatives and zero otherwise, *FIRMSIZE* is the natural log of total assets, *LEV* is total debt divided by total assets, *LNMB* is natural log of the market-to-book ratio, *TANG* is net fixed assets scaled by total assets, *CF* is the cash flow from operating activities scaled by total assets and *CF_VOL* is the standard deviation of past three years of *CF*, *BETA* is a measure of systematic risk, *TURNOVER* is stock turnover, and *STKVOL* is total stock return volatility. All continuous variables except for k_d are winsorized at the 1st and 99th percentiles. k_d is winsorized at the 1st and 95th percentiles. *t*-Statistics (in parentheses) are calculated based on heteroscedasticity-robust standard errors, which are clustered by firm. Statistical significance at the 1, 5, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 2016 to 2023.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Baseline model	Controlling for industry-year fixed effects	Clustering errors by firm and year	Fama-Macbeth (1973) regression	Median regression	Nifty50	Nifty100	Nifty200	Nifty500	Nifty Total
DERUSER	-0.006	-0.006	-0.006	-0.006	-0.006	-0.006	-0.006	-0.006	-0.006	-0.006
	(-5.416)***	(-5.298)***	(-5.232)***	(-6.785)***	(-6.265)***	(-5.435)***	(-5.371)***	(-5.607)***	(-5.449)***	(-5.659)***
FIRMSIZE	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-3.459)***	(-3.393)***	(-1.496)	(-1.596)	(-3.482)***	(-3.476)***	(-4.299)***	(-4.091)***	(-4.256)***	(-3.005)***
LEV	-0.078	-0.078	-0.078	-0.079	-0.061	-0.079	-0.085	-0.081	-0.085	-0.072
	(-30.176)***	(-30.105)***	(-8.113)***	(-8.042)***	(-23.826)***	(-30.261)***	(-31.575)***	(-31.011)***	(-31.543)***	(-28.971)***
LNMB	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(1.753)*	(1.619)	(1.485)	(2.615)**	(1.514)	(1.603)	(1.853)*	(1.524)	(1.884)*	(1.255)
TANG	-0.002	-0.002	-0.002	-0.001	0.000	-0.002	-0.003	-0.003	-0.003	-0.003
	(-0.723)	(-0.699)	(-0.637)	(-0.598)	(0.086)	(-0.713)	(-1.037)	(-1.095)	(-1.161)	(-1.047)
CF	0.040	0.040	0.040	0.039	0.046	0.040	0.039	0.040	0.039	0.039
	(9.918)***	(9.818)***	(6.873)***	(7.002)***	(11.435)***	(9.898)***	(9.491)***	(9.885)***	(9.430)***	(10.139)***
CF_VOL	-0.019	-0.018	-0.019	-0.016	-0.019	-0.019	-0.018	-0.018	-0.020	-0.018
	(-2.776)***	(-2.584)***	(-3.745)***	(-3.441)**	(-3.109)***	(-2.773)***	(-2.520)**	(-2.520)**	(-2.755)***	(-2.575)**
BETA	0.015	0.015	0.015	0.016	0.013					
	(20.220)***	(19.972)***	(5.107)***	(5.391)***	(18.207)***					
TURNOVER	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-2.809)***	(-2.801)***	(-2.027)*	(-3.118)**	(-3.150)***	(-2.745)***	(-2.869)***	(-2.915)***	(-2.898)***	(-2.564)**
STKVOL	0.025	0.025	0.025	0.023	0.020	0.025	0.025	0.024	0.025	0.023
	(8.756)***	(8.713)***	(5.584)***	(5.288)***	(7.511)***	(8.707)***	(8.631)***	(8.455)***	(8.560)***	(8.355)***
Constant	0.092	0.095	0.092	0.076	0.089	0.092	0.096	0.094	0.095	0.087
	(19.723)***	(13.999)***	(10.633)***	(6.868)***	(20.472)***	(19.621)***	(19.849)***	(19.932)***	(19.749)***	(19.483)***
Observations	10,505	10,505	10,505	10,505	10,505	10,464	10,456	10,351	10,437	10,337
Adj-R^2	0.335	0.336	0.335	0.322 (R^2)	0.330 (R^2)	0.337	0.355	0.345	0.357	0.324
Credit ratings	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES

Table 3: Effect of derivative usage on the cost of debt and cost of equity

This table presents OLS regression results in which the dependent variable (*Y*) in Columns (1)-(5) is cost of debt (k_d), defined as interest expense paid divided by total borrowings held by a firm. In Columns (6)-(10), dependent variable is cost of equity (k_e), which is computed using Capital Asset Pricing Model. *DERUSER* is one if a firm uses derivatives and zero otherwise, *FIRMSIZE* is the natural log of total assets, *LEV* is total debt divided by total assets, *LNMB* is natural log of the market-to-book ratio, *TANG* is net fixed assets scaled by total assets, *CF* is the cash flow from operating activities scaled by total assets and *CF_VOL* is the standard deviation of past three years of *CF*, *BETA* is a measure of systematic risk, *TURNOVER* is stock turnover, and *STKVOL* is total stock return volatility. All continuous variables except for k_d are winsorized at the 1st and 99th percentiles. k_d is winsorized at the 1st and 95th percentiles. *t*-Statistics (in parentheses) are calculated based on heteroscedasticity-robust standard errors, which are clustered by firm. Statistical significance at the 1, 5, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 2016 to 2023.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Baseline model	Control for industry-year fixed effects	Clustering errors by firm and year	Fama-Macbeth (1973) regression	Median regression	Baseline Model	Control for industry-year fixed effects	Clustering errors by firm and year	Fama-Macbeth (1973) regression	Median regression
	$Y = k_d$	$Y = k_d$	$Y = k_d$	$Y = k_d$	$Y = k_d$	$Y = k_e$	$Y = k_e$	$Y = k_e$	$Y = k_e$	$Y = k_e$
DERUSER	-0.009	-0.008	-0.009	-0.009	-0.009	0.000	0.000	0.000	0.000	0.000
	(-2.933)***	(-2.810)***	(-3.431)**	(-4.239)***	(-5.738)***	(0.806)	(0.568)	(0.368)	(0.542)	(0.015)
FIRMSIZE	0.001	0.001	0.001	0.001	0.001	-0.000	-0.000	-0.000	-0.000	0.000
	(1.332)	(1.345)	(1.274)	(1.382)	(2.141)**	(-1.424)	(-1.357)	(-0.390)	(-1.467)	(0.009)
LEV	-0.167	-0.167	-0.167	-0.167	-0.053	0.002	0.003	0.002	-0.000	-0.000
	(-17.833)***	(-17.843)***	(-10.837)***	(-11.284)***	(-11.218)***	(2.615)***	(3.014)***	(0.798)	(-1.584)	(-0.031)
LNMB	0.000	0.000	0.000	0.000	-0.000	-0.001	-0.001	-0.001	-0.000	-0.000
	(0.184)	(0.015)	(0.191)	(0.222)	(-0.617)	(-6.801)***	(-6.807)***	(-2.056)*	(-0.825)	(-0.080)
TANG	-0.009	-0.010	-0.009	-0.010	0.003	-0.002	-0.002	-0.002	-0.000	-0.000
	(-1.165)	(-1.213)	(-1.091)	(-1.625)	(0.587)	(-2.075)**	(-2.489)**	(-3.172)**	(-0.735)	(-0.022)
CF	0.120	0.118	0.120	0.116	0.107	0.001	0.002	0.001	-0.000	-0.000
	(7.315)***	(7.141)***	(6.407)***	(6.865)***	(14.023)***	(0.713)	(0.958)	(0.441)	(-0.112)	(-0.003)
CF_VOL	0.006	0.007	0.006	0.007	-0.045	0.000	-0.001	0.000	-0.000	0.000
	(0.212)	(0.260)	(0.209)	(0.276)	(-3.403)***	(0.128)	(-0.233)	(0.083)	(-0.744)	(0.004)
BETA						0.043	0.043	0.043	0.049	0.026
						(118.949)***	(118.479)***	(4.144)***	(3.932)***	(692.413)***
TURNOVER						-0.000	-0.000	-0.000	-0.000	-0.000
						(-1.373)	(-1.071)	(-0.568)	(-0.673)	(-0.055)
STKVOL	0.050	0.051	0.050	0.049	0.038	0.002	0.002	0.002	0.000	0.000
	(5.262)***	(5.363)***	(3.423)**	(3.114)**	(7.235)***	(1.577)	(1.598)	(0.509)	(0.359)	(0.025)
Constant	0.110	0.123	0.110	0.077	0.087	0.116	0.102	0.116	0.061	0.130
	(7.958)***	(10.023)***	(5.858)***	(3.745)***	(11.899)***	(62.345)***	(19.856)***	(12.620)***	(12.626)***	(92.855)***
Observations	10,391	10,391	10,391	10,391	10,391	10,371	10,371	10,371	10,371	10,371
Adj-R^2	0.093	0.093	0.093	0.112 (R^2)	0.061 (R^2)	0.859	0.863	0.859	1.0 (R^2)	0.816 (R^2)
Credit ratings	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	NO	YES	YES	YES	YES	NO	YES

