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The effect of option trading

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Abstract

This paper studies the effect of option trading on corporate investment and financing policies. Based on prior literature, I hypothesize that option market induces informed trading and thus reduces information asymmetry and the cost of capital. As a result, firms with high option trading have more investment and financing. Specifically, based on the United States public data, this paper finds that option trading volume increases corporate investment and financing, but reduces cash holdings and corporate payouts. These results are robust to the inclusion of industry or firm fixed effect, a control for endogenous options trading, and the use of alternative measures of option trading and corporate policies. The effect of option trading is stronger for firms with higher information asymmetry problems. Finally, this paper finds the results are inconsistent with the "quiet Life" hypothesis and the catering hypothesis.

Keywords: Option trading, Corporate policies, Investment and financing

JEL Classification: G14, G31, G32, G35

Introduction

This paper studies one key section of financial market, namely, financial derivatives. It is well recognized that option markets are a venue for informed trading (e.g. Black 1975; Easley et al. 1998; Bali and Hovakimian 2009; Cremers and Weinbaum 2010; Roll et al. 2009; Xing et al. 2010; Johnson and So 2012; An et al. 2014; Hu 2014). In addition, option trading has been exponentially growing since the establishment of the Chicago Board Options Exchange in 1973. Option markets experienced an enormous proliferation, ranging from equity options to credit derivatives. The total equity option trading has grown from 1.12 million contracts in 1973 to over 3.69 billion contracts in 2017 (The Option Clearing Corporation).[1]

Does the increase in the volume of option trading encourage or impede corporate investment and financing? This study hypothesizes that the increasing in option trading driven by informed investors improves equity efficiency for the underlying stock by increasing the amount of private information in equity prices (e.g. Figlewski and Webb 1993). As a result, option trading reduces the level of information asymmetry in the underlying stock by transferring private information to uninformed investors and thus reduces the cost of capital.[2] The reduction in the cost of capital increases the profitability

[1] http://www.optionsclearing.com.

[2] Theoretical evidence shows that an increase in information asymmetry increases the cost of capital, see, for example, Stiglitz and Weiss (1981), Myers and Majluf (1984), Diamond (1985), Merton (1987), Lucas and McDonald (1990), Botosan (1997), and Easley and O'Hara (2004).

of projects, as well as the optimal amount of investment. At the same time, the demand and the optimal amount of external financing increase as the cost reduces. For example, a firm has a choice of two positive NPV projects: Project A and Project B. The only difference is that Project A has higher expected return. The firm will choose Project A and abandon Project B due to financial constraint. When the rise of option trading reduces information asymmetry and the cost of capital, this can raise more capital and Project B will be funded. In summary, an increase in option trading causes an uprising in investment and financing.

The main hypothesis relies on the foundation laid by Easley and O'Hara (2004). They provide theoretical framework that uninformed investors are disadvantaged since informed investors are able to take advantage on their private information by shifting their portfolio to incorporate new information. They will require higher returns to hold stocks with a greater amount of private information, thus increase the cost of capital. Moreover, recent empirical studies provide empirical evidence that option trading improves informational efficiency in the underlying stock prices (e.g. Pan and Poteshman 2006), as well as the cost of capital (e.g. Naiker et al. 2012). In this paper, this paper provides empirical evidence for the resulting of the hypothesis: an increase in option trading leads to an improvement in investment and financing through the reduction of information asymmetry and the cost of capital.

To test this hypothesis, this paper assembles a large dataset containing time-varying information on option trading, and fundamentals on U.S. firms. To measure total option trading activities, this paper uses average option volume as the main proxy. Option trading volume represents the extent of informed investors' participation and the richness in the information environment (Roll et al. 2009). Therefore, firms with high options trading volume should experience greater informational efficiency. This paper runs panel data regressions on a sample of 3411 publicly traded U.S. firms in the period between 1996 and 2017. This paper commerces the analysis by employing a cross-sectional framework that regresses investment and financing measures on option volume in firms with listed options in the sample. The baseline test shows that there is a positive relation between option trading and the level of investment and financing activities. Specifically, this paper shows that there is a large improvement in total investment and total financing, and a large reduction in cash holdings and total payout in firms with high option trade volume. The positive correlation indicates a significant connection between option trading and corporate policies. These results are robust to the inclusion of various control variables including the book-to-market ratio, firm size, momentum, leverage, ROA, analyst coverage, and institutional ownership. The results are also robust after controlling for industry or firm fixed effect, endogenous option trading using two-stage least squares, or reverse causality.

To verify the results, this paper also examines the option trading effect on alternative measures of corporate investment, financing, and payout. For corporate investment, this paper finds that the growth in total asset is significantly higher for firms with high option trading. Furthermore, the growth in current asset and long-term asset experiences similar patterns. For corporate financing, following Stephens and Weisbach (1998) and Pontiff and Woodgate (2008), this paper constructs the annual issuance measures based on CRSP-reported shares outstanding, as well as the seasonal equity offering (SEO) data in

the Thomason Reuter SDC Global Issuance database. The results are qualitative similar to the main results. For corporate payout, this paper uses the CRSP data to construct the dividend payout measure and find consistent results.

While these results are consistent with the hypothesis that option trading affects corporate investment and financing, there are concerns that these results could be biased if informed investors from option markets trade based on unobservable characteristics that are correlated with corporate policies. For example, the increasing of corporate investment and financing can be driven by corporate managers' private information set, which indicates future investment opportunities. Option traders also obtain the same information from their private sources and increase the trading pressure on both call and put options. Therefore, future firm investment opportunities are likely to confound the relationship between option trading and corporate policies. In addition, option traders may open their positions because they follow the decisions made by corporate managers. To capture these profitable opportunities, option traders will trade according to the same direction as these decisions. This creates a significant concern that the baseline results are endogenous because unobservable firm characteristics are correlated with both option trading and corporate policies, or corporate policies induce option trading.

To verify that the main findings are not driven by these biases, this paper implements two different statistic tests. First, this paper use propensity score matching (PSM) to study whether firms with high option trading would have make different corporate decisions if they had not had high trading volume. Second, I estimate a two-least squares (2SLS) model using moneyness and open interest as instrumental variables. In summary, the identification tests indicate that the positive correlation between option trading and corporate investment (and financing), as well as the negative relation between option trading and payout (and cash holdings).

Next, this paper examines how the effect of option trading varies by the level of information asymmetry. If option trading increases equity price efficiency by incorporating private information and reducing information asymmetry, then the effect of option trading on corporate investment and financing decisions should be stronger for firms with higher information asymmetry. Using five different proxies from Kelly and Ljungqvist (2012), this paper finds consistent results with this prediction. This paper also tests how the effect of option trading depends on financial constraints. If the cost of capital reduces when informed option trading is more active, then the change in option activities should have stronger effect on corporate investment and financing decisions for firms that are financially constrained. On the other hand, for firms without the need to raise capital, option trading is irrelevant to corporate policies. Using different index proxies of financial constraints, this paper finds some supporting evidence that option trading indeed has a significant effect on firms with high financial constraints, but no effect on firms with low financial constraints.

This paper considers two alternative interpretations for the patterns in the sample. One possibility is that corporate managers prefer "quiet life" in their careers and avoid take risky projects to maximize shareholders' wealth. Option trading may serve as a monitoring mechanism that force corporate managers to take actions, such as increasing investment and financing. However, the results indicate that market competition and corporate governance have no significant effect on the relation between option trading

and corporate policies. Another possible explanation is corporate managers cater to equity price deviations from fundamental value, especially when the expected duration of mispricing is long and shareholders have short investment horizons. Managers change their investment and financing decisions in the direction of equity mispricing. In regression tests, option trading does not have a stronger impact on corporate policies in firms that are more subjected to equity mispricing (high R&D intensity and stock turnover).

The rest of the paper is organized as follows. "Related literature and hypothesis development" section reviews the literature and develops hypothesis. "Data and measures" section presents the sample data and summary statistics. "The effect of option trading on corporate policies" section shows the main tests and robustness checks. "The underlying economic mechanism" section offers test different possible explanations. "Conclusion" section concludes.

Related literature and hypothesis development

The finance literature has long recognized that option market attracts informed investors. Black (1975) first states that informed traders could trade on option market to achieve higher leverage opportunities. Ross (1976) states that information trading in option market can expand the contingencies that are covered by equity market. Diamond and Verrecchia (1987) and Mayhew et al. (1995) argue that informed investors will choose option market over stock market due to higher leverage and lower transaction costs in trading options. Easley et al. (1998) formalize an asymmetric information model in which informed traders choose to trade in the stock or option markets when the leverage and liquidity of the options are sufficiently high. They also argue that the availability of multiple option contracts creates barriers in learning trading options for uninformed traders, and informed traders are likely to choose option market. Cao (1999) suggests that informed traders can trade more effectively on their information using options, which improves efficiency in equity prices. In fact, Figlewski and Webb (1993) documents that option trading mitigates the effect of short sale constraints, which improves informational and transactional efficiency of stock markets.

Several academic studies suggest that option trading facilitates a channel through which informed investors incorporate private information into equity prices, and active trading on this kind of information can make stock prices more efficient. Amin and Lee (1997) and Cao et al. (2005) find evidence of informed trading in the option markets prior to earnings and takeover announcements. Easley et al. (1998) and Pan and Poteshman (2006) find that options order flow contains information about the future direction of the underlying stock price. Chakravarty et al. (2004) find that option market provides an average of 17 percent of information discovery in equity prices. Bali and Hovakimian (2009) and Cremers and Weinbaum (2010) find that changes in option prices or volatility can predict the underlying equity price movements. Truong and Corrado (2014) find that higher abnormal options trading volume around earnings announcements speeds up the stock price adjustment to earnings news and thus reduce post-earnings announcement drift.

Formally, Easley and O'Hara (2004) developed a multi-asset rational expectation equilibrium model that incorporate public and private information, as well as informed and uninformed investors. The model reveals that in equilibrium the quantity and quality

of information affect asset prices, resulting in cross-sectional differences in the firms' cost of capital. Specifically, informed investors can better shift their portfolio to incorporate new information. Uninformed investors tend to hold too much of stocks with bad new, and too little of stocks with good news because they are always on the wrong side. The difference in information between informed and uninformed investors results in a higher risk for uninformed investors. Thus, private information induces a new form of systematic risk, and average investors require extra returns for this risk. If option traders with private information engage in active trading, the rise in option volume reduces the asymmetric information problems and lead to more efficient equity prices. As a result, firms with high option trading volume are associated with a lower cost of equity capital. In fact, a recent study by Naiker et al. (2012) documents that firms with listed option have lower implied cost of equity capital than firm without listed option. Moreover, for firms with listed option, firms with higher option trading volume tend to have lower implied cost of equity capital. If some investment projects have a minimum efficient scale, then the reduction in the cost of capital can make these projects more attractive for corporate managers and external investors, thus increases the scale of corporate investment and issuance. This leads to the main hypothesis:

> **Hypothesis**: Corporate investment and financing increase with the amount of option trading volume.

This paper also related to the recent literature on the real effects of a variety of shocks derived from credit or stock markets. Theoretically, Dow and Gorton (1997) and Subrahmanyam and Titman (1999) argue that stock prices aggregate information from different participants including informed traders. Managers who may not have all this information can learn from equity market and use it to guide their decisions, such as investments.[3] In models by Fishman and Hagerty (1992), Dow and Gorton (1997), and Goldstein and Guembel (2008), decision makers may learn from market prices to guide their actions. Empirically, Baker et al. (2003) show that stock prices affect the investment decisions of equity-dependent firms. Using an equity index, they find that equity-dependent firms' investments are almost three times as sensitive to stock prices compared to nondependent firms. Chen et al. (2007) document that firm managers learn from stock price about their own firms' fundamentals and incorporate this information in the corporate investments. Sufi (2007) finds the effect of introduction of bank loan ratings on the use of debt and the increment in asset growth, cash acquisitions, and investment in working capital. Similarly, Tang (2009) shows that Moody's (1982) credit rating refinement affects debt issuance and debt dependence. Using mutual fund flows as an exogenous shock, Edmans et al. (2012) document a casual effect of equity prices on takeover decisions. Duchin et al. (2010) find that financial shocks have a negative effect on corporate investment based on the financial crisis that began in August 2007.

However, there is a limited study on the real effect of option trading on corporate policies. Two noble exceptions are the recent paper by Blanco and Wehrheim (2017) and Barton (2001). Blanco and Wehrheim (2017) find a positive relation between option trading volume and corporate innovation. Using the disclosed notional amount of

[3] See also Dye and Sridhar (2002), Dow and Rahi (2003), and Goldstein and Guembel (2008).

interest rate and foreign currency derivatives scaled by lagged total asset, Barton (2001) examines the relation between a firm's usage of option hedging and earnings management. Different from his study, this study find the monitoring effect of option trading on earnings manipulation.

Data and measures

The sample consists of U.S. public firms from 1996 to 2017 with relevant accounting information from Compustat, return information from the Center for Research in Securities Prices (CRSP), financial analyst data from the Institutional Brokers Estimate System (I/B/E/S) database, option trading data from OptionMetrics database, and institutional holdings data from Thomson's CDA/Spectrum database (form 13F). This paper identifies all firms listed firms traded on NYSE, Amex, or Nasdaq. To mitigate backfilling or survival bias, this paper requires firms to be listed on Compustat for at least two years before including them in the sample. The sample removes foreign firms, firms with missing industry SIC code, firms with missing values in sales, total asset, and net income before extraordinary items, and firms with equity prices less than $l. In addition, financial firms and utility firms are eliminated as they are heavily regulated.

This paper examine the relation between firm investment and issuance and option trading activity. This paper measures firms' corporate decisions at the end of each fiscal year and option trading during each calendar year. Specifically, firms in Compustat database at the end of fiscal year are matched with option trading volume during the same year in OptionMetrics.

Corporate police measures

To measure corporate policies, this paper uses four groups of measures, including investment, financing, payouts, and the change in cash holdings. For investment, this paper focuses on capital, research and development, acquisitions, and total investment. Capital investment (*CapEx*) is defined as total capital expenditure scaled by total asset at the beginning of fiscal year. Research and development investment (*R&D*) is total R&D expenditure over total asset at the beginning of fiscal year. Acquisitions (*Aqc*) investment is total acquisitions expenditure divided by total asset at the beginning of fiscal year. *Total Investment* is the summation of *CapEx*, *R&D*, and *Aqc*. The second group is financing measures, including total financing, equity financing, and debt financing. Equity financing (*Equity Issuance*) is total sale of common and preferred stocks over total asset at the beginning of fiscal year. Debt financing (*Debt Issuance*) is total change in current debt plus long-term debt issuance minus long-term debt reduction scaled by total asset at the beginning of fiscal year. Total financing (*Total Issuance*) is the summation of equity financing and debt financing. To measure payouts, this paper uses dividend payout, share repurchase, and total payout. Dividend payout (*Dividend*) is total cash dividend paid over total asset at the beginning of fiscal year. Share repurchase (*Repurchase*) is purchase of common and preferred stock over total asset at the beginning of fiscal year. Total payout (*Payout*) is the summation of dividend payout and share repurchase. The change in cash holdings ($\Delta Cash$) is the increase or decrease in cash and cash equivalents scaled by total asset at the beginning of fiscal year. In the section of robustness tests, this paper examines the main results using different measures of corporate policies.

Option trading and control measures

Option trading information is from the OptionMetrics database. The database has information on the daily volume and the daily bid-and-ask closing prices of each individual option (put or call) on the U.S. public firms. In this paper, this paper focuses on one measure of option volume (*Option Volume*), which is the average of the number of option trading in each day of each year across all trading days and all options listed on the stock. This measure aggregates call and put trading volume. Although this paper could examine the breakdown of call and put options with different times to maturity, the hypotheses are not clear. As Roll et al. (2009) note, while it may be the case that managers are more likely to act on "good news"than on "bad news," calls and puts can be bought and sold freely. Thus, in the absence of information on the signed order imbalance (data we unfortunately lack), disaggregating calls and puts cannot be unambiguously linked to managerial investment decisions. In addition, this paper follows Roll et al. (2009) and use the total annual dollar option volume (*Dollar Volume*). Specifically, this paper multiplies the total number of trade in each option by the average of the end-of-day bid and ask prices. Then this paper averages this number annually across all trading days and all options listed on the stock.

The independent variables are firm size (*Size*), *BM*, *Momentum*, *Leverage*, *ROA*, *Age*, *CashFlow*, the number of analyst following (*Num*), institutional ownership (*IO*). Firm size (*Size*) is the log value of market capitalization. *BM* is the book to market ratio of firm equity. Following Novy-Marx (2012), momentum returns (*Momentum*) is the cumulative monthly returns between *t-7* to *t-12*. *Leverage* is total liability over total asset. *ROA* is net income over total asset. *Age* is the number of years listed on Compustat. *CashFlow* is Earnings before extraordinary items and discontinued operations plus depreciation expenditure over total asset. The number of analyst following (*Num*) is the average numbers of earnings forecasts made by analysts over the year. Institutional ownership (*IO*) is the average percentage of common share held by institutional investors over the year from Thomson Financial's Institutional 13(f) filings. All variable definitions are summarized in "Appendix" section. All variables are winsorized at the top and bottom 1% percentile to remove outlier problems (expect for *Option Volume*, *Num*, and *IO*).

Summary statistics

Table 1 reports summary statistics of the main variables used in this study. Panel A presents the statistics for different corporate policy measures. Consistent with prior studies (e.g. Derrien and Kecskés 2013), investment cost is a significant portion in corporations. The average capital expenditure is about 5.8% of total asset with a standard deviation of 6.1%. Similarly, the average R&D expenditure is 4.9%, and acquisition expenditure is 2.6% of total asset. After adding all expenditures, the average value of total investment is 14.5% of total asset. For financing activity, the mean equity issuance is 4.6%, where the mean debt issuance is 1.3% of total asset. Total issuance is about 5.9%. For payout activity, dividend payout is 1.2% and repurchase is 2.2% of total asset. This is consistent with the recent literature that repurchase increasingly becomes a popular mechanism in distributions than dividends (e.g. Brav et al. 2005). For cash activity, the average change in cash holdings is −0.6% of total asset.

Table 1 Summary statistics of firm characteristics

Variables	Mean	SD	Q1	Median	Q3
Panel A: Corporate policies					
Investment measures					
CapEx	0.058	0.061	0.020	0.039	0.073
R&D	0.049	0.088	0	0.007	0.065
Aqc	0.026	0.060	0	0	0.018
Total investment	0.145	0.112	0.066	0.118	0.194
Financing measures					
Equity	0.046	0.135	0	0.005	0.020
Debt	0.013	0.086	− 0.015	0	0.027
Total financing	0.059	0.156	− 0.005	0.014	0.067
Payout measures					
Dividend	0.012	0.022	0	0	0.015
Repurchase	0.022	0.041	0	0	0.025
Total payout	0.034	0.049	0	0.011	0.047
Change in cash holdings					
ΔCash	− 0.006	0.151	− 0.043	0.002	0.043
Panel B: Option trading and control variables					
Option volume	12.048	35.826	0.085	2.887	9.425
Dollar volume	30.164	118.56	1.202	4.961	18.845
Size	7.285	1.685	6.088	7.165	8.399
BM	0.515	0.448	0.240	0.402	0.646
Mom	0.038	0.341	− 0.140	0.049	0.218
ROA	0.007	0.177	− 0.004	0.046	0.087
Age	23.944	16.918	10	18	35
Leverage	0.478	0.215	0.311	0.487	0.632
CashFlow	0.008	0.174	− 0.002	0.046	0.086
Num	9.594	7.263	4	7	13
IO	0.443	0.359	0.003	0.477	0.774

Panel B presents the statistics for different option trading and other control variables. Consistent with prior literature, option volume is skewed to right with mean (median) of 12.048 (2.887). Similar distribution can be found in *Dollar Volume*. Other control variables are similar to prior literature. The average Size is 7.285 and BM is 0.515, which indicates that the sample firms have high market valuation. These firms have average *Mom* of 0.038, *ROA* of 0.007, *Age* of 23.944, *Leverage* of 0.478, and *CashFlow* of 0.008. The sample has an average analyst coverage of 9.594, and institutional ownership of 0.443.

The effect of option trading on corporate policies

This section studies whether option trading affects corporate decisions. This paper begins by studying the general relation between option trading and different corporate policy measures. Then this paper examines the results in different robustness checks.

Baseline specification

This paper now examines the effect of option trading on corporate policies. To begin my analysis, this paper presents the simple relation between option trading volume and corporate policies. Specifically, for each year, all firms are grouped into quintiles

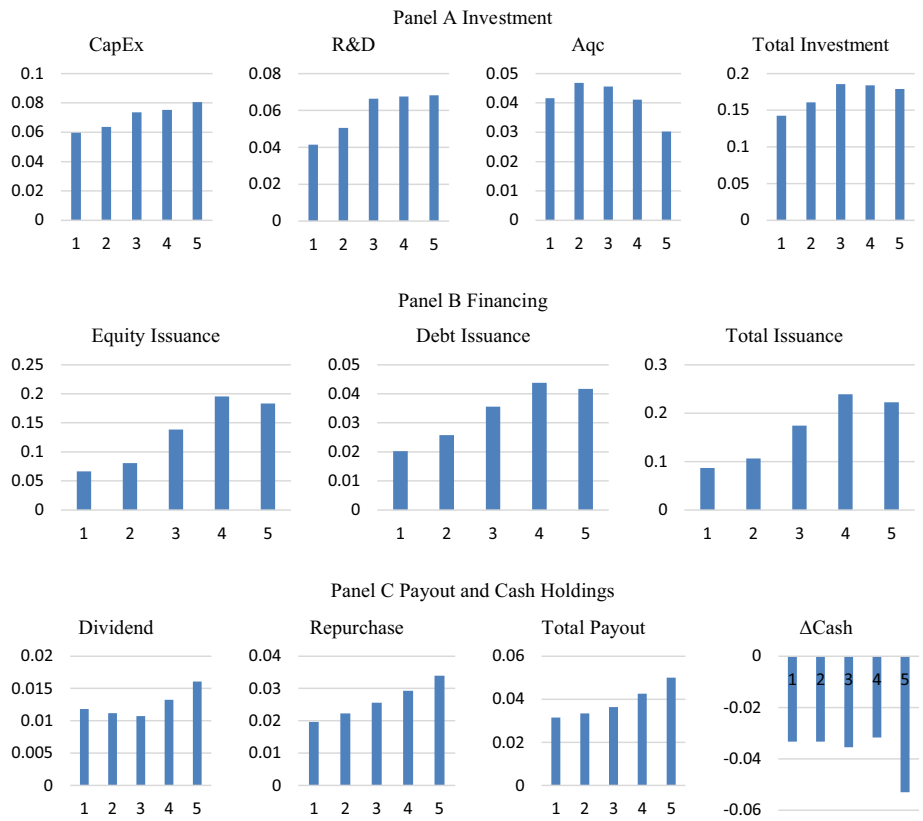

Fig. 1 Corporate policies in options trading quintiles. This figure presents the mean value of each capital police measure employed in this study over all sample years within each quintile of options trading volume. Observations are assigned into the quintiles based on options trading volume on each year, where quintile 1 contains observations with the lowest option trading volume and quintile 5 captures observations with the highest option trading volume

based on the ranking of option trading volume. Then this paper computes the mean value of difference measures of corporate policies for each quantile. Figure 1 presents, for each of corporate police proxies, the mean value across all five quintiles of option trading volume. In Panel A, this paper finds that most measures of investment (except for *Aqc*) increase monotonically moving from the lowest option volume quintile to the highest option volume quintile. Similar patterns are showed in Panel B and C, which indicates that option trading has a monotonically positive relation with financing, as well as a negative relation with payout and cash holdings. Despite the large positive skewness in options trading volume seen in Table 2, our subsequent empirical results are unlikely to be driven exclusively by observations in the highest option volume quintile.

To further assess whether option trading increase, or decrease, corporate policies, this paper uses the following specification for the regression model:

$$CorporatePolicies_{i,t} = a_0 + a_1 Log(OV)_{i,t} + a_2 X_{i,t} + Firm_i + Year_t + Error_{i,t}, \quad (1)$$

where *Corporate Policies* are different measures of corporate decisions including *CapEx*, *R&D*, *Aqc*, *Total Investment*, *Equity Issuance*, *Debt Issuance*, *Total Issuance*, *Dividend*,

Table 2 The main regression tests

Variables	CapEx	R&D	Aqc	Total investment
Panel A: Corporate investment				
Log (OV)	0.003*** (0.001)	0.001** (0.000)	0.002** (0.001)	0.005*** (0.001)
Size	− 0.010*** (0.001)	− 0.006*** (0.001)	− 0.001 (0.002)	− 0.017*** (0.003)
BM	− 0.027*** (0.002)	− 0.022*** (0.002)	− 0.008** (0.003)	− 0.061*** (0.004)
Mom	− 0.007*** (0.002)	0.002** (0.002)	− 0.007* (0.003)	− 0.025*** (0.004)
Age	− 0.004*** (0.001)	− 0.001*** (0.000)	− 0.002*** (0.000)	− 0.007*** (0.001)
Leverage	− 0.021*** (0.004)	− 0.022*** (0.004)	0.175*** (0.009)	0.129*** (0.012)
ROA	0.093*** (0.005)	0.193*** (0.005)	− 0.050*** (0.011)	0.237*** (0.014)
CashFlow	− 0.030*** (0.003)	− 0.029*** (0.003)	0.114*** (0.006)	− 0.201*** (0.008)
Num	− 0.001*** (0.000)	− 0.001*** (0.000)	− 0.004 (0.000)	− 0.003*** (0.000)
IO	− 0.031*** (0.003)	− 0.026*** (0.003)	− 0.029*** (0.006)	− 0.087*** (0.007)
Firm fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Within R^2	0.107	0.288	0.035	0.078
N	22,653	22,653	22,653	22,653

Variables	Equity issuance	Debt issuance	Total issuance
Panel B: External financing			
Log (OV)	0.017*** (0.005)	0.004*** (0.001)	0.020*** (0.003)
Size	− 0.056*** (0.003)	− 0.023*** (0.003)	− 0.079*** (0.006)
BM	− 0.093*** (0.001)	− 0.011** (0.005)	− 0.104*** (0.008)
Mom	0.015* (0.008)	− 0.010** (0.004)	0.005 (0.009)
Age	− 0.006*** (0.001)	− 0.002*** (0.000)	− 0.008*** (0.001)
Leverage	− 0.325*** (0.023)	0.436*** (0.030)	0.111*** (0.024)
ROA	1.042*** (0.029)	0.280*** (0.015)	1.322*** (0.027)
CashFlow	− 1.023*** (0.017)	− 0.212*** (0.009)	− 1.234*** (0.016)
Num	− 0.005*** (0.001)	− 0.001 (0.001)	− 0.006*** (0.001)
IO	− 0.188*** (0.015)	− 0.008 (0.008)	− 0.196*** (0.015)
Firm fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Within R^2	0.209	0.095	0.203
N	22,653	22,653	22,653

Variables	Dividend	Repurchase	Total payout	ΔCash
Panel C: Payout and cash holdings				
Log(OV)	− 0.005*** (0.000)	− 0.001** (0.000)	− 0.007*** (0.000)	− 0.010*** (0.005)
Size	− 0.001 (0.000)	− 0.001 (0.001)	− 0.001 (0.001)	− 0.008 (0.010)
BM	− 0.003*** (0.000)	− 0.007*** (0.001)	− 0.012*** (0.001)	− 0.004 (0.015)
Mom	− 0.001*** (0.000)	− 0.003*** (0.001)	− 0.011*** (0.001)	− 0.021*** (0.015)
Age	0.002*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.003*** (0.002)
Leverage	0.004*** (0.001)	− 0.034*** (0.003)	0.036*** (0.003)	0.036* (0.043)
ROA	0.010*** (0.001)	0.065*** (0.004)	0.076*** (0.004)	− 0.726*** (0.050)
CashFlow	− 0.001 (0.001)	− 0.004* (0.002)	− 0.005* (0.002)	0.376*** (0.031)
Num	0.002*** (0.000)	0.001*** (0.000)	0.002*** (0.000)	0.003*** (0.001)
IO	− 0.004*** (0.001)	0.015*** (0.002)	0.010*** (0.002)	0.081*** (0.026)
Firm fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Within R^2	0.050	0.074	0.089	0.048
N	22,653	22,653	22,653	20,874

The values of the standard error are in parentheses

* denotes significance at the 10% level

** denotes significance at the 5% level

*** denotes significance at the1% level

Repurchase, *Total Payout*, and *ΔCash*. *OV* is the option trading measure, *Option Volume*. *Log(OV)* denotes the log value of *OV*. *X* is a vector of control variables, including firm size (*Size*), book-to-market ratio (*BM*), momentum (*Mom*), *Age*, *Leverage*, *ROA*, *Cash-Flow*, *Num*, and *IO*. *Firm* is a set of firm dummies and *Year* is a set of year dummies.[4] *Error* is a stochastic error term.

Table 2 reports the estimation results using Eq. (1) as the regression model with firm and year fixed effect, where *t*-statistics are based on standard errors clustered by both year and firm per Petersen (2009), as in DeAngelo et al. (2010). Panel A shows the regression with different measures of corporate investment (including *CapEx*, *R&D*, *Aqc*, and *Total Investment*) as dependent variables. In all columns, the coefficient of *Log(OV)* are positive and statistically significant at the 1% or 5% level. They range from 0.001 to 0.005 with t-statistics from 2.27 to 4.61. The results also appear economically significant in which one standard deviation increase in option volume leads to 0.40% increases in capital expenditure, 0.19% increases in R&D expenditure, 0.23% increases in acquisition expenditure, and 0.82% increases in total expenditure. Given the average values of different measures of corporate investment in Table 1, this implies a 3.88–8.85% increments in average corporate investment.

Panel B reports the regression with different measures of external financing activities (including *Equity Issuance*, *Debt Issuance*, and *Total Issuance*) as dependent variables. Similarly, in all columns, the coefficient of *Log(OV)* are positive and statistically significant at the 1% level. They are from 0.004 to 0.020 with t-statistics from 2.55 to 6.61. A one standard deviation increase in option volume leads to 2.64% increases in equity issuance, 0.62% increases in debt issuance, and 3.11% increases in total issuance. This corresponds to a 47.82–57.44% increases in average external financing activities, which indicates that option trading promotes external financing. The capital structure theories generally argue that information asymmetry problems drive the capital structure of firms (e.g. Myers 1984; Myers and Majluf 1984). Managers tend to have more information than the rest of the market about their firm's value. The market penalized the issuance of securities, thus reducing information asymmetry can lower the cost of financing on both equity and debt. The findings in this section are consistent with the pecking-order theory.

Finally, Penal C shows the results of payout activities (including *Dividend*, *Repurchase*, and *Total Payout*) and change in cash holdings (*ΔCash*). In contrast to prior regressions, option trading has negative effects on all payout and cash holding measures. They are from −0.001 to −0.010 with t-statistics from 2.27 to 4.50. A one standard deviation increase in option volume leads to 0.78% decreases in dividend, 0.16% decreases in repurchase, and 1.09% decreases in total payout. This corresponds to a 7.07–64.76% decreases in average payout activities and 259% decrease in cash holdings. The results suggest that option trading increases the need for internal funding and firms reduce payout and cash holdings for corporate investment (e.g. Floyd et al. 2015).

The control variables in the regression are mostly significant. For example, the coefficients on firm size, book-to-market, and age are negative and significant at the 1%

[4] The results are qualitatively similar if I use industry fixed effect instead of firm fixed effect.

Table 3 Correlations between financing and investment

	CapEx	R&D	Aqc	Total investment	Equity issuance	Debt issuance	Total issuance
CapEx							
R&D	0.016***						
Aqc	0.028***	−0.011*					
Total investment	0.459***	0.598***	0.669***				
Equity issuance	0.112***	0.159***	0.037***	0.168***			
Debt issuance	0.199***	0.111***	0.400***	0.418***	0.368***		
Total issuance	0.132***	0.165***	0.089***	0.215***	0.992***	0.482***	

* denotes significance at the 10% level

*** denotes significance at the1% level

level. This suggests that small, high grow, and young firms tend to have more investing activities because these firms tend to have more growth and investment opportunities. It is interesting that the coefficient on option trading remains significant after controlling for analyst coverage and institutional ownership. This suggests that the effect of option trading on corporate investment is not affected by information asymmetry and the supply side effect.

The evidence suggests that information efficiency, following an increase in informed option trading, improves as the reduction of information asymmetry in the underlying stock by transferring private information to uninformed investors. Thus it reduces the cost of capital and increases the profitability of projects, as well as the optimal amount of investment. Corporate managers respond to these changes by increasing their financing and investment activities, as well as reducing payout and cash holdings to finance their investments. If the results are consistent with this hypothesis, the firms with the greatest increase in financing should also be the ones with the highest increase in investment. To examine this, this paper first examines the correlation between financing and corporate investment in the sample. The results are presented in the Table 3 and there are significant correlations between different measures of financing and investment. For example, the correlation between capital expenditure and equity issuance is 0.112 at the 1% statistically significant level.

Then this paper examines whether financing activities driven by informed option traders affects corporate investment. Specifically, this paper implements a two-step procedure. First, this paper obtains the estimates of option-induced financing from Table 2 where the dependent variable is *Total Issuance*. Then, this paper runs the following regressions:

$$Investment_{i,t} = a_0 + a_1 \overline{TotalIssuance_{i,t}} + a_2 X_{i,t} + Firm_i + Year_t + Error_{i,t}, \quad (2)$$

where *Investment* is *CapEx*, *R&D*, *Aqc*, or *Total Investment*. $\overline{TotalIssuance}$ is the predicted value of total financing from the regression in Column 3 of Panel B, Table 2. The results are presented in Table 4 and show that option-induced financing has significant relations with investment measures. For example, the coefficient of $\overline{TotalIssuance}$ is 0.116 with statistical significance at the 1% level in Column 1 of Table 4. This suggests

Table 4 Option-induced financing and investment

Variables	CapEx	R&D	Aqc	Total investment
Total issuance	0.116*** (0.019)	0.058** (0.019)	0.075* (0.040)	0.263*** (0.052)
Size	−0.012 (0.002)	−0.001 (0.002)	0.005 (0.004)	0.004 (0.005)
BM	−0.015*** (0.003)	−0.016*** (0.003)	−0.001 (0.006)	−0.034*** (0.007)
Mom	−0.007*** (0.002)	0.002** (0.002)	−0.007** (0.003)	−0.026*** (0.004)
Age	−0.003*** (0.000)	−0.001*** (0.000)	−0.001** (0.001)	−0.005*** (0.001)
Leverage	−0.034*** (0.005)	−0.028*** (0.005)	0.167*** (0.010)	0.100*** (0.013)
ROA	0.060 (0.024)	0.117*** (0.024)	−0.149** (0.050)	−0.110 (0.064)
CashFlow	0.113*** (0.022)	−0.214*** (0.022)	0.206*** (0.045)	0.123 (0.058)
Num	−0.001 (0.000)	−0.001*** (0.000)	−0.001 (0.000)	−0.001** (0.000)
IO	−0.008 (0.005)	−0.015*** (0.005)	−0.014 (0.010)	−0.036** (0.012)
Firm fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Within R^2	0.107	0.288	0.035	0.078
N	22,647	22,647	22,647	22,647

The values of the standard error are in parentheses

* denotes significance at the 10% level

** denotes significance at the 5% level

*** denotes significance at the1% level

that the fitted value of *Total Issuance* is positively associated with capital expenditure. Overall, the results indicates that option-induced financing is positively related to capital expenditure, R&D expenditure, acquisition expenditure, and total investment.

To make some relevant comparisons, this paper considers several recent studies in the effect of financial market on corporate decisions. Derrien and Kecskés (2013) find that an exogenous shock (brokerage house mergers and closures) in analyst coverage leads to a decrease in capital expenditures by 0.67% of total assets, research and development expenditures by 0.21%, and acquisitions expenditures by 0.97%, total investment decreases by 1.92%, long-term debt decreases by 1.07%, equity issuance decreases by 0.90%, and cash holdings decrease by 1.12% after the loss of an analyst. Sufi (2009) documents that unrated firms experience 0.274 increase in asset growth and 0.081 increase in cash acquisitions after obtaining a syndicated bank loan ratings by Moody's and Standard & Poor's (1995). Tang (2009) finds that upgraded firms experience a 20 to 30 basis point drop in the cost of debt compared to firms that are downgraded during Moody's (1982) credit rating refinements. This leads to increase long-term debt financing by roughly 2%, decrease equity financing by 2%, and decrease cash holdings by 2% of total Overall, the results in this paper are close to prior literature.

Robustness checks

In this section, this study assesses the robustness of the findings in Table 2. First, this paper repeats the regression analysis of using alternative definitions of option trading and corporate policies, to ensure that prior findings are not driven by the specific measures. Specifically, to begin this robustness check, this paper follows Roll et al. (2009) and use dollar option volume (*Dollar Volume*). The regression results are qualitatively similar to Table 2. For investment, this paper uses three different measures

including current asset growth, long-term asset growth, and total asset growth. Current asset growth is the percentage change in current asset. Long-term asset growth is the percentage change in the net value of property, plant, and equipment. The regression estimates on these variables suggest that option trading has a statistically and economically positive effect in corporate investment decisions.

For financing, following Pontiff and Woodgate (2008), this paper constructs two alternative measures of equity issuance using the CRSP monthly database. In particular, for each firm, this paper obtains the number of share outstanding and the factor to adjust shares outstanding, which adjusts for distribution events (stock splits and shares offerings). First, this paper computes a total factor over the year by calculating the cumulative product of monthly factors. Then adjusted shares outstanding are the ratio of share outstanding and total factor. The equity issuance is the percentage change in adjusted shares outstanding over the year. The second measure is the long-term equity issuance, which uses 5-year monthly data from the CRSP database (Daniel and Titman 2006). The regression results based on these two measures of equity issuance confirm that option trading has a statistically and economically positive effect on equity issuance. To further verify these results, this paper uses the seasonal equity offering (SEO) data in the Thomason Reuter SDC Global Issuance database to construct equity issuance measure and find qualitatively similar results.

For payout, this paper constructs the dividend measure using the CRSP database. Specifically, dividend payout is measured by the dollar value per share of distributions resulting from cash dividends, spin-offs, mergers, exchanges, reorganizations, liquidations, and rights issues multiplying shares outstanding scaled by total asset over the year. The results based on this dividend payout measure suggest that option trading has a statistically and economically positive effect on corporate payout. Similarly, this paper uses the share repurchase data in the Thomason Reuter Stock Buybacks database to construct share repurchase measure and find qualitatively similar results.

Second, this paper controls for different firm characteristics in a multivariate regression setting. Prior DID results are based on a panel regression setting controlling for various firm characteristics. It is possible that prior results are driven by other observable firm characteristics. To examine this possibility, this paper runs the main regression results in a regression framework with additional variables, including *PPE*, *CFstd*, *Vol*, and *Sg*. Tangible asset (*PPE*) is net property, plant and equipment over total asset. Cashflow volatility (*CFstd*) is the standard deviation of past five years' cash flow. Stock volatility (*Vol*) is the standard deviation of stock returns in the prior year. Sales growth (*Sg*) is the percentage change in firm sale. The evidence is consistent with the main regression results in Table 2. Specifically, option trading has a positive effect on corporate investment and financing, but a negative effect on corporate payout and cash holdings.

Third, Figlewski and Webb (1993) documents that option trading mitigates the effect of short sale constraints, which improves informational and transactional efficiency of stock markets. To study whether short selling can explain the relation between option trading and corporate policies, this paper controls for short selling activities in the main regression model and find that the results are not affected. This indicates that short selling is not the main driven force of the results.

Finally, While prior regressions are based on a panel regression model (Eq. (1)), this paper uses different econometric models to check the robustness of the based results. There models are the quantile regression model, the Fama and Macbeth (1973) model, and the generalized method of moments (GMM) model. The results show that the coefficients on *Log(OV)* are positive and significant at the 1% level in all models. For brevity, this paper does not report the results, but it is available upon request.

Endogenous relation between option trading and corporate policies

In this section, this paper addresses the possible endogeneity concerns that could bias the baseline results. One alternative explanation for the prior results is that unobservable firm characteristics are correlated with both option trading activities and corporate policies, or option traders tend to trade on firms that are making change in corporate decisions. This can be resulting in reverse causality. Following Blanco and Wehrheim (2017), this paper uses two different identification strategies to address these concerns. The first strategy examines the average effect of having a higher level of option trading volume on corporate policies. The second strategy studies the 2SLS methodology based on two exogenous instrumental variables: option moneyness and open interest.

For the first strategy, this paper uses propensity score matching (PSM) to study whether firms with high option trading would have make different corporate decisions if they had not had high trading volume. Nearest-neighbor logit propensity matching strategy is developed by Rosenbaum and Rubin (1983) and used in the many academic studies (e.g. Irani and Oesch 2013; Chen et al. 2015) as the basis of analyzing the effect of exogenous shocks. Specifically, this paper identifies a high trading volume group as firms with option trading volume above the yearly median in the same 3-digit SIC industry. In contrast, the low trading volume group include firms with option trading volume below the yearly median in the 3-digit SIC industry. Then this paper uses a logistic model to estimate the likelihood of being a high option trading firm as following:

$$HighTradingDummy_{i,t} = a_0 + a_1 X_{i,t} + Firm_i + Year_t + Error_{i,t}, \quad (3)$$

where *High Trading Dummy* is a dummy variable which equals to one if a firm belongs to high option trading group, zero otherwise. X is the same vector of independent variables as Eq. (1). Based on this propensity score value (predicted value), the high trading option group is matched with four controls (the low trading option group) with replacement. The results remain robust if this paper uses any number of matches from one to five. As robustness checks, this paper also uses kernel and radius matching.

The results are presented in Table 5 and are consistent with those in Table 2. Specifically, based on the result in Column 1 of Panel A using nearest-neighbor method, the high trading volume group on average has 0.9% capital expenditure, 2.2% R&D expenditure, 0.8% acquisition expenditure, and 3.8% total investment higher than the low trading volume group. In Column 1 of Panel B, the difference between the high trading volume group and the low trading volume group is 5.6% in equity issuance, 1.3% in debt issuance, and 6.9% in total issuance. In Column 1 of Panel C, the difference between the high trading volume group and the low trading volume group is −0.1% in dividend payout, −0.1% in repurchase, −0.2% in total payout, and −0.6% in change in cash holdings. There is, however, a concern that the results are sensitive to the matching estimation

Table 5 Propensity score matching

Variables	Nearest-neighbor method	Kernel matching method	Radius matching method
Panel A: Investment			
CapEx	0.009*** (0.002)	0.006*** (4.20)	0.006*** (5.33)
R&D	0.022*** (0.003)	0.018*** (4.93)	0.013*** (9.90)
Aqc	0.008*** (0.003)	0.003** (2.16)	0.007 (4.57)
Total investment	0.038*** (0.005)	0.027*** (3.69)	0.026*** (4.80)
N	9034	9034	9034
Panel B: Financing			
Equity issuance	0.056*** (0.006)	0.017*** (0.001)	0.016*** (0.004)
Debt issuance	0.013*** (0.005)	0.007** (0.003)	0.011*** (0.002)
Total issuance	0.069*** (0.014)	0.024*** (0.009)	0.027*** (0.005)
N	9034	9034	9034
Panel C: Payout and cash holdings			
Dividend	− 0.001** (0.000)	− 0.002** (0.001)	− 0.002*** (0.001)
Repurchase	− 0.001* (0.001)	− 0.004*** (0.002)	− 0.001* (0.001)
Total payout	− 0.002** (0.001)	− 0.005*** (0.002)	− 0.003** (0.001)
ΔCash	− 0.006** (0.018)	− 0.002** (0.001)	− 0.002** (0.001)
N	9034	9034	9034

* denotes significance at the 10% level

** denotes significance at the 5% level

*** denotes significance at the1% level

with PSM. To alleviate this, this paper also adapts other matching approaches. Similar findings are presented in the results based on kernel and radius matching. Overall, the evidence indicates that firms with high trading activity would have less investment and financing, as well as higher payout and cash holdings, had they not had high trading activity.

Second, this paper takes a further step to alleviate the possible endogeneity in the baseline results by using the two-stage least square methodology. Following Roll et al. (2009), this paper constructs two instrumental variables for option volume including *Option Moneyness* and *Open Interest*. *Option Moneyness* is defined as the ratio between stock price and option strike price. Specifically, for call options, *Option Moneyness* is stock price over strike price. For put options, *Option Moneyness* is strike price over stock price. As suggested by Roll et al. (2009), informed traders are more willing to trade on out-of-the-money (OTM) options because these options offer more leverage, and vice versa for uninformed traders. *Open Interest* is the average number of outstanding contracts held by market participants, which represents the number of open positions outstanding. The variations in these variables can create exogenous changes in option trading that not directly affect corporate policies other than through the option channel.

To examine the effect of information asymmetry on earnings management controlling for endogeneity, this paper estimates the following 2SLS regressions:

$$Log(OV)_{i,t} = a_0 + a_1 OptionMoneyness_{i,t} + a_2 OpenInterest_{i,t} + a_3 X_{i,t} + Firm_i + Year_t + Error_{i,t}, \quad (4)$$

$$CorporatePolicies_{i,t} = a_0 + a_1 \overline{Log(OV)_{i,t}} + a_2 X_t + Firm_i + Year_t + Error_{i,t}, \quad (5)$$

The first-stage regression results (not turbulated) with *Option Volume* as the dependent variable and *Option Moneyness* and *Open Interest* as the instrumental variables. Good instrument variables are correlated with option trading but are not inherently depended on the dependent variable except through other independent variables. As proposed by Roll et al. (2009), moneyness can be a potential candidate. Option volatility traders may prefer to trade at-the-money options since the sensitivity of these options are the highest (Chakravarty et al. 2004). Furthermore, informed traders are attracted to out of the money options for the higher leverage, but uninformed agents may prefer in-the-money options to mitigate risk (Pan and Poteshman 2006). All other control variables are the same as those in Table 2 and standard errors are clustered at the firm level. The coefficients on *Option Moneyness* and *Open Interest* are positive and statistically significant at the 1% level.

Table 6 reports the results from the second-stage regressions (Eq. (5)) with the main variable of interest of the fitted value of *Log(OV)* from the first-stage regression. Consistent with the findings from Table 2, the coefficients of the fitted value of *Log(OV)* are positive and statistically significant at the 1% level in Panel A and Panel B and negative in Panel C of Table 6. To ensure that the instrumental variables satisfy two conditions for the IV approach, this paper performs two tests, including relevant test and exclusion restriction test. Since the t-statistics of both instrument variables are large (3.33 for *Option Moneyness* and 2.13 for *Open Interest*), it indicates that *Option Moneyness* and *Open Interest* are strongly correlated with option trading. To verify this, this uses a joint significance test on the first-stage regression for both instrumental variables. The F-statistics are highly significant. Consequently, this paper rejects the hypothesis that the instrumental variables are weak.[5] In addition, the Sargan–Hansen Chi-square statistics are small and insignificant, which suggests that instrumental variables are not correlated with the error term in the Eq. (5). The coefficient estimate and standard error are likely to be unbiased.

In summary, the identification results based on the propensity matching method and the instrumental variable approach suggest that option trading has a causal effect on corporate policies. This paper also considers different estimation methods. For example, Kou et al. (2014) incorporate clustering algorithms for financial risk analysis using MCDM methods. Kou et al. (2021a, b) propose a bankruptcy prediction model for SMEs that uses transactional data and payment network–based variables under a scenario where no financial (accounting) data. Kou et al. (2021a, b) use a hybrid IT2 fuzzy multidimensional decision-making approach. Wen et al. (2019) use a large sample of Chinese listed firms and find that firms with higher retail investor attention tend to have a lower future stock price crash risk. The implementation of these different methods, the results remain consistent.

The underlying economic mechanism

Prior evidence is consistent with the implication that option trading increases information efficiency and reduces information asymmetry by incorporating private information into equity prices. Thus, the outcomes will be a lower cost of capital and improvement

[5] The rule of thumb to test the relevant of one instrumental variable for one endogenous variable is based on the t-statistics of the instrumental variable.

Table 6 Instrumental variable tests

Variables	CapEx	R&D	Aqc	Total investment
Panel A: Corporate investment				
$\overline{LOG\ (OV)}$	0.023*** (0.007)	0.063*** (0.026)	0.014* (0.007)	0.083*** (0.026)
Size	− 0.071 (0.116)	− 0.152 (0.292)	− 0.328 (0.607)	− 0.551 (1.002)
BM	0.056 (0.165)	0.187 (0.390)	0.463 (0.874)	0.706 (1.441)
Mom	0.003 (0.043)	0.051 (0.019)	0.108 (0.216)	0.163 (0.354)
Age	− 0.001 (0.004)	− 0.005 (0.013)	0.011 (0.024)	0.015 (0.042)
Leverage	0.036 (0.116)	0.122 (0.271)	0.497 (0.606)	0.655 (0.992)
ROA	0.042 (0.102)	0.069 (0.238)	− 0.332 (0.535)	− 0.222 (0.888)
CashFlow	− 0.019 (0.025)	− 0.258*** (0.057)	0.173 (0.129)	− 0.104 (0.208)
Num	− 0.012 (0.021)	− 0.028 (0.050)	− 0.061 (0.113)	− 0.101 (0184)
IO	− 0.044* (0.025)	− 0.054 (0.059)	− 0.091 (0.132)	− 0.189 (0.215)
Firm fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Within R^2	0.019	0.102	0.007	0.043
N	22,619	22,619	22,619	22,619
Variables	**Equity issuance**		**Debt issuance**	**Total issuance**
Panel B: External financing				
$\overline{LOG\ (OV)}$	0.029*** (0.005)		0.012*** (0.005)	0.051*** (0.008)
Size	− 0.717 (1.236)		− 0.546 (0.975)	− 1.263 (2.216)
BM	0.857 (1.785)		0.741 (1.398)	1.598 (3.196)
Mom	0.015* (0.008)		0.174 (0.348)	0.421 (0.780)
Age	− 0.006 (0.014)		0.019 (0.040)	0.040 (0.089)
Leverage	− 0.325 (1.250)		0.952 (0.971)	1.278*** (0.320)
ROA	0.475 (1.080)		− 0.174 (0.348)	1.322*** (0.034)
CashFlow	− 0.904*** (0.260)		− 0.116 (0.204)	− 1.234** (0.561)
Num	− 0.127 (0.227)		− 0.097 (0.180)	− 0.224 (0.407)
IO	− 0.314 (0.266)		− 0.109 (0.210)	− 0.424 (0.476)
Firm fixed effect	Yes		Yes	Yes
Year fixed effect	Yes		Yes	Yes
Within R^2	0.035		0.008	0.036
N	22,619		22,619	22,619
Variables	**Dividend**	**Repurchase**	**Total payout**	**ΔCash**
Panel C: Payout and cash holdings				
$\overline{LOG\ (OV)}$	− 0.018*** (0.007)	− 0.012** (0.006)	− 0.090*** (0.037)	− 0.048*** (0.011)
Size	− 0.018 (0.034)	− 0.004 (0.025)	− 0.022 (0.046)	0.012 (0.024)
BM	0.023 (0.050)	− 0.004 (0.033)	0.018 (0.067)	− 0.015 (0.033)
Mom	0.005 (0.014)	− 0.008 (0.008)	− 0.004 (0.017)	− 0.031 (0.097)
Age	0.001 (0.001)	0.001 (0.000)	0.002 (0.002)	− 0.048 (0.107)
Leverage	0.021 (0.034)	0.036 (0.024)	0.057 (0.047)	− 0.879 (2.511)
ROA	− 0.006 (0.032)	0.063*** (0.021)	0.058 (0.041)	0.018 (0.024)
CashFlow	0.003 (0.007)	− 0.004 (0.005)	− 0.001 (0.011)	− 0.008 (0.023)
Num	− 0.008 (0.008)	0.001 (0.005)	− 0.002 (0.004)	0.021 (0.043)
IO	− 0.008 (0.008)	0.013*** (0.005)	0.006 (0.011)	0.018 (0.035)
Firm fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Ye
Within R2	0.007	0.023	0.022	0.006
N	22,619	22,619	22,619	22,234

The values of the standard error are in parentheses

* denotes significance at the 10% level

** denotes significance at the 5% level

*** denotes significance at the1% level

in corporate investment and financing. In this section, this paper explores potential economic mechanisms through which prior results occur.

Information asymmetry effect

In this subsection, this examines whether information asymmetry could help to explain the positive effect of option trading on corporate investment and financing. Easley and O'Hara (2004) argue that information asymmetry affect asset prices and cross-sectional differences in the firms' cost of capital. If option trading reduces the asymmetric information problems and improves equity price efficiency, firms with high option trading volume tend to have a lower cost of equity capital and more corporate investment and financing. If this is the case, then the effect of option trading should be greatest for firms with high information asymmetry problems.

To examine this hypothesis, this paper conditions the effect of option trading on corporate policies for different level of information asymmetry. For information asymmetry, this paper uses five proxies as Kelly and Ljungqvist (2012): the bid-ask spread, the adverse component of the bid-ask spread, the Amihud's (2002) illiquidity, the ratio of zero and missing return days to total days, and the magnitude of earnings surprises. To estimate these measures, this paper uses the daily returns database in the Center for Research in Securities Prices (CRSP) and the I/B/E/S data. The bid-ask spread is calculated as the mean value during the year of the daily ask price minus the bid price scaled by the dollar value of trading volume. The adverse selection component of the bid-ask spread is computed as Lin et al. (1995).[6] Amihud is the Amihud's (2002) illiquidity measure, which is defined as the average ratio of the daily absolute return to the trading volume over the fiscal year (multiplying 106). The ratio of zero and missing returns days to total days is the number of trading days with zero or missing returns during the year divided by the number of trading days over the year. The magnitude of earnings surprises is the mean value during the year of the quarterly absolute value of the difference between actual earnings and consensus forecasted earnings divided by stock prices.

Specifically, this paper uses the following specification for the regression model:

$$CorporatePolicies_{i,t} = a_0 + a_1 Log(OV)_{i,t} + a_2 IAD * Log(OV)_{i,t} + a_3 X_{i,t} + Firm_i + Year_t + Error_{i,t}, \quad (6)$$

where *IAD* is an information asymmetry dummy which is equal to one if a firm is belonged to the highest information asymmetry quantile, and zero if a firms is belong to the lowest information asymmetry quantile.

Table 7 presents the results of related to the interaction between option trading volume and information asymmetry. The variable of interest is the interaction term between information asymmetry and option trading (*IAD*Log(OV)*). For all panels, this paper finds persistent results that information asymmetry enhances the effect of option trading on corporate investment, financing, payout, and cash holdings.

[6] Following Lin et al. (1995), the adverse selection component of spread is estimated using following model:

$$Q_{t+1} - Q_t = \lambda z_t + e_{t+1}$$

where Q is the average of bid and ask prices, z is the signed effective bid-ask spread, and e is the error term. Using daily stock information from CRSP, I estimate the above equation for each firm in each year. The λ estimate is the measure of the adverse selection component of spread.

Table 7 Information asymmetry effect

Variables	CAPEX	R&D	AQC	Investment	Equity issuance	Debt issuance	Total issuance	Dividend	Repurchase	Total payout	ΔCASH
Panel A: The bid-ask spread											
LOG (OV)	0.002** (0.001)	0.002** (0.001)	0.001 (0.001)	0.006** (0.003)	0.009* (0.005)	0.005* (0.003)	0.014** (0.006)	0.001 (0.001)	0.003*** (0.001)	0.003*** (0.001)	−0.033*** (0.013)
IAD*LOG (OV)	0.003*** (0.001)	0.002** (0.001)	0.002** (0.001)	0.005** (0.002)	0.022*** (0.008)	0.004 (0.004)	0.018*** (0.007)	−0.001* (0.001)	−0.005*** (0.001)	−0.006*** (0.001)	−0.009 (0.007)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.129	0.198	0.042	0.087	0.204	0.073	0.201	0.039	0.058	0.066	0.049
N	8539	8539	8539	8539	8539	8539	8539	8539	8539	8539	8332
Panel B: The adverse selection component in the BID-ASK SPREAD											
LOG (OV)	0.002 (0.001)	0.001 (0.001)	0.002* (0.001)	0.005* (0.003)	0.023*** (0.007)	0.001 (0.002)	0.025*** (0.007)	0.000 (0.002)	0.001 (0.001)	0.001 (0.001)	0.002 (0.011)
IAD*LOG (OV)	0.004*** (0.001)	0.002** (0.001)	0.002** (0.001)	0.007*** (0.003)	0.017*** (0.006)	0.007*** (0.002)	0.024*** (0.007)	−0.004** (0.002)	−0.002*** (0.001)	−0.002*** (0.001)	−0.018** (0.008)
Othercontrols	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.105	0.160	0.057	0.064	0.091	0.080	0.130	0.046	0.062	0.079	0.054
N	8807	8807	8807	8807	8807	8807	8807	8807	8807	8807	8643
Panel A: The Amihud's (2002) *illiquidity*											
Variables	CAPEX	R&D	AQC	Investment	Equity issuance	Debt issuance	Total issuance	Dividend	Repurchase	Total payout	ΔCash
LOG (OV)	0.006*** (0.001)	0.004*** (0.001)	0.002* (0.001)	0.012** (0.003)	0.030* (0.008)	0.005* (0.003)	0.035*** (0.008)	0.002*** (0.000)	0.002 (0.008)	0.002* (0.001)	−0.005 (0.004)
IAD*LOG (OV)	0.005*** (0.002)	0.003* (0.002)	0.001* (0.001)	0.007*** (0.003)	0.009* (0.005)	0.006* (0.003)	0.015* (0.008)	−0.008*** (0.002)	−0.003*** (0.002)	−0.007** (0.003)	−0.042*** (0.014)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.105	0.171	0.058	0.052	0.091	0.058	0.085	0.076	0.082	0.103	0.026
N	8952	8952	8952	8952	8952	8952	8952	8952	8952	8952	8816

Table 7 (continued)

Variables	CAPEX	R&D	AQC	Investment	Equity issuance	Debt issuance	Total issuance	Dividend	Repurchase	Total payout	ΔCASH
Panel D: The ratio of zero and missing returns days to total days											
LOG (OV)	0.002*** (0.001)	0.003*** (0.001)	0.001** (0.000)	0.002** (0.001)	0.015** (0.007)	0.004* (0.002)	0.016*** (0.006)	0.000 (0.001)	0.001 (0.001)	0.001 (0.001)	−0.003 (0.003)
IAD*LOG (OV)	0.002*** (0.001)	0.004*** (0.001)	0.005*** (0.002)	0.006*** (0.002)	0.026*** (0.007)	0.005* (0.003)	0.031*** (0.007)	−0.003** (0.002)	−0.001*(0.001)	−0.004** (0.002)	−0.027*** (0.011)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.151	0.219	0.021	0.087	0.108	0.087	0.122	0.048	0.053	0.067	0.021
N	7901	7901	7901	7901	7901	7901	7901	7901	7901	7901	7752
Panel E: The absolute value of earnings surprises											
LOG (OV)	0.001 (0.003)	0.001 (0.001)	0.001 (0.001)	0.003* (0.002)	0.006 (0.005)	0.012*** (0.003)	0.019*** (0.007)	0.001 (0.001)	0.001 (0.005)	0.002 (0.002)	0.010 (0.010)
IAD*LOG (OV)	0.004*** (0.001)	0.006*** (0.002)	0.003*** (0.001)	0.008*** (0.003)	0.015*** (0.005)	0.013*** (0.003)	0.027*** (0.007)	−0.003*** (0.001)	−0.002* (0.001)	−0.005*** (0.001)	−0.059*** (0.013)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.126	0.386	0.034	0.104	0.313	0.131	0.319	0.060	0.075	0.093	0.031
N	8917	8917	8917	8917	8917	8917	8917	8917	8917	8917	8772

The values of the standard error are in parentheses

* denotes significance at the 10% level

** denotes significance at the 5% level

*** denotes significance at the1% level

For example, in Panel A, this paper uses the bid-ask spread as the measure of information asymmetry. The coefficients on *IAD*Log(OV)* range from 0.002 to 0.005 for corporate investment, 0.004 to 0.018 for external issuance, −0.001 to −0.006 for payout, and −0.009 for cash holdings. Most of these interaction variables are statistically significant. Similar patterns can be found using other information asymmetry proxies. These results suggest that the effect of option trading on different corporate decisions is stronger for firms with higher information asymmetry than that for firms with lower information asymmetry. This is consistent with the information asymmetry hypothesis.

Financial constraint effect

In this subsection, this paper examine whether financial constraints are a possible explanation to explain the positive effect of option trading on corporate investment and financing. When option trading is motivated by informed investors, information asymmetry decreases, and thus the firm's cost of external financing declines. As a result, the optimal size of corporate investment and external financing increases. All these implications are based on the assumption that firms require external funding for their investments. In contrast, the decrease in information asymmetry due to option trading should have an insignificant effect on firms have sufficient internal capital to fund their future expenditure needs.

This paper examines the effect of option trading on corporate policies for different level of financial constraints. For financial constraints, this paper uses four proxies: the SA index (Hadlock and Pierce 2010), the KZ index (Kaplan and Zingales 1997), and the WW index (Whited and Wu 2006), and the Cashflow-investment gap (Rajan and Zingales 1998). To estimate these measures, this paper uses accounting database in the Compustat data and the definition of these measures are available in "Appendix" section. For all financial constraint index, Firms with a higher index value are more financially constrained. For the Cashflow-investment gap, firms with a more negative value are more financially constrained.

Specifically, this paper uses the following specification for the regression model:

$$CorporatePolicies_{i,t} = a_0 + a_1 Log(OV)_{i,t} + a_2 FCD * Log(OV)_{i,t} + a_3 X_{i,t} + Firm_i + Year_t + Error_{i,t}, \quad (7)$$

where *FCD* is a financial constraint dummy which is equal to one if a firm is belonged to the highest financial constraint quantile, and zero if a firms is belong to the lowest financial constraint quantile.

Table 8 presents the results of related to the interaction between option trading volume and financial constraint. The variable of interest is the interaction term between financial constraint and option trading (*FCD*Log(OV)*). Across all panels, this paper finds persistent results that the effect of option trading on corporate investment, financing, payout, and cash holdings for firm with higher financial constraints. For example, in Panel A, this paper uses the SA index as the measure of financial constraints. The coefficients on *IAD*Log(OV)* range from 0.002 to 0.007 for corporate investment, 0.003–0.021 for external issuance, −0.001 to −0.003 for

Table 8 Financial constraint effect

Variables	CAPEX	R&D	AQC	Investment	Equity issuance	Debt issuance	Total issuance	Dividend	Repurchase	Total payout	ΔCash
Panel A: The SA index											
LOG (OV)	0.002 (0.001)	0.001 (0.003)	0.001 (0.002)	0.004 (0.003)	0.015** (0.008)	0.004 (0.003)	0.018** (0.008)	−0.001 (0.003)	−0.001 (0.011)	−0.001 (0.005)	−0.004 (0.003)
IAD*LOG (OV)	0.002* (0.001)	0.001 (0.001)	0.005** (0.002)	0.007** (0.003)	0.015*** (0.006)	0.003 (0.004)	0.021** (0.010)	−0.003* (0.002)	−0.001 (0.001)	−0.003** (0.001)	−0.015** (0.007)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.077	0.284	0.026	0.122	0.249	0.076	0.224	0.039	0.061	0.068	0.033
N	8798	8798	8798	8798	8798	8798	8798	8798	8798	8798	8584
Panel B: The KZ index											
LOG (OV)	0.002 (0.001)	0.001 (0.001)	0.000 (0.002)	0.004 (0.004)	0.016*** (0.004)	0.002 (0.001)	0.017*** (0.005)	0.001 (0.001)	0.001 (0.001)	0.002 (0.001)	−0.004 (0.004)
IAD*LOG (OV)	0.001 (0.001)	0.005*** (0.001)	0.002** (0.008)	0.007* (0.004)	0.012** (0.005)	0.003* (0.002)	0.017** (0.009)	−0.002*** (0.000)	−0.002* (0.001)	−0.004*** (0.001)	−0.019*** (0.004)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.107	0.131	0.066	0.040	0.104	0.089	0.093	0.058	0.072	0.083	0.055
N	7703	7703	7703	7703	7703	7703	7703	7703	7703	7703	7538
Panel C: The WW index											
LOG (OV)	0.000 (0.004)	0.001 (0.001)	0.001 (0.002)	0.003 (0.003)	0.006 (0.005)	0.003 (0.004)	0.008 (0.006)	−0.001 (0.001)	0.000 (0.002)	−0.001 (0.001)	−0.014* (0.008)
IAD*LOG (OV)	0.003*** (0.001)	0.002** (0.001)	0.006*** (0.002)	0.005*** (0.002)	0.016*** (0.006)	0.003* (0.002)	0.019*** (0.007)	−0.003*** (0.001)	−0.001 (0.001)	−0.004*** (0.001)	−0.025*** (0.005)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.109	0.172	0.064	0.044	0.132	0.084	0.099	0.054	0.064	0.077	0.029
N	7267	7267	7267	7267	7267	7267	7267	7267	7267	7267	7178
Panel D: The cashflow-investment gap											
LOG (OV)	0.001 (0.001)	0.001 (0.002)	0.002 (0.001)	0.003 (0.003)	0.004 (0.007)	0.001 (0.002)	0.005 (0.007)	0.000 (0.026)	0.003 (0.003)	0.004 (0.006)	−0.007 (0.015)
IAD*LOG (OV)	0.003*** (0.001)	0.004*** (0.002)	0.005*** (0.002)	0.011*** (0.002)	0.035*** (0.008)	0.022*** (0.004)	0.582*** (0.092)	−0.007** (0.003)	−0.007*** (0.001)	−0.008** (0.001)	−0.011*** (0.004)

Table 8 (continued)

Variables	CAPEX	R&D	AQC	Investment	Equity issuance	Debt issuance	Total issuance	Dividend	Repurchase	Total payout	ΔCash
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.092	0.213	0.080	0.091	0.207	0.110	0.188	0.064	0.079	0.093	0.018
N	8705	8705	8705	8705	8705	8705	8705	8705	8705	8705	8474

The values of the standard error are in parentheses

* denotes significance at the 10% level

** denotes significance at the 5% level

*** denotes significance at the1% level

payout, and −0.015 for cash holdings. All interaction variables are statistically significant. Using other financial constraint proxies, the results are qualitatively similar in Panel B–D. In contrast, the coefficients on *Log(OV)* are mostly insignificant for all models. These results suggest that the effect of option trading on different corporate decisions is stronger for firms with higher financial constraints than that for firms with lower financial constraints.

The quiet life hypothesis

An alternative explanation for prior findings is that corporate managers have the tendency to stay in "quiet life". According to Hicks' (1935) argument, the best of all monopoly profits is a quiet life for less governed managers. They prefer to avoid the difficult decisions and costly efforts in making changes in their corporations, such as initiating a new production line. If option trading increases information efficiency by incorporating private information into equity prices, then it may induce monitoring mechanisms that force corporate managers to take actions, such as increasing investments.

To understand whether the "quiet life" hypothesis can explain the prior results, this paper first examines the effect of option trading on corporate policies for different competitive environment. Market competition can force managers to work harder in order to stay in their office because the threat of bankruptcy is significantly higher in highly competitive industries (e.g. Schmidt 1997). If this is the case, the effect of option trading should be weaker in highly competitive environments.

To examine this hypothesis, this paper implements a similar model as Eqs. (6) and (7), but replace the dummy variable in the interaction term with a market competition variable (*MCD*). *MCD* is equal to one if a firm is belonged to the lowest market competition quantile, and zero if a firms is belong to the highest market competition quantile. Market competition is the Herfindahl–Hirschman Index, which is the sum of the squared share of each firm in 4-digital standard industrial classification (SIC) industry sales across all firms in the entire Compustat database. Panel A of Table 9 shows the results of related to the interaction between option trading volume and market competition. The variable of interest is the interaction term between market competition and option trading (*MCD*Log(OV)*). For all regressions, this paper finds no significant different in the effect of option trading on corporate investment, financing, payout, and cash holdings between firms in competitive industries and firms in monopoly industries. These results suggest that market competition is less likely to be a factor driving prior findings.

Second, this paper examines whether the effect of option trading on corporate policies varies with different levels of agency problems. When managers are more entrenched, they are more likely to avoid addition efforts or making changes. If option trading induces monitoring mechanisms, its beneficial effect should be significant higher for firms with more agency problems. Specifically, firms with more takeover defenses are protected from the market for corporate control. These firms suffer significantly more agency problems and rely on other market mechanisms to discipline their managers, such as option markets. To examine this hypothesis, this paper analyzes the interaction between option trading and managerial entrenchment. To measure the degree of agency problem, this paper adopts the governance index (G Index) of Gompers et al. (2003). This index contains 24 corporate governance provisions, including firms level

Table 9 Quiet life tests

Variables	CapEx	R&D	Aqc	Investment	Equity Issuance	Debt Issuance	Total Issuance	Dividend	Repurchase	Total Payout	ΔCash
Panel A: Market competition											
Log (OV)	0.002** (0.001)	0.001 (0.001)	0.004 (0.003)	0.007** (0.003)	0.012** (0.006)	0.006** (0.003)	0.018*** (0.007)	−0.004* (0.002)	−0.001 (0.001)	−0.005** (0.002)	−0.030** (0.013)
MCD*Log (OV)	0.001 (0.001)	−0.004* (0.002)	−0.002 (0.003)	−0.005 (0.004)	0.008 (0.007)	0.000 (0.013)	0.008 (0.008)	0.000 (0.043)	0.001 (0.001)	0.002 (0.001)	−0.008 (0.014)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.133	0.434	0.037	0.127	0.357	0.129	0.350	0.063	0.073	0.087	0.028
N	9063	9063	9063	9063	9063	9063	9063	9063	9063	9063	8919
Panel B: The G Index											
Log (OV)	0.003* (0.002)	0.001 (0.001)	0.001 (0.001)	0.003** (0.001)	0.006** (0.003)	0.008* (0.004)	0.009** (0.004)	0.001 (0.001)	0.002 (0.002)	0.002 (0.002)	−0.020* (0.010)
GD*Log (OV)	0.000 (0.002)	−0.001 (0.003)	0.000 (0.001)	−0.001 (0.001)	0.004 (0.003)	−0.001 (0.001)	0.004 (0.008)	−0.001** (0.000)	0.001 (0.003)	0.000 (0.001)	0.007 (0.012)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.134	0.110	0.048	0.079	0.067	0.089	0.075	0.047	0.082	0.090	0.055
N	2752	2752	2752	2752	2752	2752	2752	2752	2752	2752	2732

* denotes significance at the 10% level

** denotes significance at the 5% level

*** denotes significance at the1% level

governance provisions and state corporate law statutes. A higher index score indicates more provisions for managers or more agency problems. This paper obtains the index information from RiskMetrics from 1996 to 2006.[7]

This paper uses a similar model as Eqs. (6) and (7), but replace the dummy variable in the interaction term with a G Index dummy variable (*GD*). *GD* is equal to one if a firm is belonged to the highest G Index quantile, and zero if a firms is belong to the lowest G Index quantile. Panel B of Table 9 shows the results of related to the interaction between option trading volume and the G Index where the variable of interest is the interaction term between the G Index dummy and option trading (*GD*Log(OV)*). The coefficients on *GD*Log(OV)* are insignificant across all regressions. Overall, these results suggest that the quiet life explanation is less likely to be the reason for prior findings.

The evidence contrasts with Blanco and Wehrheim (2017) who find a stronger positive effect of market competition and G Index on the relation between option trading and innovation. This paper is different from their analysis because the sample in this study is based on a larger observation size including all firms with option and accounting data. In contrast, Blanco and Wehrheim (2017) focus on patents and patent citations, which capture the quality of R&D investment.

The catering hypothesis

Another alternative explanation for prior findings is that corporate managers cater to equity mispricing in making firm investment and financing decisions. According to the intuition of Stein's (1996) short-horizon model, stock price deviations from fundamental value have a direct effect on the investment policy of a firm. When the expected duration of mispricing is long and shareholders have short investment horizons, managers are likely to alter their investment decisions in the direction of equity misvaluation. Polk and Sapienza (2008) find a positive relation between abnormal investment and equity mispricing (measured by discretionary accruals). In addition, using an ex ante misvalution measure, Dong et al. (2006) document that investor misvaluation drives takeover decisions and Dong et al. (2012) show that equity issuance and total financing increase with mispricing. Option traders also may open their positions to exploit equity mispricing. Thus, the prediction of the catering hypothesis indicates that option trading and corporate policies are driven by equity mispricing.

To examine this hypothesis, this paper follows Polk and Sapienza (2008) and test whether the effect option trading on corporate policies vary by opacity (R&D intensity) and investment horizon of investors (firms' share turnover). The catering hypothesis argue that managers with short shareholder horizon and with hard to value assets should cater more to equity mispricing. This paper uses a similar model as Eqs. (6) and (7), but replace the dummy variable in the interaction term with a R&D intensity dummy variable (*RD*) or a stock turnover dummy (*TD*). *RD* is equal to one if a firm is belonged to the highest R&D expenditure quantile, and zero if a firms is belong to the lowest R&D expenditure quantile. *TD* is equal to one if a firm is belonged to the highest stock turnover quantile, and zero if a firms is belong to the lowest stock turnover quantile.

[7] RiskMetrics provide index value of S&P 1500 firms in 1998, 2000, 2002, and 2004. I assume that the index value remain the same before it is updated.

Table 10 Catering tests

Variables	CapEx	R&D	Aqc	Investment	Equity issuance	Debt issuance	Total issuance	Dividend	Repurchase	Total payout	ΔCash
Panel A: R&D intensity											
Log (OV)	0.003*** (0.001)	0.005*** (0.002)	0.006* (0.003)	0.007* (0.004)	0.018** (0.008)	0.010*** (0.004)	0.029*** (0.009)	−0.003*** (0.001)	−0.001 (0.001)	−0.003*** (0.001)	−0.036** (0.018)
RD*Log (OV)	−0.001 (0.002)	−0.006*** (0.002)	−0.001 (0.002)	−0.001 (0.009)	0.002 (0.009)	−0.010* (0.005)	−0.007 (0.011)	0.000 (0.103)	0.000 (0.020)	0.000 (0.040)	0.014 (0.019)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.156	0.358	0.048	0.131	0.311	0.136	0.310	0.052	0.081	0.092	0.033
N	8871	8871	8871	8871	8871	8871	8871	8871	8871	8871	8679
Panel B: Stock turnover											
Log (OV)	0.006*** (0.002)	0.003** (0.001)	0.002 (0.002)	0.008*** (0.003)	0.015*** (0.006)	0.002 (0.001)	0.017** (0.007)	−0.001*** (0.000)	−0.001 (0.002)	−0.004* (0.002)	−0.015*** (0.006)
TD*Log (OV)	0.001 (0.002)	0.000 (0.003)	0.000 (0.001)	0.001 (0.001)	0.014 (0.009)	−0.001 (0.004)	0.012 (0.010)	0.001 (0.001)	−0.002(0.001)	−0.001 (0.001)	0.002 (0.017)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R^2	0.117	0.164	0.079	0.079	0.119	0.096	0.113	0.048	0.077	0.088	0.055
N	8784	8784	8784	8784	8784	8784	8784	8784	8784	8784	8626

* denotes significance at the 10% level

** denotes significance at the 5% level

*** denotes significance at the1% level

Stock turnover is defined as the daily ratio of shares traded to shares outstanding at the end of the day over the year. Table 10 shows the results and the variable of interest is the interaction term between the R&D intensity dummy variable and option trading (*RD*Log(OV)*) in Panel A and the interaction term between the stock turnover dummy variable and option trading (*TD*Log(OV)*) in Panel B. The coefficients on *RD*Log(OV)* or *TD*Log(OV)* are insignificant across all regressions. There is no indication that the effects are driven by the catering motives.

Conclusion

In this paper, this paper studies the effect of financial derivatives in the context of option trading and corporate policies. This paper hypothesizes that informed option trading improves equity efficiency for the underlying stock and reduces information asymmetry, and thus decreases the cost of capital. As a result, the profitability of projects and the optimal amount of investment increase. At the same time, the demand and the optimal amount of external financing increase as the cost reduces. In short, an increase in option trading causes an uprising in investment and financing.

Prior empirical studies provides evidence that option trading improves informational efficiency in the underlying stock prices and reduces the cost of capital. In this paper, this paper contributes to the literature by providing the resulting hypothesis that an increase in option trading leads to an improvement in investment and financing.

Empirically, this paper finds that there is a large positive effect of option trading on total investment and financing, as well as a negative effect on total payout and cash holdings. The results are robust to the inclusion of various control variables including the book-to-market ratio, firm size, momentum, leverage, ROA, analyst coverage, and institutional ownership. The results are also robust after controlling for industry or firm fixed effect, endogenous option trading using two-stage least squares, or reverse causality. The results are also robust to the use of alternative measures of corporate investment, financing, and payout.

Then, this paper provides supports on the hypothesis that the effect of option trading is affected by information asymmetry and financial constraints. Specifically, this paper finds that option trading has a stronger effect for firms with high information asymmetry and financial constraints. On the other hand, this paper finds that the results are inconsistent with the "Quiet Life" hypothesis or the catering hypothesis. Taken together, the evidence in this paper suggests that option traders are important information intermediaries that significantly affect corporate policies. These results extend our understanding of the real effects of financial derivatives.

This paper contributes to the literature of direct evidence on the real effects of financial markets. This is one of the few papers that study financial derivatives and corporate policies comprehensively. Since corporate policy is important for the nation's economic growth, and since option trading can be altered by policies and regulations, this topic is of interest to a broad audience. Thus, it uncovers a previously unidentified consequence of regulatory effort to enhance option trading activities. For example, government regulations (e.g. margin requirement) can alter the incentives of informed option traders and information asymmetry in the markets. Corporate managers are likely to change their investment and financing policies in responding to these changes.

Appendix

See Table 11.

Table 11 Variable definition

Variable	Explanation	Definition (annual data item in Compustat)
ΔCash	The increase or decrease in cash and cash equivalents scaled by total asset	CHECH/AT
Age	The number of years listed on Compustat	
Aqc	Acquisition expenditure to total asset	AQC/AT
BM	The book to market ratio of firm equity	
CapEx	Capital expenditure scaled by total asset	CAPX/AT
CashFlow	Earnings before extraordinary items and discontinued operations plus depreciation expenditure over total asset	(IB + XDP)AT
Debt issuance	Total change in current debt plus long-term debt issuance minus long-term debt reduction scaled by total asset	(DLTIS + DLCCH − DLTR)/AT
Dividend	Total cash dividend paid over total asset	DV/AT
Dollar volume	The total annual dollar option volume as Roll et al. (2009)	OptionMetrics database
Equity issuance	Total sale of common and preferred stocks over total asset	SSTK/AT
High trading dummy	A dummy variable which equals to one if a firm belongs to high option trading group, zero otherwise	
IO	The percentage of common share held by institutional investors	Thomson Financial's Institutional 13(f) filings
Momentum	The cumulative monthly returns between *t-7* to *t-12*	CRSP database
Num	The average numbers of analyst following	I/B/E/S database
Open interest	The average number of outstanding contracts held by market participants	OptionMetrics database
Option moneyness	The ratio between stock price and option strike price	OptionMetrics database
Option volume	The average of the number of option trading in each day of each quarter across all trading days and all options listed on the stock	OptionMetrics database
R&D	R&D expenditure over total assets	XRD/AT
Payout	The summation of dividend payout and share repurchase	
Repurchase	Purchase of common and preferred stock over total asset	PRSTKC/AT
ROA	Net income over total assets	NI /AT
Size	The log value of total capitalization at the end of year	Log(MV)
Total issuance	The summation of equity financing and debt financing	
Total investment	The summation of CapEx, AdEx, R&D, and Aqc	

Author contributions
The author has read and approved the final manuscript.

Declarations

Competing interests
The author declares no competing interests.

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