Table 4: Endogeneity

This table presents results from different endogeneity tests. The dependent variable is cost of debt (k_d), which is defined as the interest expense divided by total borrowings of a firm. *DERUSER* is one if a firm uses derivatives and zero otherwise, *POST* is one for year 2020 and zero for year 2017, *FIRMSIZE* is the natural log of total assets, *SALES* is annual sales divided by total assets, *TANG* is net fixed assets scaled by total assets, *ZSCORE* is Altman (1968) z-score, *RND* is R&D expenditure divided by total assets, *FRGNSALES* is one if a firm has foreign sales and zero otherwise, *LEV* is total debt divided by total assets, *DIV_DUMMY* is one if a firm pays dividend and zero otherwise, *FRGNDEBT* is one if a firm has foreign debt and zero otherwise, *LNMB* is natural log of the market-to-book ratio, *CF* is the cash flow from operating activities scaled by total assets, *CF_VOL* is the standard deviation of past three years of *CF*, IV_1 is export earnings scaled by total assets, and IV_2 is one if firm has foreign institutional investors and zero otherwise. All continuous variables except for k_d are winsorized at the 1st and 99th percentiles. k_d is winsorized at the 1st and 95th percentiles. *t*-Statistics (in parentheses) are calculated based on heteroscedasticity-robust standard errors, which are clustered by firm. For the treatment-effects model, the standard errors are calculated using bootstrapping method. Statistical significance at the 1, 5, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 2016 to 2023.

	(1)	(2)	(3)	(4)	(5)	(6)
	Treatment-effects model		2SLS		Difference-in-difference	Matched-sample
	First-stage	Second-stage	First-stage	Second-stage		
DERUSER		-0.029		-0.080	0.003	-0.007
		(-6.720)***		(-4.752)***	(0.406)	(-1.924)*
DERUSER × POST					-0.019	
					(-2.331)**	
POST					0.010	
					(1.431)	
FIRMSIZE	0.310	0.003	0.078	0.007	0.001	0.002
	(26.486)***	(4.866)***	(24.838)***	(4.357)***	(0.389)	(1.475)
SALES	-0.055					
	(-1.010)					
ZSCORE	0.185					
	(4.589)***					
RND	0.121					
	(5.483)***					
FRGNSALES	0.603					
	(15.312)***					
DIV_DUMMY	0.274					
	(6.325)***					
FRGNDEBT	0.511					
	(10.438)***					
LEV	0.312	-0.168	0.035	-0.162	-0.048	-0.168
	(2.179)**	(-21.982)***	(1.459)	(-16.345)***	(-2.457)**	(-11.453)***
LNMB		0.001	0.014	0.002	0.001	0.001
		(0.582)	(3.464)***	(1.357)	(0.454)	(0.316)
TANG	-0.025	-0.010	-0.043	-0.015	-0.031	-0.027
	(-0.259)	(-1.792)*	(-1.865)*	(-1.760)*	(-1.745)*	(-2.228)**
CF		0.125	0.011	0.127	0.105	0.116
		(6.996)***	(0.224)	(7.575)***	(2.630)***	(4.410)***

CF_VOL		0.001	0.052	0.013	-0.048	-0.088
		(0.033)	(0.646)	(0.457)	(-0.726)	(-2.498)**
STKVOL		0.052	-0.135	0.042	-0.006	0.053
		(5.700)***	(-3.982)***	(4.046)***	(-0.256)	(3.302)***
IV_1			0.345			
			(22.307)***			
IV_2			0.022			
			(2.239)**			
Constant	-4.641	0.097	-0.535	0.068	0.084	0.135
	(-36.369)***	(8.486)***	(-11.426)***	(4.095)***	(3.348)***	(4.750)***
Observations	9,950	9,950	10,285	10,285	312	3,876
Adj-R^2	-	-	0.265	0.021	0.077	0.100
Credit ratings	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	-	YES
Year FE	YES	YES	YES	YES	-	YES

Table 5: Financial constraints

This table presents OLS regression results in which the dependent variable (*Y*) is cost of debt (k_d), defined as interest expense paid divided by total borrowings held by a firm, *DERUSER* is one if a firm uses derivatives and zero otherwise, *FIRMSIZE* is the natural log of total assets, *LEV* is total debt divided by total assets, *LNMB* is natural log of the market-to-book ratio, *TANG* is net fixed assets scaled by total assets, *CF* is the cash flow from operating activities scaled by total assets and *CF_VOL* is the standard deviation of past three years of *CF*, *BETA* is a measure of systematic risk, *TURNOVER* is stock turnover and *STKVOL* is total stock return volatility. The full sample is divided into two subsamples based on different measures of financial constraints. All continuous variables except for k_d are winsorized at the 1st and 99th percentiles. k_d is winsorized at the 1st and 95th percentiles. *t*-Statistics (in parentheses) are calculated based on heteroscedasticity-robust standard errors, which are clustered by firm. Statistical significance at the 1, 5, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 2016 to 2023.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Short-term liquidity		Cash holdings		Kaplan and Zingales (1997) Index		Altman's Z-score	
	High	Low	High	Low	Low	High	High	Low
DERUSER	-0.006	-0.009	-0.004	-0.011	-0.003	-0.010	-0.005	-0.012
	(-0.937)	(-2.887)***	(-0.734)	(-3.075)***	(-0.572)	(-2.072)**	(-1.096)	(-4.018)***
FIRMSIZE	0.002	0.002	0.003	0.002	0.003	0.005	0.000	0.001
	(1.359)	(1.106)	(2.100)**	(1.719)*	(1.605)	(2.432)**	(0.286)	(1.304)
LEV	-0.195	-0.129	-0.159	-0.163	-0.240	-0.149	-0.239	-0.132
	(-12.415)***	(-11.282)***	(-12.537)***	(-10.934)***	(-7.751)***	(-8.261)***	(-13.915)***	(-12.524)***
LNMB	0.000	0.001	0.000	0.001	0.005	0.000	-0.001	0.001
	(0.135)	(0.366)	(0.007)	(0.300)	(1.091)	(0.024)	(-0.622)	(0.934)
TANG	-0.013	-0.005	-0.020	0.002	-0.008	-0.017	-0.030	-0.004
	(-1.080)	(-0.585)	(-2.077)**	(0.128)	(-0.390)	(-1.215)	(-2.154)**	(-0.496)
CF	0.122	0.125	0.114	0.136	0.161	0.090	0.146	0.100
	(4.704)***	(6.807)***	(5.541)***	(4.785)***	(4.868)***	(3.336)***	(5.864)***	(5.522)***
CF_VOL	0.068	-0.065	-0.025	0.055	0.042	-0.071	0.002	0.014
	(1.490)	(-2.353)**	(-0.767)	(1.155)	(0.590)	(-1.444)	(0.039)	(0.460)
STKVOL	0.049	0.047	0.050	0.042	0.037	0.046	0.060	0.040
	(3.544)***	(3.561)***	(3.831)***	(2.746)***	(1.698)*	(2.772)***	(3.984)***	(3.290)***
Constant	0.094	0.117	0.096	0.102	0.088	0.092	0.121	0.111
	(4.006)***	(6.801)***	(4.931)***	(5.310)***	(3.373)***	(3.559)***	(5.144)***	(7.237)***
Observations	4,481	4,555	4,480	4,548	2,541	2,486	5,162	5,208
Adj-R^2	0.089	0.110	0.096	0.098	0.102	0.091	0.095	0.109
Credit ratings	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Table 6: Corporate investments

This table presents OLS regression results in which the dependent variable (*Y*) in Columns (1) and (2) is the amount spent on the purchase of fixed assets and the amount spent on acquisition. In Column (3), *Y* is R&D spending scaled by total assets and in Column (4), *Y* is R&D spending divided by sales. *DERUSER* is one if a firm uses derivatives and zero otherwise, *FIRMSIZE* is the natural log of total assets, *LEV* is total debt divided by total assets, *LNMB* is natural log of the market-to-book ratio, *TANG* is net fixed assets scaled by total assets, *CF* is the cash flow from operating activities scaled by total assets, *CF_VOL* is the standard deviation of past three years of *CF*, *BETA* is a measure of systematic risk, *TURNOVER* is stock turnover, and *STKVOL* is total stock return volatility. All continuous variables are winsorized at the 1st and 99th percentiles. *t*-Statistics (in parentheses) are calculated based on heteroscedasticity-robust standard errors, which are clustered by firm. Statistical significance at the 1, 5, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 2016 to 2023.

	(1)	(2)	(3)	(4)
Y →	Purchase of fixed assets/Total assets	Amount spent on acquisition/Total assets	R&D/Total assets	R&D/Total sales
DERUSER	0.002	0.000	0.115	0.125
	(1.047)	(1.057)	(2.878)***	(2.176)**
FIRMSIZE	-0.004	0.000	0.019	0.048
	(-6.724)***	(0.674)	(1.640)	(2.715)***
LEV	-0.007	-0.000	-0.450	-0.615
	(-1.386)	(-0.284)	(-5.451)***	(-5.197)***
LNMB	0.009	-0.000	0.081	0.079
	(11.085)***	(-0.745)	(5.694)***	(3.849)***
TANG	0.055	-0.000	-0.077	-0.178
	(11.317)***	(-0.990)	(-0.989)	(-1.476)
CF	0.053	-0.000	0.107	-0.119
	(6.875)***	(-0.362)	(0.947)	(-0.762)
CF_VOL	-0.008	-0.000	-0.616	-1.089
	(-0.595)	(-0.990)	(-2.980)***	(-4.287)***
BETA	-0.000	-0.000	-0.004	-0.051
	(-0.096)	(-1.334)	(-0.163)	(-1.238)
TURNOVER	0.000	0.000	0.011	0.017
	(1.861)*	(0.613)	(3.020)***	(3.254)***
STKVOL	-0.013	-0.000	-0.260	-0.240
	(-2.323)**	(-1.473)	(-2.894)***	(-2.268)**
Constant	0.032	0.000	0.180	0.074
	(3.798)***	(0.677)	(1.492)	(0.501)
Observations	7,645	7,579	7,646	7,636
Adj-R^2	0.185	0.009	0.134	0.118
Credit ratings	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Table 7: Investment efficiency

This table presents OLS regression results in which the dependent variables (*Y*) in Columns (1) and (2) are under-investment and over-investment, respectively. *DERUSER* is one if a firm uses derivatives and zero otherwise, *FIRMSIZE* is the natural log of total assets, *LEV* is total debt divided by total assets, *CF* is the cash flow from operating activities scaled by total assets, *LNTOBINQ* is the natural log of firm value (*TOBINQ*), and *DIVIDEND* is dividend paid by firm scaled by total assets. All continuous variables are winsorized at the 1st and 99th percentiles. *t*-Statistics (in parentheses) are calculated based on heteroscedasticity-robust standard errors, which are clustered by firm. Statistical significance at the 1, 5, and 10% level is indicated by ***, **, and *, respectively. The sample period is from 2016 to 2023.

	(1)	(2)	(3)	(4)
	Sales Growth		Tobin's Q	
Y →	Under-investment	Over-investment	Under-investment	Over-investment
DERUSER	0.030	-0.275	-0.029	-0.520
	(0.304)	(-2.730)***	(-0.312)	(-4.328)***
FIRMSIZE	-0.047	-0.011	-0.027	-0.010
	(-1.804)*	(-0.378)	(-1.057)	(-0.297)
LEV	0.807	-0.567	0.834	0.420
	(8.535)***	(-4.394)***	(9.082)***	(2.922)***
CF	3.861	-2.423	4.120	-3.744
	(8.833)***	(-4.795)***	(9.959)***	(-6.843)***
LNTOBINQ	1.543	-0.221	1.348	-0.144
	(5.972)***	(-0.760)	(5.492)***	(-0.410)
DIVIDEND	-2.895	1.287	-2.234	1.015
	(-1.751)*	(0.711)	(-1.435)	(0.493)
Constant	-2.089	-1.394	-1.939	-2.101
	(-5.109)***	(-3.677)***	(-5.089)***	(-4.957)***
Observations	7,396	7,396	7,455	7,455
Credit ratings	NO	NO	NO	NO
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES