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Título de la tesis:
Essays on Financial Markets and Corporate Outcomes

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To my family

Contents

List of Figures

List of Tables

Acknowledgements

"If a man empties his purse into his head, no man can take it away from him. An investment in knowledge always pays the best interest."

Benjamin Franklin.

I would like to dedicate my thesis to my family, specially to my parents and my grandparents, who gave me the unconditional support that made me thrive in my PhD. To Paula, for being by my side through good and less good times. Your continuous support has been the best I could ever have had. I am so grateful for sharing the journey of life with the best person I could have ever imagined.

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Chapter 1

The Hidden Cost of Financial Derivatives: Options Trading and the Cost of Debt

1.1 Introduction

Despite the exponential growth of total equity option volume traded in the U.S., from 676 million contracts in 2000 to over 3,727 million contracts in 2015 [1], there is still considerable disagreement about the real effects of these instruments on the underlying firms. On the one hand, options can act as a managerial discipline mechanism that increases stock price informativeness, thus better reflecting fundamentals. In a seminal paper, Holmström and Tirole (1993) explore the active role of price informativeness in disciplining managers and incentivizing them to engage in value-increasing activities that ultimately benefit shareholders and debtholders. On the other hand, we argue that an active options market exacerbates the classic conflict of interest between shareholders and debtholders by providing the former with a powerful instrument to expropriate the latter. A more liquid options market for the stock allows shareholders to extract high trading gains from certain situations, altering shareholders risk-taking incentives in a way that should consequently be priced by debtholders. Take, for instance, the case of Jana Partners LLC, a multi-billion-dollar hedge fund, and CNet, the telecommunications company. By late December 2007, Jana had accumulated a large economic interest in CNet via an 8% voting interest (through common shares of the company) and an additional 8% of non-voting rights through derivative markets. In January 2008, Jana partnered with Sandell Asset Management (who had 5% economic interest in CNet through derivatives) to takeover CNet's board and gain majority control. The telecommunications company fought back this takeover attempt, leading to a controversial lawsuit between the parties that some voices interpreted as Jana pulling a public relations stunt to put pressure on the board so that a third party came in with a takeover [2]. These concerns were proven right when in May of the same year CBS Corporation bought CNet for $1.8 billion. The bid price was $11.50 a share (Jana valued it at $11 short before), a premium of 44% relative to the last market price ($7.95). Jana and its partners tendered their shares to the bidder, earning a huge profit in both stock and derivative markets.

These conflicting channels of influence raise an interesting empirical question regarding how bondholders, an important group of claimholders in the capital structure, view an active option market. In this paper, we address this open empirical question. Specifically, we study whether the volume of equity options written on the underlying asset increases or reduces firms' cost of debt. We find that a one-standard-deviation increase in options trading volume from its mean is associated with a 10-basis-point increase in the bond at-issue yield spread.

[1] Data from Options Clearing Corporation: http://www.optionsclearing.com/webapps/historical-volume-query.

[2] See, for example, 'What is Jana doing?' by Andrew Ross Sorkin, The New York Times, February 7th, 2008.

We examine in detail the reasons for and mechanisms driving these results. Our starting point is the recognition that active options markets alter the incentives for market participants to gather private information and that trading on such information makes stock prices more efficient (e.g., Cao, 1999; Chakravarty, Gulen, and Mayhew, 2004; Pan and Poteshman, 2006). However, the benefit to informed traders from options markets should depend on the volume of option trading activity because illiquid markets hamper not only informed but also uniformed traders. Accordingly, the informational benefit goes beyond the effect of the mere existence of an options market on the firm's stock and should be related to whether the market for the listed options has sufficient volume, as informed traders' incentives to trade are higher in high-volume markets (Pagano, 1989; Admati and Pfleiderer, 1988). Taken together, these works provide strong support for the conjecture that informational efficiency may be greater in highly liquid options markets. Because prices play an active role (i.e., managers learn from prices) when managerial decisions are made (Dow and Gorton, 1997; Faure-Grimaud and Gromb, 2004; Chen, Goldstein, and Jiang, 2007), greater price efficiency should serve as a more effective disciplining mechanism, mitigating the classic moral hazard problem between management and shareholders. Under this argument, stock prices reflecting more information about firms' fundamentals not only mitigate the agency problem between management and shareholders but also reduce the information asymmetry between shareholders and debtholders, which should ultimately facilitate firm financing.

Opposite to the beneficial effect stated above, there is also a more pessimistic view of the effect of options from a bondholder perspective. Active options markets can exacerbate the expropriation of bondholder wealth from shareholders. Specifically, options allow investors, including current shareholders [3], to extract high trading gains from certain events, with especially detrimental effects on bondholders' welfare.

A particular concern arises when a shift in control from shareholders to creditors is imminent as, for instance, in the event of financial distress (Borisova, Fotak, Holland, and Megginson, 2015). In the event of default, creditors become the new owners through the distribution of stock in restructuring, thereby increasing the likelihood of bondholders being expropiated by shareholders. An additional concern arises in the case of acquisitions and disciplinary takeovers. Takeovers can benefit target shareholders but also harm the target bondholders by adding more debt to the firm, thereby reducing the value of

[3] Although several restrictions on free trading in derivative markets apply to a firm's shareholders, strict requirements and prohibitions primarily affect corporate insiders, defined by the SEC as a company's officers and directors and any beneficial owners of more than ten percent of a class of the company's equity securities registered under Section 12 of the Securities Exchange Act of 1934. Any shareholder not falling into these categories faces no constraints whatsoever on engaging in, for example, options trading. The literature has documented widespread use of financial derivatives such as options by large institutional investors, including mutual funds (Koski and Pontiff, 1999) and hedge funds (Aragon and Martin, 2012).

the outstanding bonds not only by increasing the probability and deadweight costs of a possible future bankruptcy but also by reordering the priority of claims in bankruptcy (Cremers, Nair, and Wei, 2007). The literature provides extensive theoretical and empirical evidence supporting the use of options by shareholders in advance of banrupcy fillings and takeovers, to the detriment of bondholders. Back (1993) argues that informed traders may prefer to trade options rather than stocks because of increased opportunities for leverage. Cao (1999) concludes that agents with information about future contingencies should be able to trade more effectively on their information in the presence of options, and Easley, O'Hara, and Srinivas (1998) provide theoretical evidence that informed traders may choose the options market to capitalize on their private information, benefiting from the higher leverage and liquidity in the options market; therefore, informed traders also may trade in the options market before extreme corporate events to benefit from option features. More recently, Ge, Hu, Humphery-Jenner, and Lin (2016) empirically show how informed traders also exploit options markets before the event of bankruptcy filing. They find that the volume of options to stock ratio (O/S) measured from Roll, Schwartz, and Subrahmanyam (2010), computed over the interval from two days to four days before the bankruptcy filing, is significantly and negatively related to bankruptcy filing returns. In particular, they show how a one-standard-deviation increase in O/S is associated with a 10.84-percentage-point decrease in bankruptcy announcement returns. The last empirical result indicates a direct channel for shareholders to improve their payoff in the extreme case of bankruptcy. These works conclude that shareholders can significantly improve their expected payoff in the event of default by directly leveraging options' features, which could even favor strategic default decisions. Shareholders may default for solvency reasons, as well for strategic reasons (Favara, Schroth, and Valta, 2012). Thus, as a firm becomes seriously distressed, increasing shareholder control can affect managerial decisions in a way that not only augments the shareholders' expected payoff in the event of default but also contributes to the ability to anticipate the timing of default (Feldhütter, Hotchkiss, and Karakaş, 2016). The other important corporate event from a bondholder perspective is when a merger or acquisition take place. In this vein, Chan, Ge, and Lin (2015) find that the implied volatility spread and implied volatility skew have significant predictability for acquirer announcement returns in mergers and acquisitions, and Cao, Chen, and Griffin (2005) show that the call option volume imbalance has a positive relationship with target firm announcement returns in takeovers. Both empirical studies suggest that options are also used to take advantage before takeovers, providing shareholders with an effective instrument to profit from these corporate events. Although we have focused thus far on the direct use of options as potential expropiation instruments, the mere fact of the existence of a liquid option market constitutes a clear threat of being expropiated by shareholders that should be priced, accordingly, by bondholders.

Combining all of these considerations, it is apparent that the net impact of options markets on the cost of debt is theoretically unclear and ultimately an empirical issue. To resolve this ambiguity, we assemble a rich and original data set containing information on bond issues, firm-specific characteristics and options trading data. To approximate the total quarterly dollar options volume, we use the approach proposed by Roll, Schwartz, and Subrahmanyam (2009). We run panel data regressions on a sample of 4,330 bond issues by 808 different publicly traded U.S. firms during the period from 1996 to 2014.

Our baseline test reveals a detrimental effect of options trading volume on a firm's cost of debt. In particular, a more liquid option market is related to higher yield spreads over treasuries and lower bond credit ratings. These results are robust to using alternative subsamples and alternative measures of the cost of debt, the inclusion of a wide range of control variables and several econometric models.

While these findings are consistent with options markets having a net detrimental effect on bond yields and credit ratings, by augmenting the conflict of interest between shareholders and bondholders, we are concerned that our results could be explained by an alternative interpretation. This is the case if our results are totally driven by options investors trading in advance of bond issues to profit from companies with a more uncertain short-term future and, hence, costlier debt financing. Although the last argument implicitly assumes weak expected company, or stock market price, short-term behavior, options traders could benefit from options even if short-term expectations are not negative. For instance, options are a mechanism for trading on information about future equity volatility, which allows investors with information about short-term stock price volatility to benefit from options (Ni et al., 2008). Both stories support the interpretation of options traders anticipating a company's short-term market behavior after bond issues, thus, challenging our main argument suggesting an exacerbation of the classical conflict of interest between shareholders and bondholders.

To account for such selection issues, we extend our baseline specification in several ways. First, we estimate two-stage least squares (2SLS) models using moneyness and open interest as instrumental variables (Roll, Schwartz, and Subrahmanyam, 2009; Blanco and Wehrheim, 2017). Our identification strategies suggest that the detrimental association between options trading and the cost of debt is not simply driven by self-selection. Second, to avoid the possibility that our results are driven by investors more heavily trading options on highly distressed firms, we include specific proxies for firm distress in our regression specification, and we run our baseline regressions by firm distress quartiles and perform quantile regressions. Overall, we show that the negative impact of options trading on a firm's cost of debt is not totally explained by traders anticipating future firm distress, nor is neither concentrated in highly distressed firms. Moreover, we explore the effect of option trading volume on short-term firm value and stock price behavior after bond issues. We show that the detrimental impact of options on the firm's cost of debt is not caused by traders anticipating short-term negative firm or stock price evolution. Finally, we show how the inimical effect of options trading over the cost of debt remains economically and statistically significant after considering time-series yield spreads instead of bond issues. The results are also robust to the inclusion of bond fixed effects.

To address additional potential concerns about our findings, we revisit these results to provide a better understanding of the mechanisms driving them. Specifically, we investigate the intensity of the effect in different scenarios in which our hypothesis predicts option markets have a stronger detrimental effect on firms' cost of debt. First, we focus on the two previously mentioned corporate events, takeovers and firm defaults, that the literature identifies as detrimental to bondholders' welfare (Cremers, Nair, and Wei, 2007; Qiu and Yu, 2009) but are potentially profitable for option traders (Cao, Chen, and Griffin, 2005; Chan, Ge, and Lin, 2015; Ge, Hu, Humphery-Jenner, and Lin, 2016). The effect of options volume on firm cost of debt is more pronounced when the firm is more financially distressed, or closer to experiencing default, and more open to the market for corporate control (more likely to experience a takeover). Second, we assess how the type of shareholder influences our results. Consistent with our main story, we find that the effect is amplified when the proportion of dedicated owners (Bushee, 1998), which have greater incentives to be informed about firm fundamentals and to influence managerial decisions, is higher. Finally, we explore the case of debt renegotiation. When shareholders have advantages over debtholders in renegotiation, bondholders' expropriation risk increases as the threat of strategic default intensifies (Garlappi, Shu, and Yan, 2008; Favara, Schroth, and Valta, 2012). Options are particularly damaging for bondholders when shareholders' incentives for default and bargaining power are higher. In summary, these results provide compelling evidence regarding the role of option markets inducing shareholders to act to the detriment of bondholders' interests.

Our paper makes several contributions to the literature. First, to the best of our knowledge, it is the first study to specifically examine the real effect of financial derivatives on the firm's cost of debt. In this vein, there is a growing literature that empirically explores the effects of financial derivatives on the real economy. Roll, Schwartz, and Subrahmanyam (2009) show that options trading is positively associated with firm value and price informativeness, Blanco and Wehrheim (2017) find a positive association between options trading volume and firm innovation, and Naiker, Navissi, and Truong (2013) show how high-volume options markets reduce the cost of equity.

Second, we contribute to the understanding of the determinants of the cost of debt. While there is a vast literature studying the determinants of corporate bond spreads, such an analysis of the relationship between options trading and the firm's cost of debt has not previously been undertaken. Empirical studies have examined, for instance, the effect of liquidity (Odders-White and Ready, 2006), competition (Valta, 2012), government ownership (Borisova, Fotak, Holland, and Megginson, 2015), an open market for corporate control (Qiu and Yu, 2009), political rights (Qi, Roth, and Wald, 2010) or strategic ownership (Aslan and Kumar, 2012).

Third, our paper builds on a recent empirical literature showing that options trading contains information on several important upcoming corporate events, such as earnings announcements (Easley, O'Hara, and Srinivas, 1998; Roll, Schwartz, and Subrahmanyam, 2010; Johnson and So, 2012), takeovers (Cao, Chen, and Griffin, 2005; Chan, Ge, and Lin, 2015; Augustin, Brenner, and Subrahmanyam, 2015) and bankruptcy fillings (Ge, Lin, and Pearson, 2016). In addition, Poteshman (2006) investigates unusual put option buying before the terrorist attack of September 11, 2001, finding informed trading in the options market for two airline companies prior to the attack. This study empirically explores the direct economic consequencies of the potential use of options by shareholders at the expense of bondholder interests.

Finally, we also enrich the debate on the regulation of financial derivatives. Unlike stock market listings, where firms apply, options listings are exogenous to firm decisions; they are made within exchanges. These exchanges are self-regulating institutions that are members of the Options Clearing Corporation (OCC), which operates under the jurisdiction of the Securities and Exchange Commission (SEC) (for exchange-listed options). Because the SEC plays an important role in determining the eligibility criteria for securities in options trading (Mayhew and Mihov, 2004), this topic is of particular interest to policy makers.

The remainder of the paper is organized as follows. Section 1.2 describes the sample, the measurement of variables and descriptive statistics. Section 1.3 presents our main results. We perform a rich set of robustness tests in Section 1.4. In Section 1.5, we discuss the underlying mechanism through which options trading may affect the cost of debt. Section 1.6 concludes the paper.

1.2 Data and methodology

We compile information on bond issues, firm-specific characteristics and options trading data from a variety of sources. Detailed definitions of all variables and their sources are provided in A.1. We begin by extracting bond-level data from the Thomson Reuters SDC Platinum Global New Issues Database. Our main focus is on new issues, rather than secondary market quotes, as they provide direct and more accurate measures of the cost of debt (e.g., Datta, Iskandar-Datta, and Patel, 1999; Elton, Gruber, Agrawal, and Mann, 2001; Maxwell and Stephens, 2003; Qi, Roth, and Wald, 2010; Francis, Hasan, John, and Waisman, 2010). We limit our sample to U.S. companies and issues of fixed-rate [4] corporate bonds defined in U.S. dollars over the period 1996-2014 [5]. In addition to our measures of the cost of debt (bond rating and yield spread), we retrieve from the SDC Global New Issues data on bond *maturity* and *principal* amount, and we construct two dummy variables that indicate whether the bond is *callable*[6] and *public*. These variables have previously been successfully used as determinants of the cost of debt [7].

We measure a firm's cost of debt using the bond yield spread and bond rating. Both metrics are standard in the literature and provide direct values of the real cost incurred by firms to access debt financing via bond markets. Our first measure of the cost of debt is the bond yield spread at the time of bond issue. Following Cremers, Nair, and Wei (2007) and Qiu and Yu (2009), we calculate the yield spread as the difference between the bond's yield to maturity and the Treasury bond yield with the same maturity. We collect constant maturity Treasury yields from the Federal Reserve H-15 Release for the six-month, one-year, three-year, five-year, seven-year, 10-year, 20-year and 30-year maturities. In the few cases in which there is not a maturity-equivalent Treasury bond, we use linear interpolation between the two closest maturities to calculate the yield of the risk-free bond [8].

Alternatively, we use bond ratings to capture the perceived risk of a bond. To measure these ratings, we rely on the Standard and Poor's rating reported by SDC [9]. We convert the traditional bond rating by S&P into a numerical scale, where lower values correspond to poorer ratings [10] and vice versa.

For data on options trading activity, we use Option Metrics. This database contains information on daily put and call contracts traded for each individual stock along with bid and ask closing prices from 1996 onward. To define our measure of options volume, we follow Roll, Schwartz, and Subrahmanyam (2009). We first multiply the total trade in each option by the end-of-day quote midpoint for that option. Next, we aggregate this

[4] We retrieve bond issues for fixed and floating rate bonds from SDC Global New Issues. After applying all filters, floating bond issues represent less than 6.5% of all bonds. Given this small amount, the greater difficulty of properly assessing yields to maturity on floating bonds with different complex benchmarks, and for the sake of homogeneity in our main sample, we decide to drop issues of floating rate bonds. In any case, when we add this small sample, the results remain qualitatively intact. These results are available from the authors upon request.

[5] Options Metrics data coverage starts in 1996.

[6] There are no putable bonds in the sample once we apply all filters.

[7] See, among others, Qiu and Yu (2009),Qi, Roth, and Wald (2010), Francis, Hasan, John, and Waisman (2010) or Borisova, Fotak, Holland, and Megginson (2015).

[8] There are more complex methods for interpolating a piece-wise term structure. However, there is no reason to believe that our approach poses a problem. Most of our bonds either match a maturity-equivalent treasury or have maturities within one year of an existing Treasury.

[9] Whereas other agencies such Moody's also provide with individual bond ratings, Standard and Poor's is the standard in recent literature (Qiu and Yu, 2009; Qi, Roth, and Wald, 2010; Borisova, Fotak, Holland, and Megginson, 2015).

[10] The complete numerical scale is as follows: 1-CCC-, 2-CCC, 3-CCC+, 4-B-, 5-B, 6-B+, 7-BB-, 8-BB, 9-BB+, 10-BBB-, 11-BBB, 12-BBB+, 13-A-, 14-A, 15-A+, 16-AA-, 17-AA, 18-AA+, 19-AAA-, 20-AAA, 21-AAA+.

number quarterly across all trading days and all options on the listed stock. We construct this variable, which we call *Options Volume*, for the quarter prior to that of bond issuance [11].

Existing empirical research on structural credit risk modeling and market microstructure finds a significant role of firm-specific characteristics in determining the cost of debt (Collin-Dufresne, Goldstein, and Martin, 2001; Campbell and Taksler, 2003; Odders-White and Ready, 2006; Avramov, Jostova, and Philipov, 2007; Ericsson, Jacobs, Oviedo, et al., 2009; Qiu and Yu, 2009). To control for these effects, we gather firm-specific data from CRSP-Compustat Merged (CCM) on the quarter prior to bond issuance. Specifically, we collect data to construct the following variables: *Size* (as the log of total assets), return on assets or *ROA* (net income over total assets), *Leverage* (total debt divided by total assets), growth opportunities as proxied by *Tobin's Q* (sum of the market capitalization of a firm's common equity, liquidation value of its preferred shares and the book value of debt, divided by book value of assets), relative *Bid-ask spread*, and *Firm risk* (as proxied by the standard deviation of a firm's quarterly cash-flow during previous year [12]). We drop firms that have missing observations for the quarter of interest in any of these variables and require them to be reporting to the CRSP database for at least two years, to mitigate back-filling bias. We remove from our sample firms that are not quoted in the three major American markets (Amex, NYSE, or Nasdaq). Finally, we exclude financial firms (Standard Industry Classification (SIC) code 6000-6999)[13], as their leverage may be influenced by their idiosyncrasy, and their debt-like liabilities are not strictly comparable to those of non-financial firms (Rajan and Zingales, 1995). In line with existing literature, all variables are winsorized at the 1st and 99th percentiles to ensure that our results are not driven by outliers.

Because, after applying all filters, our data sets do not perfectly overlap, we lose some observations when merging data from these three sources. Our final sample comprises 4,330 bond issues in the period 1996-2014 for 808 different firms [14]. Table 1.1 provides information on the number of issues per year and the number of issuers.

[11] We set the value of *Options Volume* equal to zero when the firm is not quoted in the options market. Although firms not listed in options markets could be idiosyncratic and should be treated with caution (Mayhew and Mihov, 2004), only two observations in our final sample have options volume equal to zero. The results remain completely unchanged when excluding these observations.

[12] For robustness, we also use stock return volatility instead of that of the cash-flows, which does not change the results.

[13] We drop 222 financial firms. The results remain economically and statistically significant when we include these firms.

[14] We aggregate bond issues at the 6-digit-CUSIP level, which is the identifier provided by SDC Platinum.

Table 1.1: Number of Bond Issues per Year

Year	Number of Issues	Number of Firms
1996	77	53
1997	144	85
1998	188	111
1999	101	71
2000	118	76
2001	170	102
2002	131	65
2003	101	66
2004	31	26
2005	87	56
2006	159	101
2007	229	117
2008	253	125
2009	349	213
2010	400	253
2011	384	212
2012	470	257
2013	441	224
2014	497	259
Total	4330	

1.2.1 Summary statistics

Table 1.2 reports the summary statistics for the main variables used in this study. The average issue in our sample has a spread over treasuries of approximately 215 basis points (bps) with a median of 157 bps, which is consistent with similar recent studies [15] in the literature (e.g., Borisova, Fotak, Holland, and Megginson, 2015). With respect to bond ratings, the average (median) according to our numerical scale is 11.54 (12.00), which corresponds to a Standard and Poor's rating between BBB and BBB+ (BBB+). The average firm has a quarterly options trading volume of $165 million (median $ 22.46 million). This substantial number reflects the dramatic, exponential growth in the use of derivatives in recent years [16]. For other variables, firms in our sample have a mean (median) size of $33.48 ($13.58) billion with an average Tobin's Q of 1.80 (median 1.57). The average bond in our sample has a principal equal to $558 million and maturity of approximately 12 years. Finally, 99.5% of our bonds are public, and less than 5% include a callable option. All these statistics fall within the standards in the literature. Due to high skewness that may jeopardize our results, we use the natural logarithm of some of the variables for the analysis. Specifically, we calculate the natural logarithm of the yield spread, options volume, total assets, firm risk, bid-ask spread and (one plus) maturity.

[15] Obviously, in existing studies with a sample ending before 2007, the average yield spread is much lower (approximately 120 bps.). The average yield spread in our sample pre-2007 is 130 bps.

[16] Our number is considerably larger than those reported by previous articles using this variable. Nonetheless, these studies (e.g., Roll, Schwartz, and Subrahmanyam, 2009; Blanco and Wehrheim, 2017) focus on a period ending before 2005. The sample statistics prior to that date fall within those of the literature.

Table 1.2: Summary Statistics

	Mean	StdDev	25%	Median	75%	Observation
Yield Spread (bps)	215.582	170.244	96.000	157.300	280.800	4330
S&P Rating	11.545	3.322	10.000	12.000	14.000	4330
Option Volume ($ Millions)	165.016	414.441	3.450	22.465	111.857	4330
Open Interest	1006.922	1728.727	117.367	382.986	1164.368	4328
Moneyness	0.283	0.138	0.200	0.256	0.323	4328
Total Assets ($ Billions)	33.488	59.883	5.062	13.586	33.883	4330
Tobin's Q	1.804	0.792	1.231	1.573	2.151	4330
ROA	0.015	0.015	0.006	0.014	0.023	4330
Leverage	0.273	0.156	0.161	0.251	0.355	4330
Bid-Ask Spread	0.003	0.006	0.000	0.001	0.003	4330
Firm risk	0.073	0.099	0.022	0.041	0.079	4330
Callable Dummy	0.045	0.207	0.000	0.000	0.000	4330
Public Bond Dummy	0.995	0.071	1.000	1.000	1.000	4330
Maturity (in years)	11.353	8.296	5.353	10.014	10.077	4330
Principal Amount ($ Millions)	558.060	457.799	250.000	450.000	700.000	4330

Notes: This table presents the summary statistics for the variables used in this study. Definitions of all variables are provided in A.1. The sample period is 1996-2014.

1.2.2 Specification

In our baseline specification, we analyze the effect of options trading volume on a firm's cost of debt by estimating the following ordinary least squares (OLS) regressions, where i indexes bond issues and t indexes time:

$$Y_i = \alpha + \beta Ln(OptionVolume) + \gamma Z_i + \delta_t + \lambda_i + \epsilon \tag{1.1}$$

The dependent variable, Y_i, measures a firm's cost of debt under the two metrics previously discussed. Thus, one type of econometric model in our analysis will take the natural logarithm of the at-issue bond yield spread, *Ln(Yield Spread)*, as the dependent variable; another will use the bond's *S&P Rating* [17]. *Ln(Option Volume)* is the natural logarithm of the previously discussed options trading volume variable. The vector Z_i contains a set of bond- and firm-level controls [18]. We control for firm size (log total assets), growth opportunities (Tobin's Q), profitability (ROA), leverage, firm risk, illiquidity (bid-ask spread), bond maturity and callable option[19] and include a dummy for public bonds. A

[17] We are aware of the potential problems of using OLS regression with a count variable such as S&P Rating. To mitigate concerns regarding this issue, we fit a Poisson model for S&P Rating, and we repeat the analysis with a Negative Binomial and an Ordered Logit model. Moreover, we transform the rating variable to the natural log of one plus the rating in a traditional OLS regression. All these tests are reported in Table A2.5 in A.2 and confirm our initial results.

[18] In subsequent analyses in the robustness section, we add various additional controls in both of these dimensions that leave our initial results unchanged.

[19] The callable dummy is typically not used in the literature as a control for Standard and Poor's bond rating. For this reason, we leave the callable variable as a control only in the case with the bond yield

complete definition of these variables is presented in A.1. In line with existing research, we expect that a firm's size, growth potential and profitability have positive impacts on (by reducing) the cost of debt. Conversely, leverage and firm risk (cash-flow volatility) will increase the return demanded by bondholders, which is contrary to the firm's interest. Similarly, bonds including a callable option or having longer maturities reflect, in principle, higher perceived risk. The control variable on stock market liquidity (or illiquidity) is of special relevance for this analysis. First, this is because exchanges are more prone to quote options from firms with high stock trading volume (Mayhew and Mihov, 2004), but second and more important, this is due to the asymmetric information embedded in stock market liquidity measures [20]. In particular, Odders-White and Ready (2006) find a negative relationship between a firm's credit rating and equity market liquidity. Moreover, common microstructure measures of adverse selection such as the relative bid-ask spread can be used to predict future changes in ratings. Following this rationale, we expect the relationship between stock liquidity and debt cost to be negative. We treat stock liquidity with caution by first using the relative bid-ask spread (used more prominently in the recent literature) as a proxy and then repeating the analysis with the Amihud (2002) measure [21].

Although our focus is on bond issues (and hence a pooled OLS model) rather than time-series (panel) data, there exist some time-varying features not related to bond or firm characteristics that could undesirably influence our analysis. For example, the economic conditions surrounding a crisis (e.g., the dotcom bubble, recent financial crisis) can increase debt financing costs in a manner unrelated to firm or bond fundamentals. Similarly, the exponential growth of derivatives markets in recent years [22] demands a close control of time effects. For these reasons, we include in our regression model the term δ_t, which accounts for time dummies. In a similar fashion, following past studies in the literature, λ_i controls for industry dummies (at the two-digit SIC code level[23]). Finally, we report robust standard errors clustered at the firm level, which is the most accurate and conservative approach (Petersen, 2009).

spread as a dependent variable. The results (unreported) when including the callable dummy as a control for bond rating remain substantially unchanged.

[20]See, among others, Roll (1984), Glosten and Harris (1988), Stoll (1989), Hasbrouck (1991), Easley, Kiefer, O'hara, and Paperman (1996) or Huang and Stoll (1997) for seminal work on the issue.

[21]In fact, using the Amihud (2002) measure yields a higher economic significance of the effect related to options volume. As it is most commonly used to capture the adverse selection component, we adopt a conservative approach and retain the traditional relative bid-ask spread in the main procedure. The results when using the Amihud (2002) measure are reported in Table A2.8 in A.2.

[22]The growth is especially surprising in equity options markets, the volume of which increased from 200 million contracts in 1996 to almost 4,000 million in 2015 (see Options Clearing Corporation).

[23]Table A2.6 in the robustness section shows that our results are robust to the inclusion of four-digit SIC dummies.

1.3 Main results

We begin the analysis with the results from the regression specification in Eq. 1.1, which we display in Table 1.3. In column 1 of Table 1.3, we start with a specification including only firm-level controls and time and industry dummies for the natural logarithm of bond yield spread as the dependent variable. The same specification for our second dependent variable, *S&P Rating*, is reported in column 3. We extend this analysis to include bond-level controls in columns 2 and 4 of Table 1.3. Column 5 reports the results of a Poisson regression using *S&P Rating*.

The coefficient on *Ln(Option Volume)* is of high statistical significance (p-value $<$ 0.01) across all specifications in Table 1.3. Our baseline test reveals a detrimental effect of options trading volume on a firm's cost of debt. In particular, a more liquid option market is related to a higher yield spread over treasuries and a lower credit rating. In sum, increasing options trading volume is associated with costlier debt financing, after controlling for firm and bond characteristics, as well as for industry and time effects. The economic magnitude of the effect is strong. For example, taking the coefficient of 0.037 specified in column 2, a one-standard-deviation increase in options volume from its mean of $165.01 million is associated with an increase in the *Yield Spread* of nearly 10 bps.

The control variables in Table 1.3 take the expected estimated coefficients for yield spread and credit rating. While firm size, growth opportunities, profitability and liquidity relate negatively with the cost of debt, leverage, firm risk and the existence of a callable option on the bond are positively associated with the cost of debt financing. One special case is maturity, which is associated with an increasing yield spread but a higher (better) credit rating. The relationship between spreads and time to maturity is not surprising and reflects reduced uncertainty over coupon and par value payments as the bond's maturity date approaches. The case of credit ratings can be explained by a tendency on the part of larger, financially stable, companies to issue debt with longer maturities, leading agencies to evaluate these issues with better ratings.

1.3.1 Endogeneity

In this section, we address concerns related to endogeneity. Option markets are a particularly beneficial trading venue for informed traders where trading and short-selling costs are minimized. Moreover, they are particularly useful in situations of high uncertainty. Given these particular features, it is fair to argue that our results can be explained by reverse causality. Since option markets contain information regarding future stock prices (e.g. Chakravarty, Gulen, and Mayhew, 2004; Roll, Schwartz, and Subrahmanyam, 2010; Johnson and So, 2012; Ge, Lin, and Pearson, 2016), an increase in option trading volume

Table 1.3: Options Volume and Cost of Debt

	Ln(Yield Spread)		S&P Rating		
	OLS (1)	OLS (2)	OLS (3)	OLS (4)	Poisson (5)
Ln(Option Volume)	0.038***	0.037***	-0.224***	-0.222***	-0.019***
	(0.010)	(0.010)	(0.046)	(0.045)	(0.004)
Ln(Total Assets)	-0.288***	-0.280***	1.530***	1.526***	0.130***
	(0.017)	(0.017)	(0.089)	(0.089)	(0.008)
Tobin's Q	-0.310***	-0.296***	1.359***	1.364***	0.100***
	(0.024)	(0.023)	(0.104)	(0.104)	(0.009)
ROA	-4.868***	-5.313***	24.192***	23.629***	2.345***
	(0.893)	(0.896)	(3.837)	(3.810)	(0.365)
Leverage	0.913***	0.833***	-6.018***	-6.045***	-0.611***
	(0.105)	(0.101)	(0.431)	(0.429)	(0.046)
Ln(Firm risk)	0.033***	0.035***	-0.076	-0.074	-0.010**
	(0.013)	(0.012)	(0.047)	(0.047)	(0.004)
Ln(Bid-Ask Spread)	0.137***	0.148***	-0.231**	-0.224**	-0.032***
	(0.029)	(0.030)	(0.098)	(0.097)	(0.011)
Public Bond Dummy		-0.220		0.674	0.066
		(0.179)		(0.623)	(0.050)
Ln(Maturity)		0.230***		0.193***	0.020***
		(0.021)		(0.050)	(0.004)
Callable Dummy		0.311***			
		(0.042)			
Observations	4330	4330	4330	4330	4330
R^2	0.668	0.706	0.741	0.742	

Notes: This table presents OLS and Poisson regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables. Detailed definitions of all variables are provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

may be driven by future market expectations of firm distress. For example, investors that operate through option markets may bias their trades toward those companies facing a more turbulent short-term future and, hence, costlier debt financing. We address these concerns by performing a wide range of tests that include instrumental variable regression as well as analyses across firms with different levels of distress and the behavior of equity returns following bond issuance.

Instrumental variable analysis

We first address endogenous effects using an instrumental variable approach and two-stage least squares (2SLS) regression. Instrumental variable regression will help not only to assess the causal direction of the relationship between options volume and cost of debt but also to mitigate the possible measurement error in the independent variable of interest.

A good instrument for our setting is a variable that is highly correlated with options trading (which we can test, for example, via the first stage of the 2SLS procedure) but uncorrelated with our measures of the cost of debt except through other independent (control) variables (i.e., the exclusion restriction holds). Roll, Schwartz, and Subrahmanyam (2009) introduce two variables that serve as good instruments for our framework: (i) open interest in the stock's listed options and (ii) moneyness (i.e., the average absolute difference between the stock's market price and the option's strike price). We devote this section to the analysis of open interest as an instrument and show in A.2 that the results are similar when, first, using moneyness as an instrument and, then, both instruments together [24]. *Open interest* consists of the number of open options contracts on each day in a listed stock. As Roll, Schwartz, and Subrahmanyam (2009) argue, this measure should not be inherently related to firm value, as it includes the summation of both call and put contracts [25]. Extending this argument, open interest should not be associated either with higher or lower bond yield spreads or credit ratings in any mechanical way. To construct the variable open interest, we average open interest, from Options Metrics, across all options on a stock throughout the calendar quarter. The correlation between open interest and options volume in our full sample is 0.4305, suggesting that open interest is indeed related to options trading volume. As in the case of options volume, we measure open interest in the quarter prior to bond issuance and use the natural log of this variable,

[24] Previous works, including Roll, Schwartz, and Subrahmanyam (2009) and Blanco and Wehrheim (2017), use moneyness as their preferred instrument. However, we note that from 2007 onward, the correlation of moneyness with options volume starts decreasing, and this is probably related to the increased uncertainty related to the financial crisis. Although our results hold when using moneyness in the 2SLS, we retain open interest in the main analysis, as its correlation with options trading is strong throughout the sample period.

[25] High or low levels of call or put interest could be associated with higher or lower firm values but not the sum of the two.

Ln(Open Interest), for the 2SLS analysis.

Table 1.4: Options Volume and Cost of Debt: Open Interest as Instrument

	First stage	Second stage	
	Ln(Option Volume)	Ln(Yield Spread)	S&P Rating
	(1)	(2)	(3)
Ln(Open Interest)	0.910***		
	(0.040)		
Ln(Option Volume) (instrumented)		0.075***	-0.407***
		(0.015)	(0.065)
Ln(Total Assets)	0.565***	-0.335***	1.786***
	(0.050)	(0.023)	(0.105)
Tobin's Q	0.544***	-0.328***	1.512***
	(0.060)	(0.026)	(0.112)
ROA	3.640*	-5.490***	24.843***
	(2.142)	(0.890)	(3.739)
Leverage	-0.750***	0.863***	-6.175***
	(0.240)	(0.098)	(0.420)
Ln(Firm risk)	0.082***	0.026**	-0.025
	(0.030)	(0.011)	(0.044)
Ln(Bid-Ask Spread)	-0.221***	0.149***	-0.228**
	(0.072)	(0.031)	(0.102)
Public Bond Dummy	-0.005	-0.201	0.581
	(0.362)	(0.195)	(0.700)
Ln(Maturity)	-0.034	0.231***	0.189***
	(0.028)	(0.021)	(0.051)
Callable Dummy	0.129	0.292***	
	(0.116)	(0.039)	
Observations	4328	4328	4328
R^2	0.860	0.702	0.739

Notes: This table presents 2SLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables with average quarterly open interest (Open interest) as the instrumental variable. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

We display the results from the 2SLS procedure in Table 1.4. Column 1 comprises the results for the first stage of the 2SLS analysis, in which we regress options volume, *Ln(Option Volume)*, on the set of independent variables from Eq. 1.1 plus open interest, *Ln(Open Interest)*, and a full set of time and industry dummies. The positive and highly significant coefficient of 0.91 for open interest provides additional evidence of the strong relationship between this variable and option volume. Additionally, instrument irrelevancy is rejected (p-value<0.01) using the Kleibergen and Paap (2006) statistic test. The value of the Cragg-Donald Wald F-statistic is above 10 (the standard rule of thumb) and higher than Stock and Yogo (2005) critical values, rejecting the null that the instrument is weak.

Columns 2 and 3 in Table 1.4 report the second stage from the 2SLS on our two measures of the cost of debt. The coefficients on the instrumented options volume variable for the bond yield spread and bond rating of 0.075 and -0.407, respectively, are strongly significant (p-values < 0.01), thus advocating for a causal effect of options trading on the cost of debt. These coefficients are slightly larger in magnitude that those reported via OLS (0.037 and -0.222, respectively). However, discrepancies between OLS and 2SLS coefficients are common and arise due to various factors primarily related to the mitigation of errors-in-variables biases [26]. Since the analysis with the other instrument (moneyness) reveals similar qualitative results [27], this divergence is unlikely to jeopardize the validity of our results but, rather, provides more accurate estimates that strengthen them.

In summary, the results from the 2SLS analysis are consistent with the notion of a significant causality running from more active option markets to a firm's cost of debt financing. Moreover, mitigating the bias due to the possible endogenous link between options and debt costs amplifies the main effect.

Options volume and firm distress

In the previous section, we show that the positive association between a firm's cost of debt and its options trading volume is unlikely to be driven by investors more heavily trading options on those firms that they predict will face a more adverse future. However, some questions remain unsolved, namely, whether the effect occurs throughout the distribution of firms or, rather, is concentrated among those firms that are highly distressed. In this section, we perform an in-depth analysis to ensure that our results are not driven by highly distressed firms.

We begin by including a direct measure that proxies for firm distress, the well-known Kaplan and Zingales (1997) index (*K-Z Index*), in the regression specification [28]. We define the *K-Z Index* as in the synthetic specification from Lamont, Polk, and Saaá-Requejo (2001) and defined in A.1. A higher value of the *K-Z Index* indicates that a firm relies more strongly on external financing and, ultimately, has larger financial constraints. Table 1.5 presents the results from including the *K-Z Index* as a control in our baseline regressions (columns 1 and 3) and then interacting it with options volume for our two

[26] Beaver, McAnally, and Stinson (1997) and Irwin and Terviö (2002) provide a comprehensive analysis of the relevant econometric issues related to this process.

[27] For the sake of space, we report the estimates from the instrumental variable analysis with moneyness as an instrument in A.2. Table A2.1 provides the results from the analysis using moneyness as an instrument, whereas Table A2.2 displays the results from using both instruments in the 2SLS.

[28] The results remain unchanged (unreported) if we instead use the Altman (1968) Z-score to predict corporate bankruptcy. These results are available from the authors upon request.

Table 1.5: Options and Financial Distress: K-Z Index

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.039***	0.041***	-0.245***	-0.265***
	(0.011)	(0.011)	(0.048)	(0.048)
K-Z Index	0.046	-0.040	-1.147**	-0.491
	(0.094)	(0.096)	(0.542)	(0.646)
Ln(Option Volume) × K-Z Index		0.064**		-0.489***
		(0.026)		(0.177)
Ln(Total Assets)	-0.281***	-0.277***	1.542***	1.510***
	(0.018)	(0.018)	(0.092)	(0.091)
Tobin's Q	-0.316***	-0.315***	1.451***	1.446***
	(0.025)	(0.025)	(0.113)	(0.115)
ROA	-4.866***	-4.588***	18.345***	16.211***
	(0.920)	(0.901)	(3.748)	(3.527)
Leverage	0.849***	0.849***	-6.166***	-6.168***
	(0.110)	(0.110)	(0.474)	(0.474)
Ln(Firm risk)	0.034***	0.037***	-0.061	-0.084*
	(0.013)	(0.013)	(0.049)	(0.047)
Ln(Bid-Ask Spread)	0.141***	0.144***	-0.196*	-0.221**
	(0.032)	(0.032)	(0.103)	(0.103)
Public Bond Dummy	-0.223	-0.224	0.745	0.756
	(0.173)	(0.163)	(0.574)	(0.503)
Ln(Maturity)	0.224***	0.226***	0.195***	0.186***
	(0.022)	(0.022)	(0.053)	(0.052)
Callable Dummy	0.310***	0.314***		
	(0.043)	(0.042)		
Observations	3782	3782	3782	3782
R^2	0.702	0.704	0.748	0.752

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of options volume with the K-Z Index (Kaplan and Zingales, 1997) as a measure of financial constraints. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

measures of firms cost of debt (columns 2 and 4). The coefficients on *Ln(Option Volume)* in columns 1 and 3 remain unaltered in significance and magnitude after controlling for firm distress. However, the interaction terms in columns 2 and 4 are significant and consistent with the effect of options on a firm's cost of debt being more pronounced when firms are more distressed. These results are consistent with, first, firm distress not driving the results and, second, our main hypothesis that options exacerbate shareholder-debtholder conflicts, as the effect is more pronounced in those situations where owning voting rights is more valuable. We revisit these results for further discussion in the mechanisms section.

Next, we assess whether the effect of options on bond yield spread and rating occurs homogeneously across firms with different levels of distress. We begin by running the regression specification in Eq. 1.1 on the bond yield spread across four quartiles of firm distress (as proxied by the *K-Z Index*), where Q1 indexes the least distressed and Q4 the most distressed firms. Table 1.6 shows the results. Whereas, as predicted, the effect is economically larger for more distressed firms, it remains significant across all quartiles, even for firms with the lowest level of financial constraints (0.043, p-value<0.05).

To take the analysis of the effect and firm quality to the extreme, we now include as a control Standard and Poor's rating for the firm (which we convert to a numerical scale with lower values indicating lower ratings). This specification is highly demanding for the effect, as bond rating and yield spread are explained primarily by the rating of the firm. Columns 1 and 3 in Table 1.7 show the results when introducing firm rating as a control for bond yield spread and bond rating as dependent variables, respectively. Columns 2 and 4 contain the regression with bond yield spread and bond rating, respectively, for the subsample of firms rated A or above according to the S&P rating scale. Even with this demanding specification, the results are in line with the existence of an effect of options volume on firm cost of debt beyond firm quality.

Finally, we perform a quantile regression to check whether the effect is limited to issues of bonds with particularly high yield spreads or poor credit ratings. Table 1.8 contains the results from a bootstrapped quantile regression with the specification in Eq. 1.1 for 10th and 90th percentiles of bond yield spread and bond credit rating, respectively. Highly significant coefficients (p-value<0.01) for *Ln(Option volume)* across the different specifications in Table 1.8 reveal that the effect of options on the cost of debt is not driven by highly distressed firms. Furthermore, the effect is stronger for bond issues of higher quality (10th percentile).

Taken together, these results are consistent with the view that option markets have a specific effect on a firm's cost of debt that is not driven by lower quality firms. In addition to being consistent with our hypothesis, these results reinforce the thesis that option markets lead the effect toward an increase in the cost of debt, and not *vice versa*. If the effect we find were to appear due to option traders anticipating firms' distress, we

Table 1.6: Options Volume and Cost of Debt: Firm Distress Quartile

	Ln(Yield Spread)			
	Firm distress quartile			
	Q1	Q2	Q3	Q4
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.043**	0.040**	0.061***	0.053***
	(0.019)	(0.020)	(0.019)	(0.017)
Ln(Total Assets)	-0.321***	-0.282***	-0.326***	-0.204***
	(0.033)	(0.039)	(0.034)	(0.036)
Tobin's Q	-0.300***	-0.339***	-0.362***	-0.318***
	(0.038)	(0.043)	(0.055)	(0.063)
ROA	-3.478***	-2.585	-4.051***	-3.672**
	(1.332)	(1.574)	(1.399)	(1.610)
Leverage	0.487***	0.809***	0.695***	0.971***
	(0.179)	(0.205)	(0.261)	(0.232)
Ln(Firm risk)	0.017	0.055**	-0.004	0.030
	(0.025)	(0.025)	(0.026)	(0.023)
Ln(Bid-Ask Spread)	0.116***	0.120**	0.221***	0.096**
	(0.043)	(0.051)	(0.048)	(0.045)
Public Bond Dummy	1.336***	0.000	-0.552***	-0.032
	(0.167)	(.)	(0.065)	(0.142)
Callable Dummy	0.272*	0.405***	0.344***	0.192***
	(0.157)	(0.099)	(0.085)	(0.053)
Ln(Maturity)	0.307***	0.222***	0.270***	0.065
	(0.027)	(0.028)	(0.037)	(0.056)
Observations	945	946	945	946
R^2	0.771	0.708	0.714	0.698

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables on two subsamples of data. Quartiles of firm distress are defined according to values of the K-Z Index (Kaplan and Zingales, 1997). A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 1.7: Options Volume and firm distress: Firm rating

	Ln(Yield Spread)		S&P Rating	
	All firms (1)	A-tranche (2)	All firms (3)	A-tranche (4)
Ln(Option Volume)	0.022**	0.037**	-0.174***	-0.156**
	(0.010)	(0.016)	(0.047)	(0.067)
Firm Rating	-0.105***		0.384***	
	(0.013)		(0.052)	
Ln(Total Assets)	-0.227***	-0.308***	1.357***	1.446***
	(0.019)	(0.030)	(0.093)	(0.156)
Tobin's Q	-0.241***	-0.237***	1.185***	0.948***
	(0.023)	(0.036)	(0.115)	(0.143)
ROA	-4.183***	-5.535***	18.351***	31.053***
	(0.924)	(1.340)	(4.125)	(5.770)
Leverage	0.796***	0.744***	-6.126***	-5.135***
	(0.093)	(0.153)	(0.433)	(0.668)
Ln(Firm risk)	0.019	0.007	0.008	-0.035
	(0.012)	(0.023)	(0.047)	(0.079)
Ln(Bid-Ask Spread)	0.106***	0.067	-0.054	0.088
	(0.031)	(0.049)	(0.097)	(0.137)
Public Bond Dummy	-0.068	-0.741***	0.111	2.348***
	(0.206)	(0.096)	(0.686)	(0.413)
Ln(Maturity)	0.239***	0.289***	0.195***	0.132**
	(0.020)	(0.032)	(0.054)	(0.066)
Callable Dummy	0.280***	0.327**		
	(0.043)	(0.147)		
Observations	3891	1785	3891	1785
R^2	0.727	0.721	0.757	0.787

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables. Firm rating is measured as Standard and Poor's rating. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 1.8: Options Volume and Cost of Debt: Quantile Regression

	Ln(Yield Spread)		S&P Rating	
	10th perc. (1)	90th perc. (2)	10th perc. (3)	90th perc. (4)
Ln(Option Volume)	0.040***	0.026***	-0.216***	-0.117***
	(0.011)	(0.009)	(0.063)	(0.036)
Ln(Total Assets)	-0.271***	-0.266***	1.819***	1.256***
	(0.022)	(0.016)	(0.095)	(0.068)
Tobin's Q	-0.333***	-0.270***	1.420***	1.272***
	(0.033)	(0.023)	(0.123)	(0.088)
ROA	-3.544***	-4.988***	23.158***	19.443***
	(0.944)	(0.937)	(5.928)	(3.086)
Leverage	1.000***	0.849***	-6.535***	-6.008***
	(0.093)	(0.096)	(0.517)	(0.341)
Ln(Firm risk)	0.004	0.057***	-0.316***	0.065
	(0.013)	(0.012)	(0.067)	(0.044)
Ln(Bid-Ask Spread)	0.134***	0.114***	-0.229**	0.001
	(0.020)	(0.021)	(0.112)	(0.070)
Public Bond Dummy	-0.506	-0.012	0.458	-0.085
	(0.572)	(0.091)	(0.461)	(1.137)
Ln(Maturity)	0.303***	0.082***	0.002	0.140**
	(0.018)	(0.023)	(0.043)	(0.068)
Callable Dummy	0.346***	0.216***		
	(0.063)	(0.040)		
Observations	4330	4330	4330	4330
Pseudo R^2	0.484	0.469	0.544	0.520

Notes: This table presents regression results of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables from a bootstrapped quantile regression at the 10th and 90th percentiles with 200 replications. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

should observe (i) no effect whatsoever in financially stable firms and (ii) the absence of statistical significance for the options coefficient after accounting for firm financial quality.

Options volume and subsequent firm value and equity returns

Thus far we have mitigated concerns related to reverse causality by showing that (i) the results from the instrumental variable analysis reinforce the thesis of option markets leading the positive association between options and a firm's cost of debt, (ii) the effect prevails after the inclusion of different proxies for firm distress, and (iii) the effect exists even in those scenarios in which the reverse-causality thesis (firm distress being the main driver behind and increasing in options trading volume) would predict its disappearance. We turn now to investigate the effect on a firm's equity market bond issues preceded by higher options trading volume.

This analysis contributes to the previous discussion on the leading factor in the relationship between options and the cost of debt. If option traders invest more intensively in those firms that they expect to experience a more turbulent future (i.e., future firm distress drives the relationship), bond issues preceeded by higher options trading volume should be associated with lower equity returns and firm value. Conversely, if bond issues from firms with more active option markets are followed by an increase in equity returns, the hypothesis of a volume increase in option markets caused by traders discounting expectations of firm distress becomes groundless.

The previous literature finds a positive association between more active option markets and firm value. Roll, Schwartz, and Subrahmanyam (2009) show that options trading increases future firm value as proxied by Tobin's Q. In a similar vein, Naiker, Navissi, and Truong (2013) investigate whether there is a causal effect of options by reducing the a firm's cost of equity. While these studies seem to support the fact that higher option trading is associated with larger equity returns, the reported results focus on the 'average' firm of a large sample and need not hold for our specific universe of firms. Consequently, we investigate firms' equity returns after bond issues in our sample via two different forward measures: firm value as proxied by *Tobin's Q* and buy and hold abnormal returns (BHAR) post bond issuance.

Table 1.9 contains the results from an OLS regression of future firm value (*Tobin's Q*) on options volume (Option Volume) and a series of control variables similar to the specification in Roll, Schwartz, and Subrahmanyam (2009). These controls include size (*market capitalization*), share *turnover*, return on assets (*ROA*), *capex* (capital expenditures over sales), *leverage* (long-term debt over total assets) and a *dividend dummy* equal to one if the firm pays dividends [29]. Columns 1 to 4 in Table 1.9 use as their dependent

[29] Please refer to A.1 and/or Roll, Schwartz, and Subrahmanyam (2009) for a complete definition and justification of these variables.

Table 1.9: Options Volume and future firm value

	Tobin's Q			
	Q_{t+1} (1)	Q_{t+2} (2)	Q_{t+3} (3)	Q_{t+4} (4)
Ln(Option Volume)	0.059***	0.062***	0.064***	0.062***
	(0.013)	(0.013)	(0.014)	(0.014)
Market Cap	0.027***	0.028***	0.027***	0.025***
	(0.007)	(0.007)	(0.007)	(0.007)
Turnover	-0.002***	-0.003***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
ROA	7.653***	7.354***	7.158***	6.638***
	(1.536)	(1.537)	(1.613)	(1.523)
CapX	0.001	0.004	0.002	-0.004
	(0.015)	(0.016)	(0.016)	(0.017)
Leverage	0.522***	0.501***	0.493**	0.477**
	(0.179)	(0.187)	(0.200)	(0.196)
Dividend dummy	-0.066	-0.042	-0.038	-0.018
	(0.051)	(0.054)	(0.060)	(0.058)
Observations	4107	4101	4082	4062
R^2	0.464	0.458	0.444	0.443

Notes: This table presents OLS panel regression estimates of future firm value (as proxied by Tobin's Q) on options trading volume (Option volume) and a set of control variables following Roll, Schwartz, and Subrahmanyam (2009) . The variables are constructed on a quarterly basis. The time period reference is also quarterly, meaning that Q_{t+1} refers to firm value one quarter ahead, Q_{t+2} to two quarters ahead, etc. A detailed definition of all variables is provided in A.1. Robust standard errors are in parentheses. All regressions include a full set of time and industry dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

variable firm value one quarter, two quarters, three quarters and four quarters (one year) ahead, respectively. As shown by the positive and significant coefficients (p-value<0.01) for *Ln(Option Volume)* across all four columns (with magnitudes ranging from 0.059 to 0.064), bond issues from firms with a more active options market are associated with higher subsequent firm values as proxied by Tobin's Q.

Table 1.10: Options Volume and future equity returns

	Buy-Hold Abnormal Returns (BHARs)			
	$[-1,+10]$		$[+1,+30]$	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.001	0.038	0.064	0.076
	(0.052)	(0.055)	(0.090)	(0.102)
Tobin's Q		-0.810***		-1.037***
		(0.192)		(0.359)
ROA		4.397		10.403
		(10.149)		(17.682)
Leverage		-1.474		-2.914*
		(0.973)		(1.692)
Ln(Firm risk)		-0.036		-0.133
		(0.136)		(0.204)
Ln(Bid-Ask Spread)		0.024		-0.057
		(0.184)		(0.334)
Observations	4170	4170	4170	4170
R^2	0.043	0.052	0.046	0.052

Notes: This table presents OLS regression estimates of Buy and hold abnormal returns (BHARs) calculated using the market model with an estimation window of 100 days ending 50 days prior to bond issuance on options trading volume (Option Volume) and a set of control variables. Time windows in all columns refer to days with respect to bond issuance. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Because the adjustment in equity markets can occur as rapidly as within days from bond issuance, we now turn to explore short-term abnormal returns in the stock following the issue. Table 1.10 contains information regarding the effect of options trading volume on buy and hold abnormal returns (BHAR) around bond issuance. We calculate BHAR using the market model with an estimation window of a minimum of 100 days ending 50 days prior to bond issuance for two different windows: [-1,+10] (columns 1 and 2 in Table 1.10) and [+1,+30] (columns 3 and 4) days surrounding the issue. Columns 1 and 3 contain the results from a pooled OLS regression of BHAR on options volume with time and industry fixed effects, whereas columns 2 and 4 add to the specification control variables previously used that account for firm size and growth opportunities, return-on-assets, leverage, firm risk and liquidity. Coefficients for *Ln(Option Volume)* are not significant, but positive, across all specifications in Table 1.10, revealing no significant short-term reaction of equity markets to bond issues preceded by higher options trading volume.

We show that the positive impact of options on the firm's cost of debt is not driven by poorer firm quality or traders anticipating future firm distress. Overall, these results suggest that options indeed have a causal effect on a firm's cost of debt. We discuss these mechanisms in further detail in Section 1.5

1.4 Robustness

Having established that our results are not due to reverse causality, we turn to analyze the robustness of our results along other dimensions. In this section, we consider various issues that may jeopardize the validity of our results at different levels. Specifically, we begin by considering a time-series sample of bond prices, which enables us to extend our baseline specification to consider a much more demanding one with bond fixed effects. We also expand the analysis to consider different measures of stock-return volatility and stock market liquidity, two well-known determinants of option listing by exchanges (Mayhew and Mihov, 2004). More important, we discuss the impact of price informativeness on our results, which is an important effect associated with more active options markets. Finally, we perform a set of other miscellaneous robustness checks that include different econometric specifications, the exploration of the monotonicity of the effect and the inclusion of other additional controls.

Taken together, all these tests confirm the robustness of our main results and provide a foundation for the discussion of the main mechanisms by which the effect is channeled, which we perform in Section 1.5.

1.4.1 Bond fixed effects and time series analysis

Although our regression models include a full set of firm and bond characteristics with high explanatory power, time and industry dummies, and the considerably large r-squared statistics we report (e.g., ranging from 0.668 to 0.742 in Table 1.3), some concerns remain regarding biases related to omitted variables and time-series effects. We address these issues, following most studies in the corporate finance literature, by including time and bond fixed effects in the regression specification. This approach allows us to control for every possible unobservable, time-invariant bond and time characteristic that may influence the results.

To perform this analysis, however, the at-issue data employed for the baseline procedure are of no use, as we need panel data that include time-bond observations. To this end, we retrieve from Thomson Reuters Eikon (Datastream) bond-quarter information on bonds matching our initial criteria (i.e., bonds with fixed coupons, issued by U.S. corporations). After applying the usual filters and merging these data with the CRSP-Compustat variables described in Section 1.2, and defined in A.1, we are left with 2,028 bond-quarter observations with non-missing yield to maturity for 292 bonds. We follow the previous methodology to calculate the variable *Yield spread* (i.e., bond yield to maturity in excess of a maturity-matched Treasury bond) for each bond and quarter. Because the Thomson Reuters Eikon database only offers time-series data for active bonds, our sample covers the period 2002-2015. Table 1.11 provides the main summary statistics, which confirm that our time-series sample includes similar firms, on average, as our main sample. For example, the average firm in our main sample has total assets equal to $33 billion vs. $39 billion in the time-series sample; *Tobin's Q* of 1.8 vs. 2.2 in the time-series sample; or *Leverage* equal 0.27 in the main sample vs. 0.35. However, the summary statistics for our options volume variable are radically different across the two samples. This issue, however, is far from posing a problem, as this divergence results from a significant number of quarter observations coming from firms with no options trading [30].

Table 1.11: Summary Statistics: Time-series Sample

	Mean	StdDev	25%	Median	75%	Observation
Yield spread	57.267	497.285	-147.465	111.003	236.604	2028
Option Volume ($ Millions)	30.910	195.222	0.000	0.000	0.329	2028
Total Assets ($ Billions)	39.974	50.324	8.180	23.484	47.392	2028
Tobinś Q	2.202	2.356	0.976	1.213	2.200	2028
ROA	-0.007	0.040	-0.012	0.004	0.009	2028
Leverage	0.355	0.165	0.260	0.323	0.405	2028
Bid-ask spread	0.001	0.001	0.000	0.001	0.001	2028
Firm risk	0.118	0.209	0.024	0.043	0.110	2028
Maturity	8.657	7.922	4.000	5.000	8.000	2028

Notes: This table presents the summary statistics for the variables used in the time-series analysis. A definition of all variables is provided in A.1 and Section 1.4.1. Observations with positive options volume total 1,003. The sample period is 2002-2015.

Extending our core analysis to this data sample has a dual benefit. The first advantage is in terms of mitigating concerns related to omitted variables. Second, it allows us to investigate whether the main effect of options trading on yield spreads occurs beyond the time of bond issuance. For this purpose, we use the following econometric model, which is similar to that of Eq. 1.1:

$$Spread_{i,t} = \alpha_{i,t} + \beta Ln(OptionVolume)_{i,t} + \gamma X_{i,t} + \delta_t + \lambda_i + \epsilon \quad (1.2)$$

[30] As before, we set options volume to zero when a firm has no options trading. Because of the time-series nature of this particular data set, the number of observations with positive options volume is lower. Specifically, 1,003 out of 2,028 observations have positive (greater than zero) options trading volume.

where t indexes time and i indexes a specific bond. $Spread_{i,t}$ is the bond yield spread over the maturity-equivalent Treasury at the end of quarter t. $Ln(OptionVolume)_{i,t}$ measures option trading volume in quarter t. We include time and bond fixed effects with the variables δ_t and λ_i, respectively. Finally, the vector X contains the set of time-varying controls used above, including *size*, *Tobin's Q*, *return on assets*, *leverage*, *firm risk*, *bid-ask spread* and bond time to *maturity* [31].

Table 1.12: Options Volume and Cost of Debt: Time-series Analysis

	Yield spread			
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.112***	0.112**	0.098***	0.098**
	(0.038)	(0.047)	(0.037)	(0.049)
Ln(Total assets)	-0.375**	-0.375	-4.080***	-4.080***
	(0.184)	(0.341)	(0.425)	(1.014)
Tobin's Q	-1.352***	-1.352***	-2.013***	-2.013***
	(0.074)	(0.153)	(0.099)	(0.249)
ROA	-13.520***	-13.520***	-10.266***	-10.266**
	(2.356)	(4.511)	(2.414)	(4.622)
Leverage	6.733***	6.733***	7.621***	7.621***
	(0.873)	(1.696)	(1.100)	(1.962)
Ln(Firm risk)	-0.482***	-0.482***	-0.506***	-0.506***
	(0.088)	(0.181)	(0.090)	(0.168)
Ln(Bid-Ask spread)	3.245***	3.245***	3.304***	3.304***
	(0.180)	(0.713)	(0.192)	(0.832)
Ln(Maturity)	-0.224	-0.224	-1.570***	-1.570**
	(0.346)	(0.421)	(0.536)	(0.709)
Bond Fixed Effect	No	No	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
Clustered S.E.	No	Bond level	No	Bond level
Observations	2028	2028	2028	2028
R^2	0.458	0.458	0.843	0.843

Notes: This table presents OLS panel regression estimates of firm-level measures of bond yield spread over Treasuries on options trading volume (Option volume) and a set of control variables. The variables are constructed on a quarterly basis. A detailed definition of all variables is provided in A.1 and Section 1.4.1. Robust standard errors are in parentheses. All regressions include a full set of time dummies, whereas columns 3 and 4 also include bond fixed effects. Observations with positive options volume total 1,003. The sample period is 2002-2015. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

The results from Eq. 1.2 are shown in Table 1.12. Columns 1 and 2 display the results of the regression model without bond fixed effects, which we include in columns 3 and 4. Additionally, columns 2 and 4 extend the analysis by clustering the standard errors

[31] Obviously, we exclude any bond-level invariant characteristics, as we already account for them using bond fixed effects. We include the time to maturity of a bond as control, as it is well recognized that yields tend to decrease as maturity approaches.

at the bond level, the most demanding specification. The coefficients in Table 1.12 range from 0.112 to 0.098 and exhibit high significance across all four columns, with p-values lower than 5% even in the most constrained specification. These results provide further evidence regarding the nature of our main effect. First, the detrimental effect of active options markets on a firm's cost of debt is not limited to the time of the issue but, rather, seems to occur dynamically. Second, and more important, time-invariant omitted variables related to bond characteristics are not the drivers of the effect.

Because time-invariant characteristics are not the only source of omitted variable bias, we perform a battery of additional robustness tests in the next sections, which range from the in-depth exploration of the monotonicity of the effect to the inclusion of additional controls.

1.4.2 Stock return volatility

In our baseline regression model we follow existing literature and control for firms' volatility using cash-flow volatility (*firm risk*), as this should be the primary channel by which debtholders perceive firm risk. However, it is another measure of risk, *stock return volatility*, that is considered one of the key determinants of options listing by exchanges (Mayhew and Mihov, 2004). Furthermore, investors may trade out-of-the-money options to speculate in volatility (Ni et al., 2008) and, thus, may be particularly interested in highly volatile firms.

To ensure that our results are not driven by firms with higher stock return volatility that attract more option traders, we replace the control variable of cash-flow volatility with that of stock returns [32]. Specifically, we include in Table 1.13 the volatility of daily stock returns during the quarter prior to bond issuance (columns 1 and 3), as well as that of the year (columns 2 and 4), in the main regression specification for our two measures of the cost of debt. Although the estimates for *Stock volatility* are statistically relevant, the coefficients for options volume remain positive and highly significant (p-value<0.01), with a slight decrease in economic magnitude (e.g., the coefficient with yield spread as the dependent variable drops from 0.037 to 0.035 after including the quarterly volatility of stock returns).

1.4.3 Information asymmetries and price informativeness

Prior literature finds a role of option markets in increasing price informativeness (e.g., Back, 1993; Easley, O'Hara, and Srinivas, 1998; Cao, 1999) which ultimately decreases information asymmetries. This informational enhancement has been shown to benefit

[32] Including stock return volatility simultaneously with that of cash flows yields similar results.

Table 1.13: Options Volume and Cost of Debt: Stock return volatility

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.035***	0.030***	-0.220***	-0.189***
	(0.010)	(0.010)	(0.046)	(0.046)
Stock volatility (quarter)	0.526**		-0.877	
	(0.225)		(0.591)	
Stock volatility (year)		0.366***		-1.437***
		(0.082)		(0.408)
Ln(Total Assets)	-0.280***	-0.269***	1.528***	1.473***
	(0.018)	(0.018)	(0.090)	(0.093)
Tobin's Q	-0.286***	-0.283***	1.344***	1.328***
	(0.023)	(0.022)	(0.103)	(0.101)
ROA	-5.730***	-5.472***	24.510***	23.460***
	(0.926)	(0.891)	(3.763)	(3.778)
Leverage	0.819***	0.798***	-6.019***	-5.916***
	(0.100)	(0.098)	(0.429)	(0.419)
Ln(Bid-Ask Spread)	0.143***	0.143***	-0.217**	-0.193**
	(0.029)	(0.029)	(0.097)	(0.095)
Public Bond Dummy	-0.181	-0.175	0.609	0.503
	(0.180)	(0.179)	(0.626)	(0.629)
Ln(Maturity)	0.234***	0.233***	0.187***	0.181***
	(0.021)	(0.021)	(0.050)	(0.049)
Callable Dummy	0.309***	0.310***		
	(0.040)	(0.040)		
Observations	4330	4330	4330	4330
R^2	0.711	0.711	0.743	0.748

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, using stock return volatility as a control. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

shareholders by increasing firm value (Roll, Schwartz, and Subrahmanyam, 2009) or lowering the cost of equity capital (Naiker, Navissi, and Truong, 2013). Similarly, a reduction of informational asymmetries can also have positive effects for debtholders. These results highlight the importance of information in our setting.

Although it is nearly impossible to isolate the effect of options that is not directly related to the firm's informational environment, we can perform some tests that ensure our main results are not driven by different levels of information asymmetries across firms. To this end, we introduce in our main regression specification control variables that proxy for the degree of information asymmetries regarding a firm. First, we use analyst coverage. Previous studies support an inverse relationship between the number of analysts covering a stock and the severity of the information asymmetry problem (Brennan and Subrahmanyam, 1995; Hong, Lim, and Stein, 2000). Second, we use the probability of informed trading (PIN) as a proxy for stock price informativeness. The PIN measure is based on a structural market microstructure model developped in a series of studies (Easley, Kiefer, O'hara, and Paperman, 1996; Easley, Kiefer, and O'Hara, 1997; Easley, O'Hara, and Srinivas, 1998; Easley, Hvidkjaer, and O'hara, 2002) and measures the probability that a trade comes from an informed party. The strong theoretical foundations of PIN have made it one of the preferred measures in the literature on the effects of private information on other variables (e.g., Chen, Goldstein, and Jiang, 2007; Ferreira, Ferreira, and Raposo, 2011).

We include these two variables that proxy for the information content of a stock as controls in the main specification from Eq. 1.1 and display the results in Table 1.14.

Specifically, we include the natural logarithm [33] of the number of analysts covering the firm's stock as reported in I/B/E/S, *Ln(Analyst coverage)*, in columns 1 and 3 of Table 1.14 with bond yield spread and rating as dependent variables, respectively. Because we lack information on analyst coverage for some firms in our sample, our initial number of observations suffers a slight decrease (from 4,330 to 4,184 obs.). Despite the high statistical significance of the coefficients on analyst coverage for both dependent variables, the coefficients on option volume remain highly statistically significant (p-value<0.01), with a slight increase in economic magnitude.

Columns 2 and 4 in Table 1.14 include the PIN measure as a control for price informativeness.[34]. We follow Roll, Schwartz, and Subrahmanyam (2009) and use the logistic transformation[35] of this measure, which we call *PINL*, since PIN varies between zero and one. As before, PIN estimates are not available for all stocks in our sample and

[33]Given the distribution of analyst coverage across our sample taking logarithms is a more accurate specification, although the results remain intact when using the raw number of analysts.

[34]We are grateful to Professor Stephen Brown for kindly making the PIN estimates available through his website: http://scholar.rhsmith.umd.edu/sbrown/pin-data

[35]This transformation does not affect the nature of our results, only the significance of PIN estimates.

Table 1.14: Options volume and information production

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.051***	0.038**	-0.289***	-0.333***
	(0.010)	(0.016)	(0.046)	(0.071)
Ln(Analyst Coverage)	-0.157***		0.631***	
	(0.036)		(0.166)	
PINL		0.852**		-4.083**
		(0.400)		(1.728)
Ln(Total Assets)	-0.270***	-0.202***	1.506***	1.299***
	(0.018)	(0.026)	(0.095)	(0.132)
Tobin's Q	-0.271***	-0.253***	1.285***	1.335***
	(0.024)	(0.029)	(0.105)	(0.132)
ROA	-5.374***	-5.570***	22.911***	21.680***
	(0.843)	(0.952)	(3.680)	(4.997)
Leverage	0.795***	0.855***	-5.966***	-6.407***
	(0.101)	(0.160)	(0.435)	(0.612)
Ln(Firm risk)	0.031**	0.015	-0.066	-0.098
	(0.012)	(0.017)	(0.046)	(0.066)
Ln(Bid-Ask Spread)	0.140***	0.155***	-0.165*	-0.095
	(0.029)	(0.027)	(0.089)	(0.110)
Public Bond Dummy	-0.497***	0.000	1.880***	0.000
	(0.067)	(.)	(0.352)	(.)
Ln(Maturity)	0.230***	0.236***	0.191***	0.194***
	(0.022)	(0.031)	(0.052)	(0.073)
Callable Dummy	0.303***	0.479***		
	(0.043)	(0.065)		
Observations	4184	1792	4184	1792
R^2	0.713	0.707	0.750	0.698

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, including analyst coverage as a measure of firm adverse selection (Brennan and Subrahmanyam, 1995) and the logistic transformation of the probability of informed trading (PINL) (Easley, O'Hara, and Srinivas, 1998) as a proxy for price informativeness. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

the number of observations declines substantially (from 4,330 to 1,792 obs.). Even with this reduced sample of bond issues, the *PINL* coefficients exhibit statistical significance (p-value<0.05). Moreover, the coefficientes for *Ln(Option volume)* remain statistically and economically significant after the inclusion of *PINL* as a control for both dependent variables accounting for the firm's cost of debt.[36].

Taken together, these results provide support for a relationship between information asymmetries and a firm's cost of debt. When information asymmetries are higher (lower analyst coverage and greater PIN), debtholders demand a higher return for their money.

Even after the inclusion of different proxies for a firm's information environment, the regression coefficients on *Ln(Option volume)* exhibit strong significance and economic magnitude for both measures of the cost of debt. In sum, price informativeness does not explain the effect of option markets on debtholders. These results support the view that options markets affect bondholders through a channel not directly related to price informativeness. As we argue, option markets may facilitate bondholder expropriation by providing shareholders with a financial instrument that enables high trading profits in situations that are especially harmful for bondholders. These potential profits result in a shift in shareholders incentives that, in turn, increases the risk borne by bondholders. We discuss the validity of this hypothesis in the mechanisms section and dedicate the next section to a set of miscellaneous robustness checks.

1.4.4 Other robustness tests

We devote this section to performing an extensive battery of robustness checks. For the sake of space, we report the empirical results of these analyses in A.2.

Our additional robustness tests begin with the investigation of the monotonicity of options trading. That is, we are interested in determining whether the effect occurs monotonically or is limited to extreme values of options volume. To do so, we include in our main regression specification (from Eq. 1.1) two additional features, reported in Table A2.3 in A.2. First, we add a squared term for *Ln(Option volume)*, which is displayed in columns 1 and 3 of Table A2.3 for bond yield spread and credit rating, respectively. Second, we use the interaction of our main variable, *Ln(Option volume)*, with a dummy variable, *High options volume*, that takes value one if a firm's options' volume is above the median for that year and zero otherwise. These results are reported in columns 2 and 4. The coefficients for *Ln(Options volume)* in columns 1-4 of Table A2.3 remain of high statistical significance (p-value < 0.01) after accounting for the effect of extreme values

[36]The statistical significance of options volume when using bond yield spread as the dependent variable declines relative to the baseline results (p-value<0.05). However, we check that this reduction comes from the use of a significantly lower number of observations rather than the inclusion of *PINL* in the specification.

of options trading, thus supporting the notion that the effect is not limited to extreme cases of options trading volume.

Next, we consider possible time-varying omitted variables. Specifically, we augment the main econometric specification with the *Principal* amount of the bond issue and the level of *Institutional ownership* of the firm as controls. Firms demanding a larger principal amount may be those in a more fragile situation and urgent need of financing, which would explain why debtholders demand a higher return on their money. Moreover, Cremers, Nair, and Wei (2007) find a positive association between shareholder control and yield spreads. Because institutions are the group most prone to exert active shareholder control, we include total institutional ownership from the Thomson Reuters 13F filing [37] to rule out the possibility that our results are driven by correlations between active option markets and a firm's level of institutional ownership. Table A2.4 in A.2 contains the results from both additions. The coefficient of *Ln(Option Volume)* remains highly statistically significant (p-value<0.01) with a small decrease in magnitude (0.032 from 0.037 for yield spread and -0.192 from -0.207 for bond rating) as a result of the inclusion of both control variables. These results provide evidence of option markets having a direct impact on a company's cost of debt, rather than being a secondary effect from preexisting findings.

To test the robustness of the effect on bond ratings and given the special construction of this variable, we perform 2 different tests. First, we run the baseline OLS model on a transformed variable equal to the natural log of one plus the bond rating, *Ln(*1+*Rating)*. Second, we fit ordered logit and negative binomial models to the specification in Eq. 1.1. The results are reported in Table A2.5 in A.2 and confirm the validity of our initial results.

Because different industries may have special features that lead to mechanically higher or lower costs of debt, we include two-digit SIC code fixed effects in our regression analysis, the most common specification in the literature. We expand this analysis by including the more restrictive four-digit SIC code fixed effects in columns 1 and 3 of Table A2.6 in A.2. Furthermore, columns 2 and 4 in Table A2.6 include industry (SIC-4) by time fixed effects, to control for assymetric growth in option market volume across indsutries and over time. All of these tests validate our initial results.

Given that our sample period includes the 2007-2008 financial crisis, one concern is that our results are driven by bond issues during this financially turbulent period. To investigate whether this is the case, we estimate the regression in Eq. 1.1 for two subsamples of bond issues during and outside the financial crisis period. We consider the financial crisis period to be those years between, and including, 2007 and 2010 [38].

[37] As noted in Bushee (1998), not all institutions are interested in active governance. We explore this issue in the mechanisms section.

[38] In untabulated tests, we also consider as the 'crisis' the years covering the tech bubble of the 2000s, and the results are unchanged.

Table A2.7 in A.2 contains the results, which do not support the thesis of unstable financial periods driving the results.

Previous literature highlights the importance of stock market liquidity in the decision of exchanges to quote options on a firm's stock (Mayhew and Mihov, 2004). Although we control for stock market liquidity in our baseline tests by including the natural log of the bid-ask spread, we further investigate the effect of liquidity to ensure that it is not the main driver of our results. We begin by replacing the bid-ask spread with a different proxy for stock liquidity, the Amihud (2002) illiquidity measure. Table A2.8 in A.2 contains the results of this analysis, which provide support for our initial results and display an even larger economic magnitude of the options volume coefficient. Second, we divide the sample into firms with high and low stock market liquidity according to the median bid-ask spread and run the regression in Eq. 1.1. Table A2.9 in A.2 displays the results, which demonstrate that the effect occurs in both subsamples of stock market liquidity. Overall, these tests show that our results are not driven by stock market liquidty but, rather, by trading activity in the options market.

1.5 Possible mechanisms

Our evidence thus far is consistent with a detrimental effect of options trading volume on a firm's cost of debt, even after accounting for potential endogeneity concerns and performing a rich set of additional robustness tests that discard other variables such as price informativeness, stock volatility, or poorer market expectations as the main drivers of this effect. In this section, we turn to the last part of our analysis and discuss potential underlying mechanisms through which this may occur. It is of course challenging to provide definite proof, and hence, our tests are only suggestive.

In our main thesis, we argue that option markets produce a shift in shareholders' attitudes toward certain events by enabling them to extract trading gains in situations that may have especially harmful results for bondholders. This imbalance in incentives contributes to the exacerbatation of shareholder-bondholder conflicts and results in bondholders facing higher expropriation risk and, ultimately, increases a firm's cost of debt. Consistent with this hypothesis, the effect of options on firm cost of debt should be larger in certain scenarios, which we proceed to explore in detail.

First, the presence of an active options market that shareholders can exploit should damage bondholders more intensively as the firm is closer to a shift in the control of the company that damages bondholders' interests while being potentially beneficial to shareholders. In such cases, the expropriation trade-off must be a distinct concern. Second, bondholders will suffer more severely from the presence of a liquid options market when the shareholder structure of the company is more prone to be actively informed about firm fundamentals and likely to influence managerial decisions. Third, the expropriation risk faced by bondholders will increase with the threat of shareholders forcing actions that can directly reduce bondholder wealth, such as default.

1.5.1 Corporate events and shift in control

We consider two different events that can produce a change in ownership that is detrimental to bondholders: default and takeover. Firm default forces a change in control whereby creditors become the new owners of a defaulted firm through the distribution of stock during restructuring. As a firm becomes more seriously distressed, the probability of a shift in control to bondholders increases, as does the likelihood of bondholders being expropriated by shareholders. Ge, Hu, Humphery-Jenner, and Lin (2016) explore how informed traders exploit the options market to increase their payoff in the event of bankruptcy, providing a direct channel through which shareholders can benefit from this event. Acquisitions are another important corporate event to bondholders. Cremers, Nair, and Wei (2007) and Qiu and Yu (2009) document a negative effect of takeovers on firm bondholders. Intense shareholder governance (facilitated by an open market for corporate control) reduces bondholder wealth. Cao, Chen, and Griffin (2005) and Chan, Ge, and Lin (2015) study the use of option markets by traders prior to acquisition announcements. Both studies find evidence consistent with investors using option markets to extract trading gains before the event of a takeover. Combining all of these considerations, our thesis predicts that the detrimental effect of option markets on a firm's cost of debt financing will be exacerbated when a firm is more financially constrained (closer to experiencing default) and more vulnerable to a takeover.

Firm distress

Table 1.5 contains information regarding the effect of options on the cost of debt and firm distress. Columns 2 and 4 display the results from interacting the coefficient of options volume, *Ln(Option volume)*, with the Kaplan and Zingales (1997) index (our measure of firm distress). The coefficients for the interaction term are positive (p-value$<$0.05) with bond yield spread as the dependent variable and negative (p-value$<$0.01) for the regression using bond ratings. These results are consistent with our main thesis. The effect of options trading volume on a firm's cost of debt is more pronounced as the firm becomes more financially constrained.

Takeover vulnerability

To measure a firm's takeover vulnerability, we rely on the anti-takeover index (ATI) in Cremers and Nair (2005) and Cremers, Nair, and Wei (2007). The index is constructed based on the presence in a firm of three anti-takeover provisions that the literature has recognized to be critical for takeovers. These provisions include the existence of blank check preferred stock, classified boards, and restrictions on calling special meetings and actions through written consent.[39] ATI values vary from 1 to 4, substracting one point from 4 if any of these provisions is in place. The larger the value of ATI, the more prone a firm is to takeovers.

We classify companies with ATI values of 4 and 3 (2 and 1) as firms with high (low) takeover vulnerability. Consequently, we run our baseline regression in Eq. 1.1 for two subsamples, depending on the firm's level of takeover vulnerability (high and low).

Table 1.15: Options Volume and Cost of Debt: Takeover vulnerability

	Ln(Yield Spread)		S&P Rating	
	High (1)	Low (2)	High (3)	Low (4)
Ln(Option Volume)	0.080***	0.035***	-0.354***	-0.242***
	(0.024)	(0.012)	(0.096)	(0.057)
Ln(Total Assets)	-0.339***	-0.255***	1.607***	1.471***
	(0.043)	(0.022)	(0.185)	(0.117)
Tobin's Q	-0.251***	-0.298***	1.293***	1.414***
	(0.040)	(0.026)	(0.192)	(0.119)
ROA	-2.519	-6.000***	7.614	25.394***
	(1.842)	(1.031)	(5.896)	(4.826)
Leverage	0.910***	0.757***	-6.752***	-5.567***
	(0.178)	(0.143)	(0.837)	(0.585)
Ln(Firm risk)	0.015	0.015	0.007	0.045
	(0.026)	(0.015)	(0.090)	(0.057)
Ln(Bid-Ask Spread)	0.216***	0.156***	-0.283*	-0.295***
	(0.040)	(0.025)	(0.154)	(0.102)
Public Bond Dummy	0.059	-0.444***	-0.802	1.943***
	(0.148)	(0.047)	(0.666)	(0.325)
Ln(Maturity)	0.245***	0.247***	0.144	0.142**
	(0.035)	(0.024)	(0.088)	(0.058)
Callable Dummy	0.399***	0.491***		
	(0.101)	(0.060)		
Observations	929	3353	929	3353
R^2	0.729	0.675	0.761	0.699

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and by subsamples of takeover vulnerability as proxied by the anti-takeover index (ATI) developed in Cremers and Nair (2005). A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

[39] For a detailed description and justification of the use of these provisions, please refer to Cremers and Nair (2005).

Table 1.15 contains the coefficient estimates of these regressions. Columns 1 and 3 (2 and 4) display information for the subsample of *High* (*Low*) takeover vulnerability firms for bond yield spread and credit rating, respectively. Consistent with data in Cremers and Nair (2005) and Cremers, Nair, and Wei (2007), the number of firms with one or no anti-takeover provisions (high vulnerability) is lower as, therefore, is the number of observations for this subsample. Despite this difference in the number of observations in the estimates, the coefficients for *Ln(Option volume)* are significant (p-value<0.01) across all four regressions. More interestingly, the coeffcient estimates for the subsample of high takeover vulnerability firms are considerably larger in economic magnitude than those for the low vulnerability firms when bond yield spread is the dependent variable (0.080 vs. 0.035) and when bond rating is the dependent variable (-0.354 vs. -0.242).

These results demonstrate that the detrimental effect of liquid option markets on the firm's cost of debt is larger when the company is more open to the market for corporate control, as predicted by our theory of bondholder expropriation.

1.5.2 Shareholder control

To provide additional insights into the role of option markets in the bondholder-shareholder conflict, we explore the interaction of *Ln(Option volume)* with variables accounting for the ownership level of institutions with different levels of commitment to governance (control) practices. In particular, we make use of the Bushee (1998) institutional investor classification [40]. In this classification, institutional investors fall into three different types, according to variables such as past performance, portfolio turnover or diversification. *Dedicated* owners are those with low portfolio turnover and concentrated stakes and, hence, those more prone to exert shareholder control. *Transient* institutions are those with high turnover and diversified portfolios, which tend to exhibit momentum returns. *Quasi-index* investors use indexing or buy-and-hold strategies that produce low portfolio concentration and high diversification and are, therefore, the group least likely to perform active control.

Bearing this classification in mind, in line with our prior of active option markets exacerbating the agency cost of debt, we expect the adverse effect of options trading to intensify in cases in which shareholders are more likely to engage in active governance practices (Cremers, Nair, and Wei, 2007). Tables 1.16 and 1.17 show the results of interacting, in our baseline specification, *Ln(Option volume)* with the percentage of ownership in hands of *Dedicated* and *Quasi-index* owners, respectively [41].

[40] We are grateful to Brian Bushee for kindly providing these data on his website: http://acct.wharton.upenn.edu/faculty/bushee/IIclass.html

[41] For the sake of space, we report the results of the interaction with *Transient* owners, the least interesting group for our analysis, in Table A2.10 in A.2.

Table 1.16: Options Volume and Cost of Debt: Dedicated Owners

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.035***	0.028***	-0.215***	-0.176***
	(0.011)	(0.011)	(0.046)	(0.046)
Own. Dedicated	0.134	-0.120	0.237	1.706*
	(0.239)	(0.232)	(0.945)	(0.883)
Ln(Option Volume) × Own. Dedicated		0.164**		-0.950***
		(0.067)		(0.281)
Intitutional Ownership	0.050	0.046	-0.965***	-0.945***
	(0.072)	(0.072)	(0.311)	(0.309)
Ln(Total Assets)	-0.277***	-0.276***	1.452***	1.443***
	(0.019)	(0.019)	(0.092)	(0.091)
Tobin's Q	-0.302***	-0.304***	1.301***	1.313***
	(0.025)	(0.025)	(0.112)	(0.111)
ROA	-5.881***	-5.778***	26.145***	25.533***
	(0.881)	(0.872)	(3.957)	(3.889)
Leverage	0.865***	0.876***	-6.236***	-6.289***
	(0.108)	(0.108)	(0.434)	(0.431)
Ln(Firm risk)	0.034***	0.034***	-0.096*	-0.096*
	(0.013)	(0.013)	(0.050)	(0.049)
Ln(Bid-Ask Spread)	0.137***	0.138***	-0.193*	-0.194*
	(0.033)	(0.032)	(0.102)	(0.099)
Public Bond Dummy	-0.547***	-0.552***	1.107**	1.141***
	(0.051)	(0.052)	(0.468)	(0.439)
Ln(Maturity)	0.209***	0.210***	0.194***	0.188***
	(0.023)	(0.023)	(0.053)	(0.053)
Callable Dummy	0.322***	0.316***		
	(0.045)	(0.045)		
Observations	3649	3649	3649	3649
R^2	0.712	0.713	0.748	0.750

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of options volume with ownership by dedicated institutions as defined in Bushee (1998). A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

The coefficient for the interaction term of options and ownership by dedicated investors in column 2 (4) of Table 1.16 is positive (negative) and significant at the 5% (1%) level for the regression on yield spread (bond rating). However, the coefficient for the interaction of options and ownership by quasi-indexers in column 2 (4) of Table 1.17 is negative (positive) and significant at the 5% (1%) level for the dependent variable yield spread (bond rating).

Table 1.17: Options Volume and Cost of Debt: Quasi-index Owners

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.029***	0.060***	-0.183***	-0.357***
	(0.011)	(0.020)	(0.046)	(0.087)
Own. Quasi-Index	-0.768***	-0.625***	4.111***	3.292***
	(0.191)	(0.207)	(0.793)	(0.837)
Ln(Option Volume) × Own. Quasi-Index		-0.068**		0.384***
		(0.030)		(0.140)
Intitutional Ownership	0.583***	0.593***	-3.738***	-3.788***
	(0.155)	(0.154)	(0.638)	(0.629)
Ln(Total Assets)	-0.258***	-0.259***	1.351***	1.354***
	(0.019)	(0.019)	(0.092)	(0.092)
Tobin's Q	-0.287***	-0.290***	1.220***	1.235***
	(0.025)	(0.025)	(0.110)	(0.109)
ROA	-6.063***	-5.980***	27.165***	26.661***
	(0.878)	(0.879)	(3.906)	(3.892)
Leverage	0.817***	0.819***	-5.941***	-5.941***
	(0.104)	(0.104)	(0.422)	(0.419)
Ln(Firm risk)	0.031**	0.031**	-0.079	-0.081*
	(0.012)	(0.012)	(0.048)	(0.048)
Ln(Bid-Ask Spread)	0.136***	0.134***	-0.185*	-0.173*
	(0.032)	(0.032)	(0.097)	(0.096)
Public Bond Dummy	-0.537***	-0.554***	1.062*	1.160*
	(0.056)	(0.059)	(0.582)	(0.616)
Ln(Maturity)	0.209***	0.210***	0.196***	0.190***
	(0.023)	(0.023)	(0.053)	(0.054)
Callable Dummy	0.317***	0.305***		
	(0.043)	(0.043)		
Observations	3649	3649	3649	3649
R^2	0.716	0.717	0.754	0.756

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of options volume with ownership by Quasi-index institutions as defined in Bushee (1998). A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Overall, these results are consistent with the detrimental effect of options being exacerbated in cases in which shareholders have more control and, as a consequence, the risk of unfavorable renegotiation/expropriation for bondholders increases.

1.5.3 Threat of strategic default

We devote the last part of our analysis to investigating the specific situation in which bondholders' concerns about expropriation might be heightened. Specifically, we focus on shareholders incentives for strategic default, which will fundamentally depend on their potential losses and bargaining power in renegotiation. In firms in which shareholders have an advantage over bondholders in renegotiation, the threat of strategic default becomes more intense, thereby increasing bondholders' expropriation risk. Following this rationale, under the bondholder expropriation hypothesis, we expect the effect of option volume to be particularly large in cases in which shareholders' incentives for strategic default are higher.

It is important to note that this mechanism does not require the actual occurrance of firm default but, rather, depends on each claimholder's advantages in future renegotiation. Garlappi et al. (2008) and Favara et al. (2012) find a negative relationship between shareholders' bargaining power relative to bondholders and equity risk and return in distressed firms, consistent with shareholders' ability and expectations to extract rents from other claimholders when they have sufficient advantage.

Following Garlappi et al. (2008) and Favara et al. (2012), we define two variables that proxy for shareholders' advantages. First, we consider liquidation costs, as proxied by the degree of tangibility of the firms' assets. A higher value of intangible assets should make liquidation costlier (as these assets are lost in the event of default) and, hence, strategic default by shareholders less likely. We measure liquidation costs using the intangibles measure introduced in Berger, Ofek, and Swary (1996) and displayed in Eq. 1.3.

$$Intangibles = 1 - \frac{(Cash + 0.715 \times Receiv. + 0.547 \times Invent. + 0.535 \times PPE)}{Assets} \tag{1.3}$$

We report the interaction of *Ln(Option volume)* and *Intangibles* in Table 1.18.

The interaction coefficients of -0.070 in column 2 for yield spread and of 0.602 in column 4 for bond rating are statistically significant at the 10% and 1% levels, consistent with the idea of options trading activity being especially harmful for bondholders when liquidation costs are low.

Our second proxy for shareholders' advantage in renegotiations over bondholders is shareholders' bargaining power. As in previous literature, we define bargaining power as the ratio between total shares held by insiders (which we obtain from Worldscope) and total shares outstanding. We name this variable *Insider ownership* and display the results from its interaction with options volume in Table 1.19.

The interaction coefficient with yield spread as the dependent variable in column 2 of Table 1.19 is positive and significant at the 5% level. When using bond ratings, the coefficient from the interaction between insider ownership and options volume in

Table 1.18: Options and Strategic Default: Liquidation Costs

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.037***	0.084***	-0.221***	-0.622***
	(0.010)	(0.026)	(0.045)	(0.161)
Intangibles	0.430**	0.632***	-2.314***	-4.046***
	(0.171)	(0.200)	(0.789)	(0.929)
Ln(Option Volume) × Intangibles		-0.070*		0.602***
		(0.038)		(0.233)
Ln(Total Assets)	-0.282***	-0.279***	1.534***	1.509***
	(0.018)	(0.018)	(0.091)	(0.089)
Tobin's Q	-0.295***	-0.294***	1.373***	1.370***
	(0.024)	(0.024)	(0.102)	(0.103)
ROA	-5.450***	-5.364***	23.716***	22.971***
	(0.923)	(0.921)	(3.846)	(3.728)
Leverage	0.881***	0.868***	-6.307***	-6.196***
	(0.106)	(0.107)	(0.433)	(0.426)
Ln(Firm risk)	0.034***	0.036***	-0.070	-0.083*
	(0.012)	(0.012)	(0.047)	(0.045)
Ln(Bid-Ask Spread)	0.149***	0.152***	-0.209**	-0.239**
	(0.030)	(0.031)	(0.096)	(0.098)
Public Bond Dummy	-0.205	-0.198	0.625	0.569
	(0.180)	(0.178)	(0.627)	(0.603)
Ln(Maturity)	0.232***	0.233***	0.173***	0.165***
	(0.021)	(0.021)	(0.049)	(0.048)
Callable Dummy	0.329***	0.331***		
	(0.045)	(0.045)		
Observations	4228	4228	4228	4228
R^2	0.705	0.706	0.742	0.745

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of options volume with liquidation costs proxied by intangible assets as in Favara, Schroth, and Valta (2012). A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 1.19: Options and Strategic Default: Insider Ownership

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.030**	0.025**	-0.192***	-0.180***
	(0.012)	(0.012)	(0.051)	(0.054)
Inside Own.	0.333***	0.197*	-1.084***	-0.755
	(0.088)	(0.106)	(0.378)	(0.482)
Ln(Option Volume) × Inside Own.		0.069**		-0.166
		(0.031)		(0.166)
Institutional Ownership	0.110*	0.118*	-1.008***	-1.026***
	(0.063)	(0.063)	(0.281)	(0.280)
Ln(Total Assets)	-0.265***	-0.265***	1.397***	1.398***
	(0.020)	(0.019)	(0.096)	(0.096)
Tobin's Q	-0.315***	-0.318***	1.345***	1.350***
	(0.025)	(0.025)	(0.111)	(0.112)
ROA	-6.347***	-6.271***	26.997***	26.808***
	(0.938)	(0.939)	(3.958)	(3.964)
Leverage	0.883***	0.893***	-6.240***	-6.262***
	(0.113)	(0.113)	(0.421)	(0.422)
Ln(Firm risk)	0.036**	0.036**	-0.091*	-0.090*
	(0.014)	(0.014)	(0.049)	(0.049)
Ln(Bid-Ask Spread)	0.098***	0.098***	-0.092	-0.093
	(0.037)	(0.037)	(0.100)	(0.100)
Public Bond Dummy	-0.566***	-0.560***	1.175***	1.162**
	(0.051)	(0.052)	(0.453)	(0.456)
Ln(Maturity)	0.210***	0.209***	0.181***	0.183***
	(0.024)	(0.024)	(0.056)	(0.056)
Callable Dummy	0.308***	0.303***		
	(0.042)	(0.041)		
Observations	3852	3852	3852	3852
R^2	0.705	0.705	0.748	0.749

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of options volume with insider ownership as a measure of shareholders' bargaining power (Favara, Schroth, and Valta, 2012). A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

column 4 is negative, although not statistically significant. These results confirm that the relationship between options and the cost of debt is worsened when shareholders have high bargaining power.

Overall, these analyses support the thesis of options markets increasing a firm's cost of debt by exacerbating conflicts of interest between shareholders and debtholders. Specifically, options seem to induce a change in shareholders' incentives with respect to the expropriation of bondholder wealth. Bondholders respond to this shift by demanding a higher return for their money in firms with a more liquid options market, which shareholders can exploit to their own advantage.

1.6 Conclusion

In this paper, we novelly investigate the extent to which an active options market relates to a firm's cost of debt. The increasing importance of options markets in the contemporary financial world contrasts with the relatively few papers studying the effects of such growth in real variables. Whereas previous research finds that the positive informational enhancement flowing from high-volume option markets translates into greater firm value (Roll, Schwartz, and Subrahmanyam, 2009), higher innovation quality (Blanco and Wehrheim, 2017) or a lower cost of equity capital (Naiker, Navissi, and Truong, 2013), our results show a perverse effect of these instruments for a group that is highly relevant in the corporate structure: debtholders. We find that a one-standard-deviation increase in options volume from its mean is associated with an increase in the bond at-issue yield spread of nearly 10 basis points.

Additionally, we explore the specific paths along which this effect is channeled. The results from several analyses that include interaction terms suggest that the impact of option markets occurs via the exacerbation of the traditional debtholder-shareholder conflict. The effect of options volume is more pronounced in situations in which the expropriation risk for bondholders is higher. Thus far, our results are consistent with the notion of options markets inducing a shift in shareholders' incentives toward certain events, such takeovers or firm default, which has detrimental results for bondholder wealth, thereby revealing a hidden cost of these financial derivatives for a firm's debtholders. However, we do not conclude that there is not a positive informational impact from options for bondholders, by reducing information asymmetries, but instead we empirically find that, at least, the net effect of options trading on bondholders is negative, thereby augmenting firms' cost of debt. In other words, the bondholders' gains from information enhancement seem to be outweighed by the threat of expropriation.

While our study draws on one particular "hidden cost" of financial derivatives, we are agnostic about how these instruments may affect other stakeholder groups in other dimensions. Moreover, we do not provide evidence on how options modify firms' financing decisions, for instance, whether a liquid option market makes bank loans ex ante more attractive than bonds or vice versa. We leave a proper evaluation of the net effects on ex ante firm financing decisions for future research.

In this study, we empirically demonstrate that option markets have a net detrimental effect on bondholders. Since firm financing is vital for the real economy, further theoretical and empirical research on the direct effects of derivatives markets on firm financing decisions is needed.

Chapter 2

The Role of Option Markets in Shareholder Activism

2.1 Introduction

Financial derivatives have become an intrinsic part of the modern financial world. Option markets, in particular, have experienced an exponential growth over the past decades, with total equity option volume traded in the U.S. raising from 676 million contracts in 2000 to over 3,727 million contracts in 2015 [1]. Despite the undeniable importance of these instruments, we remain unaware of their potential effects on several fronts. One pivotal example is the case of shareholder activism. Many voices have raised against the use of derivatives by large shareholders [2], as these instruments facilitate the decoupling of economic and voting rights, which may incentivize individual shareholders not to act in the best interest of a firm. On the other hand, derivative markets can be seen as a good venue for trading on information, facilitating the profitability of an intervention, and, thus, increasing shareholders incentives to engage in active governance. In this paper, I tackle this issue by exploring the effect of an active equity options market on shareholder's incentives for activism. I find that more liquid option markets promote subsequent shareholder activism in various forms, including higher probability of a firm receiving a proxy contest and a shareholder proposal, as well as a larger proportion of dissent voting with management.

I start by acknowledging that any potential effect of option contracts on shareholder incentives for activism should be related to whether the derivatives market is sufficiently liquid. Not only because informed traders incentives to trade are higher in high-volume markets, but also because illiquid markets hamper uninformed traders as well (Admati and Pfleiderer, 1988; Pagano, 1989). More active option markets promote trading that induces higher stock price informativeness (Cao, 1999; Chakravarty, Gulen, and Mayhew, 2004; Pan and Poteshman, 2006) which ultimately serves as a more effective managerial discipline device (Holmström and Tirole, 1993; Dow and Gorton, 1997; Faure-Grimaud and Gromb, 2004; Chen, Goldstein, and Jiang, 2007) and makes shareholders less prone to exert direct activism (i.e. via 'voice') in favor of the 'exit' mechanism (Edmans, 2009; Admati and Pfleiderer, 2009; Edmans and Manso, 2011; Edmans, Fang, and Zur, 2013).[3]

Additionally, more liquid option markets can have a detrimental effect on shareholders incentives for activism by facilitating investors' trading. For example, a large shareholder may abstain from initiating a value-enhancing intervention when the cost of selling a

[1]Data from Options Clearing Corporation: http://www.optionsclearing.com/webapps/historical-volume-query.

[2]A clear example is the petition of the law-firm Watchell, Lipton, Rosen & Katz to the SEC on 2011, in which they pointed out the problems arising from investors using financial derivatives in their governance practices. See the complete text for the petition here: https://www.sec.gov/rules/petitions/2011/petn4-624.pdf.

[3]Following the literature I will use the term 'voice' henceforth to refer to shareholder governance exerted through direct activism, whereas the terms 'exit' or 'voting with their feet' will refer to investors exerting governance through financial markets (i.e. via the threat of selling a sizable stake in the market).

sizable stake in the market is reduced (Coffee, 1991; Bhide, 1993). To the extent that trading in the options market can mitigate the costs associated with price impact, investors may view options as an instrument to reduce the costs of exit. Moreover, since derivatives facilitate the decoupling of economic and voting rights, liquid option markets may exacerbate perverse empty-voting behaviour (Hu and Black, 2006, 2007). Lastly, the presence of a market for insurance may decrease investors' incentives for monitoring. Bolton and Oehmke (2011) show how, when debtholders obtain insurance against default, their monitoring efforts can be reduced as they otherwise retain control rights in and outside bankruptcy. Because option markets can also serve as insurance instruments, the presence of a more liquid options market may result in shareholders decreasing monitoring efforts.

Alternatively, an active options market can strengthen incentives for costly activism. Shareholders have the power to affect the governance of a public company through their voting rights. However, despite effective, is not often that we observe activism in practice, mainly due to its considerable costs [4]. Shareholders trade-off these costs against private benefits from intervention to decide whether to undertake an intervention. The literature identifies different channels by which shareholders' incentives for activism may be strengthen. For example, Shleifer and Vishny (1986) argue that only shareholders with large stakes have incentives to actively monitor management, as they will enjoy a higher fraction of the gains in firm value derived from intervention. In Maug (1998) and Kahn and Winton (1998) liquidity is the main mechanism that boosts shareholder intervention. When a stock is liquid enough, a shareholder planning an intervention can purchase shares at a price that does not fully reflect the future increase in firm value. Consistent with these theories, Norli, Ostergaard, and Schindele (2015) find a role of liquidity in encouraging shareholder activism. Similarly, Edmans, Fang, and Zur (2013) find an unconditional effect of liquidity on governance via voice and exit. These works support the thesis that shareholders' incentives for governance increase when they can access additional trading gains from their governance activities. Consistent with this idea, option markets can serve as an alternative venue for shareholders to gather trading profits from activism. To the extent that liquidity eases investors trading also in the options market, more active option markets should encourage shareholder activism by increasing the potential net benefits from intervention.

Combining all these arguments together, it is apparent that the net impact of options on shareholder activism is ultimately an empirical question. In order to undertake such analysis, I conform an orginal and representative data set containing information on shareholder activism, voting behaviour, as well as options trading data, and firm-level

[4] Activist shareholders running a campaign incur in substantial costs including research, hiring legal expertise, or marketing a campaign. Gantchev (2013) estimates the average costs of a campaing ending in a proxy fight in $10.71 million.

characteristics for the period 2003-2014. To approximate the total annual dollar options volume I follow Roll, Schwartz, and Subrahmanyam (2009). I rely on several measures proposed by the literature in order to account for the level of shareholder activism in a firm, including the event of a proxy contest (Norli, Ostergaard, and Schindele, 2015), a shareholder proposal, or dissent voting with management (Iliev, Lins, Miller, and Roth, 2015).

In order to assess how options trading volume influences the probability of subsequent shareholder activism, I rely on a probit regression model similar to that in Norli, Ostergaard, and Schindele (2015). Specifically, I regress the conditional probability of a firm receiving a proxy contest or a shareholder proposal in year t on one and two-year lagged options dollar trading volume and a set of known determinants of activism lagged one year. The results reveal a positive association between more liquid option markets and subsequent shareholder activism. For example, an increase from the 10th to the 90th percentile in one-year lagged options volume corresponds to an increase of nearly 62% relative to the sample probability of a firm receiving a proxy contest. I then investigate the impact of an active options market on shareholder voting behavior in management-sponsored elections. Results from ordinary least-squares regression shows that in firms with a more liquid market of options for the stock, shareholders are less likely to follow management recommendations.

Whereas these findings are consistent with the thesis of option contracts stimulating shareholder activism by increasing net benefits from intervention, there are alternative explanations that may jeopardize the robustness of my results. First, I ensure that my results are robust to considering different econometric models, different measures of shareholder activism, and do not respond to differences between firms quoted and not quoted in the options market. Then, I consider the more delicate case of reverse-causality effects driving the results. This is the case if option traders are more prone to trade in those firms which they predict are more likely to experience activism. Although higher shareholder activism may associate with poor stock performance, option traders can benefit from negative expectations over firm value (e.g., by directly purchasing puts or selling call options). Moreover, since volatility traders can exploit option markets to their advantage (Ni, Pan, and Poteshman, 2008), the mere expectation of a turbulent short-term future can be enough to induce investors to trade options more heavily in certain firms.

To mitigate concerns related to reverse-causality issues, I estimate an instrumental variable analysis via a two-staged least squares (2SLS) model. I use open interest and moneyness as instrumental variables (Roll, Schwartz, and Subrahmanyam, 2009; Blanco and Wehrheim, 2017; Blanco and García, 2017). The results from this identification strategy provide support to the notion of a significant causality running from more liquid option markets to subsequent shareholder activism in the form of proxy contest, shareholder proposal, and dissent voting with management. Overall, all these tests suggest that the positive association between trading volume in option markets and shareholder governance activities is not simply driven by self-selection.

I continue by investigating the different mechanisms that channel these results. First, I consider the role of option markets in promoting trading among shareholders. Specifically, I focus on overvalued firms. Privately informed shareholders observing a firm is highly overvalued may find optimal to exit rather than to intervene (Coffee, 1991; Bhide, 1993). Consistent with the view of options stimulating shareholders' stock market trading, I find that the effect on shareholder activism is lower for highly overvalued firms, where the costs of intervention clearly outweigh those of exit. Second, I investigate if active option markets affect shareholder voting behavior in a way that reflects an increase in their net benefits from voting. Iliev and Lowry (2014) find that shareholders with higher net benefits from voting are less likely to rely on Institutional Shareholders Services (ISS) recommendations, and to follow the one-size-fits-all approach. Consistent with this evidence, I find that shareholders in firms with higher options trading volume are less likely to follow ISS, specially where recommendations lack any value (blanket issues). Third, I analyze the impact of options-motivated activism on firm value. Following Cuñat, Gine, and Guadalupe (2012) and Iliev and Lowry (2014), I analyze the effect of shareholder proposals on the firm abnormal return on the meeting day. I focus on proposals that pass or fail by a small margin to mitigate effects related with stock markets anticipating the results and effects on firm value of a proposal. Contrary to predictions from empty voting theories, I find no negative effect (coefficient is positive and lacks statistical significance) on stock abnormal returns for passed proposals forerun by larger options trading volume. Moreover, in the more dubious case of a shareholder proposal passed that lacks the 'for' recommendation by ISS, higher activity in option markets associates with larger and significant abnormal stock returns. Overall, these results are consistent with the view of option markets stimulating shareholder governance by augmenting the net benefits from activism. This activism does not have, on average, perverse effects on equity value, contrary to traditional empty voting predictions.

This paper is, to the best of my knowledge, the first to empirically explore the effect of derivative markets on shareholders' incentives for activism. I contribute to several fronts in the literature. First, I add to recent work on how trading activity in options market affects corporate outcomes. The informational enhancement associated with more active option markets has been shown to lead to greater firm values (Roll, Schwartz, and Subrahmanyam, 2009), lower cost of equity financing (Naiker, Navissi, and Truong, 2013), or higher innovation quality (Blanco and Wehrheim, 2017). Additionally, Blanco and García (2017) find that more active option markets encourage shareholder decisions that are detrimental to bondholders' wealth, thus incresing the firm's cost of debt financing.

Second, I extend the literature on shareholder activism. Early work on the subject has focused on the activism of large individual shareholders (Smith, 1996; Carleton, Nelson, and Weisbach, 1998; Strickland, Wiles, and Zenner, 1996) and institutional investors (Del Guercio and Hawkins, 1999; Gillan and Starks, 2000). More recent papers focus on determinants of activism such country-specific regulation (Iliev, Lins, Miller, and Roth, 2015), or the effect to shareholder value (Cuñat, Gine, and Guadalupe, 2012). A more related branch of the literature explores the role of financial markets in affecting shareholder incentives to undertake governance activities. In this vein, stock market liquidity has received the largest attention by researchers on the theoretical (e.g., Maug, 1998; Kahn and Winton, 1998; Coffee, 1991) as well as the empirical front (e.g., Edmans, Fang, and Zur, 2013; Bharath, Jayaraman, and Nagar, 2013; Norli, Ostergaard, and Schindele, 2015).

Third, I add to recent literature exploring the impact of financial derivatives on shareholder governance. Results from these studies are mixed. While Christoffersen, Geczy, Musto, and Reed (2007) and Kalay and Pant (2009) argue that derivative markets facilitate the trading of votes from uninformed to informed investors and lead to a more efficient voting outcome, Brav and Mathews (2011) claim that these instruments may induce perverse investor behavior and exacerbate empty voting practices.

Finally, the implications drawn by this study also enrich the regulatory debate on the use of derivatives by activist shareholders. Large shareholders and activist hedge funds have incorporated derivatives to their regular practices, calling for a close regulation on the issue. Securities and Exchange Commission (SEC) Commissioner Daniel M. Gallagher recently stated[5] that *'derivatives and other and other synthetic forms of ownership can mask the size of the stake. As a result the purpose of the rule [Section 13 reporting obligations administered by the SEC] (...) is not being served'.* Given that the decision of option listing is made by the exchanges, which are members of the Options Clearing Corporation (OCC) under the jurisdiction of the SEC, these results are specially relevant for policy makers in general and the SEC in particular.

The remainder of this paper is organized as follows. In Section 2.2 I describe the research design and methodology, along with the main variables and source of data. Section 2.3 analyzes the baseline results and robustness issues. In Section 2.4 I discuss the main mechanisms that channel the effect. Finally, Section 2.5 concludes.

2.2 Data and research design

The primary focus of my research is to assess whether liquid option markets encourage shareholder activism. In other words, does higher options trading activity make share-

[5] June 23rd, 2015, Speech on Activism, Short-termism, and the SEC: Remarks at the 21st Annual Stanford Director's College. See the complete text here: https://www.sec.gov/news/speech/activism-short-termism-and-the-sec.html

holders more prone to exert activism?. I start by recognizing that any effect of option markets on corporate governance practices must go beyond the mere existence of a market and, rather, should be related to whether such market has sufficient volume, as incentives for informed agents to trade are higher in high-volume markets (Pagano, 1989; Admati and Pfleiderer, 1988). Consequently, I follow previous literature (Roll, Schwartz, and Subrahmanyam, 2009; Blanco and Wehrheim, 2017; Blanco and García, 2017) to define a continuous variable for option trading volume. Specifically, I construct the total annual dollar options volume for a firm by multiplying the total trade in each option by the end-of-day quote midpoint for that option and aggregate this number annually across all trading days and all options listed on the stock.

In order to assess how a more liquid options market influences the probability of subsequent shareholder activism I rely on the following probit regression model in the spirit of Norli, Ostergaard, and Schindele (2015):

$$Prob(ACT_{i,t} = 1|OptVol_{i,t-s}, X_{i,t-1}) = \Phi(\gamma_t + \beta_1 OptVol_{i,t-s} + \beta_2 X_{i,t-1}) \tag{2.1}$$

where i and t index firm and year, respectively. The dependent variable, $ACT_{i,t}$, equals one if firm i experiences shareholder activism on year t and zero otherwise. $\Phi()$ is the normal cumulative distribution function, $OptVol_{i,t-s}$ is the total annual dollar options trading volume as in Roll, Schwartz, and Subrahmanyam (2009) lagged s periods, γ_t accounts for time fixed-effects, and $X_{i,t-1}$ is a vector of control variables lagged one year. I also follow Norli, Ostergaard, and Schindele (2015) to define a complete set of controls. These controls include firm size, institutional ownership level, past abnormal performance, Tobins' Q, dividend yield, or analyst coverage, as well as a measure for a firm's stock liquidity. A more detailed and accurate definition of all variables can be found on Section 2.2.1 and B.1.

I define the probability of shareholder activism as the probability of a firm experiencing a *proxy contest* in year t, as in Norli, Ostergaard, and Schindele (2015). *Proxy contests* are situations in which a shareholder (or group of shareholders) disagrees with managerial proposals/decisions and require the support from other shareholders to run a dissident campaign. Although this metric is standard in the literature, proxy contests do not occur very often. For this reason, I also consider the event of a shareholder-sponsored proposal as an action of activism. *Shareholder proposals* are a costly means of activism through which investors can express their disagreement with management (e.g. by proposing directors or questioning director's pay) that have been the focus of a vast literature on shareholder governance (Karpoff, Malatesta, and Walkling, 1996; Del Guercio and Hawkins, 1999; Gillan and Starks, 2000). Because the costs of issuing a proposal for an investor are considerably lower than those of a proxy contest, these events ocur more regularly. Similar to the proxy contest activism, I define an activist event based on shareholder proposals as the probability of a firm experiencing a shareholder-sponsored proposal on year t.

As a complementary measure of shareholder involvement in firm governance, I investigate whether the presence of an active options market influences shareholder voting behaviour in management-sponsored elections. Even in cases where withheld votes in a plurality voting election lack legal significance, several arguments support their validity as a channel through which shareholders can express their dissatisfaction with management. Proxy advisors such Glass Lewis or Institutional Shareholder Services (ISS) consider withheld votes a meaningful disciplining device in uncontested elections. On the academic front, Del Guercio, Seery, and Woidtke (2008) report that vote-no campaigns in director elections are associated with higher CEO turnover and subsequent operating performance. Director appointments in private offerings that lack shareholders' symbolic vote are associated with poorer firm perfomance and a larger degree of managerial entrenchment, as reported by Arena and Ferris (2007). Cai, Garner, and Walkling (2009) find that fewer votes in directors' elections lead to a higher probability of removing poisson pills, classified boards and CEO turnover, as well as to lower CEO 'abnormal' compensation.

I follow Cai, Garner, and Walkling (2009) to define a measure of shareholder support to managerial proposals. Shareholders can opt among three basic choices during an election: shares can be voted for, withheld, or not voted. The base of votes for an election, as ISS and most companies define it, consist on the sum of 'for + withhold' votes. Consequently, the ratio of 'for' votes divided by 'for + withhold' constitutes a measure of shareholder support to an election. In order to get a firm-year measure, the ratio of 'for' votes is averaged across all election for firm i in year t, hence obtaining the *Average percent of "for" votes*. Because, as noted in Cai, Garner, and Walkling (2009), director elections may be different from others, I first calculate this measure for director elections and, then, extend the analysis to other elections, in which the voting base is constructed as specified by the company bylaws [6].

To assess how an active options market affects the way shareholders vote in elections I use the following regression specification defined in Eq. 2.2.

$$Avg.\ percent\ 'for'\ votes_{i,t} = \alpha + \beta_1 OptVol_{i,t-s} + \beta_2 X_{i,t} + \gamma_t + \theta_d \tag{2.2}$$

where i and t index firm and year, respectively. The average percent of 'for' votes is regressed on s-period lagged annual options trading volume, *OptVol*, and a set of control variables as in Cai, Garner, and Walkling (2009) and defined in Section 2.2.1 and B.1. γ_t and θ_d account for time and industry (4-digit Standard Industry Classification code)

[6]Although most companies also use as the base for other elections the number of for+withhold votes, depending on the type of voting some conform the base as the sum of for+against votes, as well as for+against+abstain. For those votings in which this information is available I define the voting base consequently.

fixed-effects, respectively.

2.2.1 Data and samples

The data required for this study comes from various sources. I gather information on options trading volume from Option Metrics. This database provides with daily put and call prices and volume, as well as option strikes and expiration dates. I use Option Metrics data to construct three variables. First, I define options trading volume (*OptVol*) as in Roll, Schwartz, and Subrahmanyam (2009), as the total annual dollar options volume over all options on a listed stock. Second, I construct two additional variables: *Open interest* and *Moneyness*, which I will use as instrumental variables in a two-stage least squares procedure to mitigate concerns related to endogeneity. I will define these variables in depth and discuss their validity as instruments in Section 2.3.2. Finally, due to high skewness, I use the log-transformations of these variables (e.g. *Ln(OptVol)*) for the regression analysis.

Data on shareholder activism is from Institutional Shareholder Services (ISS, formerly Risk Metrics). ISS provides detailed information on shareholder meetings and voting results for U.S. companies from 2003. This information includes, for example, the type on shareholder meeting (e.g. annual, special, etc.) which will allow me to identify those firms in which a proxy contest takes place. ISS also discloses information of the sponsor of each proposal voted, which permits the differentiation between management and shareholder initiated proposals. Finally, voting information, as well as management and ISS recommendation on each proposal is also provided by ISS.

As argumented before, my core analysis is based on two different regression models, defined in Eq.2.1 and Eq.2.2 above, that require different control variables and, hence, data samples. I proceed now to define each of these samples, which are based on the same data on shareholder activism, options market activity, and time period, but differ in information available regarding different control variables.

Direct shareholder activism sample

I define various control variables following Norli, Ostergaard, and Schindele (2015) to account for determinants of shareholder activism in the regression model specified in Eq. 2.1. First, I gather data from the Center for Research in Security Prices (CRSP) to construct firms stock market past performance, as bad performance is one of the main triggers of activism. Specifically, I compute $Abnormal\ Performance_{i,t}$ as the annual stock return on firm i minus the return of a value-weighted market index (CRSP value weighted) on year t. $Volatility_{i,t}$ is the standard deviation of monthly returns during year

t. I also use CRSP data to calculate Amihud (2002) measure of stock market illiquidity.[7]

The second source of data for defining my control variables is Thomson Reuters. I gather information regarding institutional ownership holdings for firm i and year t. Using this data I define *Institutional Ownership*$_{i,t}$ as the portion of shares in hands of institutional investors over total shares outstanding (which I obtain from CRSP) and a institutional ownership Herfindahl concentration index. I also gather data on *Analyst coverage*$_{i,t}$ from the I/B/E/S database. I construct this variable by aggregating the number of analyst following a stock in year t.

Lastly, I make use of the Compustat database to obtain firm-level characteristics. I define *Nasdaq* as a dummy variable that equals one if the firm is listed on Nasdaq market, $Ln(MarketCap)_{i,t}$ as the firm's end-of-December market capitalization, *Tobin's* $Q_{i,t}$ as the sum of the market capitalization of a firm's common equity (stock price times shares outstanding at the end of the quarter), liquidation value of its preferred shares and the book value of debt, divided by book value of assets. $Ln(Sale)$ is the natural log of sales. *Dividend yield*$_{i,t}$ is measured as the total dividend (common and preferred) over market value of common equity plus book value of preferred equity. $Cash_{i,t}$ equals cash and marketable securities divided by total assets. $R\&D_{i,t}$ is research and development expenses divided by total assets. I replace missing values in R&D expenses with zeros.

The final sample comprises data from all these different sources, 33736 firm-year observations for the period 2003-2014. To be included in the final sample, I require a firm to have non-missing values on all the variables aforementioned, have at least one institutional shareholder reporting the 13F filling, and to actively report to CRSP database for at least two years.[8] Lastly, to ensure my results are not driven by outliers and in line with standard practices in the literature, I winsorize all variables at upper and lower 0.005 percentiles. Additionally, I assign a value of zero in *Option Volume* to those firms that do not have options trading activity.[9]

Table 2.1 contains information on the main summary statistics of this sample. Only 0.34% of the firm-year observations experience activism. Whereas this number may seem low, it is in line with existing literature (e.g. Norli, Ostergaard, and Schindele (2015) hand-collected activism events add up to approximately 0.5% of the observations). The event of a shareholder proposal is significantly more frequent (8.5% of firm-year observations).

[7]Whereas Norli, Ostergaard, and Schindele (2015) use also Hasbrouck (2009) liquidity measure, this metric is only available until 2005. I use Amihud (2002) as it is widely available and standard in the literature. The results remain unchanged when using the relative bid-ask spread as a measure of stock market liquidity.

[8]I apply these filters in order to ensure my results are not driven by selection issues or subject to back-filling biases.

[9]Firms listed in options markets are intrinsically different from those that are not (Mayhew and Mihov, 2004) and analyze them together may lead to some errors. In further analysis I deal with this problem by focusing on the sample of firms with positive options volume as I argue the effect of options markets should be related to option market activity.

Table 2.1: Summary statistics: Direct activism

	Mean	StdDev	25%	Median	75%	Observations
Proxy Contest	0.0034	0.059	0.000	0.000	0.000	33736
Shareholder Proposal	0.0855	0.280	0.000	0.000	0.000	33736
Options Volume$_{(t-1)}$ ($millions)	78.692	347.545	0.000	0.356	10.660	33736
Ln(Mkt Cap)$_{(t-1)}$	6.462	2.093	4.959	6.321	7.864	33736
Tobin's $Q_{(t-1)}$	1.777	1.358	1.035	1.312	1.970	33736
Ln(Sales)$_{(t-1)}$	6.108	2.177	4.540	5.998	7.578	33736
Dividend yield$_{(t-1)}$	0.017	0.027	0.000	0.004	0.024	33736
Cash$_{(t-1)}$	0.117	0.143	0.020	0.061	0.162	33736
R&$D_{(t-1)}$	0.035	0.089	0.000	0.000	0.030	33736
Nasdaq$_{(t-1)}$	0.528	0.499	0.000	1.000	1.000	33736
Illiquidity$_{(t-1)}$	-0.103	4.530	0.001	0.006	0.065	33736
Volatility$_{(t-1)}$	0.115	0.078	0.065	0.097	0.143	33736
Ab. Performance$_{(t-1)}$	0.009	0.038	-0.010	0.006	0.025	33736
Ab. Performance$_{(t-2)}$	0.012	0.044	-0.010	0.008	0.028	33736
Insitutional HHI$_{(t-1)}$	0.130	0.155	0.044	0.071	0.146	33736
Institutional Ownership$_{(t-1)}$	0.512	0.289	0.260	0.553	0.767	33736
Analyst Coverage$_{(t-1)}$	6.085	6.741	1.000	3.750	8.750	33736

Notes: This table presents the summary statistics for the variables in the direct activism sample. Definitions of all variables are provided in B.1. The sample period is 2003-2014.

The rest summary statistics fall within normal values in the literature. *Options volume* for the average firm is $78.69 million, a large number taking into account that among the 33,736 firm-year observations, 13,945 correspond to observations with an asigned value of zero for options volume (meaning the firm is not quoted in the option market in that year). When considering only firms with positive options volume the mean (median) for *Options volume* is $134.61 millions ($6.18). Firms in the sample are, on average, large. The average firm exhibits a *Tobin's Q* of 1.77 (1.31 for the median), is followed by 6.08 analysts (3.75 for the median) and its ownership structure is composed by more than 50% of institutional owners (55.3% for the median). Additionally, more than half of the firm-year observations refer to firms quoted in the *Nasdaq*.

Dissent shareholder voting sample

Cai, Garner, and Walkling (2009) explore the firm-level determinants of election results. Following their baseline specification, I define these determinants as the set of control variables for my analysis formalized in Eq. 2.2. Some of these variables are common to the shareholder direct activism sample and, thus, I construct them following exactly the same procedure as described before. Common variables include Amihud (2002) illiquidity measure, natural logarithm of a firm's market capitalization, Tobin's Q, lagged stock market abnormal performance, percentage of institutional ownership, and institutional owners *Herfindahl-Hirschman* (H-H) concentration index.

Variables specific to the election sample focus on the governance structure of the firm. I gather data from the ISS (Risk Metrics) Governance database to construct several variables. To account for managerial entrenchment I use Bebchuk, Cohen, and Ferrell (2009) *E-index*. *Unequal voting dummy* is a dummy variable with value 1 if the firm has various classes of shares with unequal voting power, and 0 otherwise. *Confidential voting dummy* takes value 1 if the firm's policy prevents management from knowing how shareholders vote with their proxy cards. From ISS Directors database I withdraw information relative to *Board size*, the number of shares in hands of the board (*Board shares held*), and the percentage of the the board who are independent directors (*Independent directors*).

Using the ISS voting data, I create a dummy variable with value 1 if, in an election, ISS recommends voting 'for', and zero otherwise. *Average ISS recommendation* value corresponds to the average value of this dummy across all election in that firm-year. Lastly, I calculate total *CEO compensation* using data from Execucomp.

Table 2.2: Summary statistics: Voting sample

	Mean	StdDev	25%	Median	75%	Observations
Avg. vote for management (%)						
Directors elections	95.309	6.934	94.834	97.424	98.893	10150
Other elections	92.819	8.679	89.876	95.860	98.322	4885
All elections	94.518	6.345	93.100	96.394	98.171	10206
Options Volume ($millions)	176.519	524.961	0.900	8.165	72.894	12173
Ln(Mkt Cap)	7.909	1.522	6.779	7.765	8.922	12173
Illiquidity	-0.021	1.316	0.000	0.001	0.003	12173
Tobin's Q	1.845	1.130	1.118	1.481	2.146	12173
Ab. Performance	0.008	0.026	-0.007	0.006	0.021	12173
E-Index	2.859	1.286	2.000	3.000	4.000	12173
CEO compensation	0.570	0.719	0.161	0.347	0.732	12173
Board size	9.519	2.450	8.000	9.000	11.000	12173
Board shares held	74.656	141.054	9.624	25.529	80.591	12173
Independent directors(%)	0.761	0.128	0.667	0.778	0.875	12173
Avg. ISS recommendation	0.911	0.176	0.889	1.000	1.000	12173
Unequal voting dummy	0.031	0.173	0.000	0.000	0.000	12173
Confidential voting dummy	0.131	0.337	0.000	0.000	0.000	12173
Institutional HHI	0.048	0.025	0.033	0.043	0.056	12173
Institutional Ownership	0.737	0.150	0.643	0.756	0.853	12173

Notes: This table presents the summary statistics for the variables in the shareholder voting sample. Definitions of all variables are provided in B.1. The sample period is 2003-2014.

Table 2.2 summarizes the main descriptive statistics for this sample. A total of 10.206 firm-year observations correspond to data on all elections, from which 10.150 correspond to 'director' elections, and only 4.885 correspond to 'other' elections. Although the percentage of votes 'for' management may seem somehow large (e.g. 94.5% of average support to management in all elections), these values are close to those in the literature (e.g. Cai, Garner, and Walkling (2009) report a 93.93% of shareholders support to management). The statistics on the remaining variables are slightly different than those in the direct activism sample, making evident that firms in this sample have a larger size, as a result of the inclusion of additional control variables, for which data is not abundant. The average firm in this sample has a slightly larger *Tobin's Q* (1.84 vs. 1.77) as well as larger market capitalization (7.91 vs. 6.46 in natural logarithm terms). However, the greatest difference in the sample is in the level of institutional ownership (73.7% vs. 51.2%).

2.3 Baseline results

Table 2.3 shows the results from the baseline regression specified in Eq. 2.1. Columns 1 and 3 display the results from regressing $Ln(OptVol)_{(t-1)}$ and the aforementioned control variables on the probability of a firm experiencing a proxy contest and a shareholder proposal, respectively, on year t. Similarly, columns 2 and 4 perform the same analysis but using $Ln(OptVol)_{(t-2)}$ as an independent variable. As observed in Table 2.3, the coefficient of $Ln(OptVol)_{(t-j)}$ is positive and highly significant (p-value<0.05 for the coefficients on probability of a proxy contest and p-value<0.01 for the probability of shareholder proposal) across all four specifications. This evidence confirms that there is a positive association between an active options market and subsequent shareholder activism. Specifically, an increase in one-year lagged options trading volume from the 10th to the 90th percentile is associated with an increase in the probability of a proxy contest (shareholder proposal) of 0.21% (3.42%). Although this number may seem low, a proxy contest is a rare event. This change of 0.21% corresponds to a change of 61.76% relative to the sample probability of activism (around 0.36%), which is in line with previous findings in the literature.[10]

The coefficients on the different control variables take the value and direction expected and are coherent with previous findings in the literature. Whereas higher liquidity, institutional ownership, dividend yield or analyst coverage positively predict shareholder activism, past performance, firm size, stock volatility or firm cash negatively associates with the probability of investors exerting governance in the form of voice.

Table 2.4 contains the results from the regression specification in Eq. 2.2. Column 1 uses the average 'for' vote in director elections as dependent variable, whereas columns 2 and 3 explore the effect on shareholder voting on 'other' and 'all' elections, respectively. The negative coefficients on one-year lagged *Ln(OptVol)* reveal that shareholders in firms more actively traded in the options market tend to dissent from management more often. These coefficients have strong statistical significance in the three dimensions of elections considered (p-value<0.05 for director elections, p-value<0.01 for other and all elections.). Specifically, an increase of one-standard deviation in one-year lagged options volume corresponds to a decrease of 0.73 percentage points in shareholder support to management proposals. This effect is lower for director elections, but still significant, whereas is stronger for 'other' proposals, which include governance and director compensation issues, where shareholders can typically have a more direct impact on the company with their voting.

The coefficient estimates on the remaining control variables have expected direction. Shareholders are more prone to align their votes with management when the stock is more

[10] Norli, Ostergaard, and Schindele (2015) report an effect of liquidity relative to the sample probability of activism of 71.2%.

Table 2.3: Options Volume and Activism

	Proxy Contest$_t$		Shareholder Proposal$_t$	
	(1)	(2)	(3)	(4)
Ln(OptVol)$_{(t-1)}$	0.055**		0.087***	
	(0.021)		(0.010)	
Ln(OptVol)$_{(t-2)}$		0.050**		0.089***
		(0.022)		(0.009)
Ln(Illiquidity)$_{(t-1)}$	-0.075*	-0.080*	-0.131***	-0.135***
	(0.041)	(0.042)	(0.019)	(0.019)
Ab. Performance$_{(t-1)}$	-0.597	-0.414	0.267	0.730
	(0.971)	(0.982)	(0.507)	(0.506)
Ab. Performance$_{(t-2)}$	-2.204***	-1.905**	-3.216***	-2.652***
	(0.852)	(0.843)	(0.450)	(0.444)
Insitutional HH$I_{(t-1)}$	-0.453	-0.410	-0.032	-0.021
	(0.318)	(0.313)	(0.208)	(0.208)
Institutional Ownershi$p_{(t-1)}$	0.730***	0.715***	0.488***	0.486***
	(0.160)	(0.161)	(0.069)	(0.069)
Analyst Coverag$e_{(t-1)}$	-0.004	-0.003	0.015***	0.014***
	(0.008)	(0.008)	(0.002)	(0.002)
Volatilit$y_{(t-1)}$	-0.256	-0.213	-1.750***	-1.685***
	(0.517)	(0.496)	(0.358)	(0.340)
Nasda$q_{(t-1)}$	0.079	0.076	-0.012	-0.016
	(0.078)	(0.078)	(0.034)	(0.034)
Ln(Mkt Cap)$_{(t-1)}$	-0.243***	-0.244***	-0.092***	-0.096***
	(0.057)	(0.058)	(0.024)	(0.024)
Tobin's $Q_{(t-1)}$	-0.056	-0.051	-0.008	-0.005
	(0.042)	(0.042)	(0.016)	(0.016)
Ln(Sales)$_{(t-1)}$	0.034	0.035	0.193***	0.194***
	(0.032)	(0.032)	(0.018)	(0.018)
Dividend yiel$d_{(t-1)}$	0.967	1.025	2.672***	2.858***
	(1.013)	(1.016)	(0.451)	(0.451)
Cas$h_{(t-1)}$	0.182	0.162	-0.663***	-0.698***
	(0.269)	(0.269)	(0.166)	(0.167)
R&$D_{(t-1)}$	0.053	0.073	0.193	0.169
	(0.396)	(0.395)	(0.440)	(0.443)
Observations	33736	33736	33736	33736
Pseudo R^2	0.074	0.074	0.323	0.323
Change in probability of activism when OptVol				
is increased from 10th to 90th perc. (marginal eff. at means).	0.21%	0.18%	3.42%	3.38%
(p-value Wald diff test)	(0.03)	(0.05)	(0.00)	(0.00)
Change relative to sample probability of activism	61.76%	52.94%	40.01%	39.51%

Notes: This table presents probit regression estimates of firm-level shareholder activism events (proxy contest and shareholder proposal) on one and two-year lagged options volume and a set of determinants of shareholder activism. A detailed definition of all variables is provided in B.1. All regressions include year dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

Table 2.4: Voting with management

	Average Vote for Management (%)		
	Directors	Other	All
	(1)	(2)	(3)
$Ln(OptVol)_{(t-1)}$	-0.072**	-0.242***	-0.114***
	(0.035)	(0.077)	(0.034)
Illiquidity	-0.053***	-0.031	-0.042***
	(0.016)	(0.022)	(0.015)
Ln(Mkt Cap)	0.460***	0.962***	0.531***
	(0.068)	(0.184)	(0.073)
Tobin's Q	0.162***	0.120	0.164**
	(0.060)	(0.158)	(0.064)
Ab. $Performance_{(t-1)}$	6.206***	-6.476	3.384
	(2.058)	(7.073)	(3.032)
E-Index	-0.394***	-0.150	-0.543***
	(0.052)	(0.137)	(0.059)
CEO compensation ($ thousands)	-0.191**	-1.345***	-0.423***
	(0.078)	(0.235)	(0.077)
Board size	0.063**	0.030	0.092***
	(0.031)	(0.073)	(0.032)
Board shares held	0.003***	0.004***	0.005***
	(0.001)	(0.001)	(0.001)
Independent directors(%)	2.729***	-0.852	1.701***
	(0.581)	(1.266)	(0.557)
Avg. ISS Recommen.	23.493***	11.187***	22.269***
	(0.614)	(1.096)	(0.636)
Unequal voting dummy	1.742***	2.108**	1.174*
	(0.390)	(1.020)	(0.605)
Confidential voting dummy	-0.080	-0.223	-0.167
	(0.149)	(0.350)	(0.162)
Institutional HHI	8.520***	25.608***	10.867***
	(2.612)	(6.888)	(2.577)
Institutional Ownership	-0.951**	-0.594	-0.570
	(0.464)	(1.152)	(0.455)
Observations	10150	4885	10206
Adjusted R^2	0.585	0.119	0.408

Notes: This table presents OLS regression estimates of the average shareholder vote for management-sponsored proposals on one-year lagged options volume and a set of known determinants of shareholder support to management. Column 1 contains the results for proposals on Directors, column 2 for Other proposals, and column 3 for All proposals. A detailed definition of all variables is provided in B.1. All regressions include year and industry (four-digit sic code) dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

liquid, the firm is larger, past performance has been positive, governance quality of the firm is stronger, and ISS recommends voting 'for'. On the other hand, shareholders tend to withdraw their support to management when the CEO is heavily compensated, and the firm has higher and less concentrated institutional ownership.

Taken together, these first results point at options trading volume being related to a stronger shareholder attitude towards activism. However, even I carefully introduce control variables, and measure options trading one year before the activist event, I cannot, so far, argue a causal effect of option markets on shareholder governance via voice or voting behaviour. It may be that, for example, investors are more prone to trade options over firms that have historically more active shareholder governance. I analyze this endogeneity problem, as well as other issues related to the robustness of the results in the next sections.

2.3.1 Firms with positive options volume

So far I have explored the effect of option markets on shareholder governance over an universe of firms that include both companies traded in the options market, as well as firms not quoted on the options market. As Mayhew and Mihov (2004) point out, exchanges use a different set of criteria to decide whether to quote a firm in the options market, although the decision is ultimately discretionary. Consequently, even though I control for a set of known determinants of access to options market such liquidity or firm size, companies in my sample that do have options trading activity may be inherently different from those that do not in some unobservable characteristic.

To mitigate concerns related to these potential omitted variable bias, I repeat the probit and OLS regression specifications in Eq. 2.1 and 2.2, respectively, for the subsample of observations with positive options trading volume. The results from the direct activism sample are in Table 2.5. Columns 1 and 2 use the probability of a proxy contest as a dependent variable for one-year and two-year lagged options volume, respectively, whereas columns 3 and 4 use the probability of a shareholder proposal as a signal of activism for one and two-years lagged option trading activity as well. Overall, the results confirm previous findings. Furthermore, one-year lagged options volume has a significant larger effect than in the previous specification. Specifically, an increase in options activity from the 10th to the 90th percentiles now associates with a 82.63% change in the likelihood of receiving a proxy contest relative to the sample probability. Surprisingly, the probability of a firm receiving a shareholder proposal looses statistical significance for the case of one-year lagged options volume, although the coefficient remains highly statistically significant (p-value$<$0.01) for the two-year-lagged options volume. I explore this finding in detail when I investigate the endogeneity of the effect in a forward section.

Table 2.6 contains the results of the OLS specification for the shareholder voting sample. Similarly to the previous case, despite loosing some observations corresponding

Table 2.5: Options Volume and Activism: Firms with positive Options volume

	Proxy Contest$_t$		Shareholder Proposal$_t$	
	(1)	(2)	(3)	(4)
Ln(OptVol)$_{(t-1)}$	0.060**		0.017	
	(0.025)		(0.012)	
Ln(OptVol)$_{(t-2)}$		0.044*		0.032***
		(0.025)		(0.011)
Ln(Illiquidity)$_{(t-1)}$	-0.027	-0.054	-0.266***	-0.250***
	(0.053)	(0.060)	(0.038)	(0.035)
Ab. Performance$_{(t-1)}$	-1.847	-1.567	0.339	0.285
	(1.230)	(1.347)	(0.590)	(0.607)
Ab. Performance$_{(t-2)}$	-3.663***	-3.147***	-3.261***	-3.034***
	(1.146)	(1.174)	(0.555)	(0.555)
Insitutional HH$I_{(t-1)}$	-1.245	-1.088	-0.978**	-1.367***
	(0.853)	(0.812)	(0.435)	(0.404)
Institutional Ownershi$p_{(t-1)}$	0.845***	0.809***	0.754***	0.799***
	(0.202)	(0.214)	(0.096)	(0.098)
Analyst Coverag$e_{(t-1)}$	-0.007	-0.007	0.009***	0.008***
	(0.008)	(0.008)	(0.003)	(0.003)
Volatilit$y_{(t-1)}$	-0.162	0.007	0.011	-0.129
	(0.768)	(0.680)	(0.411)	(0.399)
Nasda$q_{(t-1)}$	0.077	0.102	-0.022	-0.037
	(0.098)	(0.099)	(0.040)	(0.040)
Ln(Mkt Cap)$_{(t-1)}$	-0.207***	-0.224***	-0.088***	-0.088***
	(0.067)	(0.073)	(0.034)	(0.034)
Tobin's $Q_{(t-1)}$	-0.037	-0.021	0.004	0.003
	(0.048)	(0.046)	(0.018)	(0.018)
Ln(Sales)$_{(t-1)}$	0.057	0.065*	0.229***	0.231***
	(0.037)	(0.039)	(0.023)	(0.023)
Dividend yiel$d_{(t-1)}$	1.681*	1.307	3.590***	3.978***
	(1.014)	(1.086)	(0.546)	(0.567)
Cas$h_{(t-1)}$	0.001	-0.015	-0.503***	-0.498***
	(0.356)	(0.357)	(0.183)	(0.183)
R&$D_{(t-1)}$	0.280	0.213	0.523	0.557
	(0.453)	(0.463)	(0.464)	(0.460)
Observations	19791	18689	19791	18689
Pseudo R^2	0.074	0.072	0.289	0.287
Change in probability of activism when OptVol				
is increased from 10th to 90th perc. (marginal eff. at means).	0.34%	0.28%	1.30%	3.18%
(p-value)	(0.03)	(0.07)	(0.22)	(0.00)
Change relative to sample probability of activism	82.63%	67.08%	9.55%	23.36%

Notes: This table presents probit regression estimates of firm-level shareholder activism events (proxy contest and shareholder proposal) on one and two-year lagged options volume and a set of determinants of shareholder activism, for the subsample of firms with positive options trading volume. A detailed definition of all variables is provided in B.1. All regressions include year dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

to firms not quoted on the option market, coefficients for options trading volume remain strong statistically with slight increases in their economic magnitude. For example, the coefficient on *Ln(Optvol)*$_{t-1}$ for all elections changes from -0.114 to -0.130. These results are in line with the prior of a beneficial effect of option markets on activism coming from the liquidity of the market rather than solely from whether it exists.

Table 2.6: Voting with management: Firms with positive OptVol

	Average Vote for Management (%)		
	Directors	Other	All
	(1)	(2)	(3)
Ln(OptVol)$_{(t-1)}$	-0.082**	-0.302***	-0.130***
	(0.036)	(0.079)	(0.035)
Controls	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Observations	9428	4598	9478
Adjusted R^2	0.598	0.107	0.418

Notes: This table presents OLS regression estimates of the average shareholder vote for management-sponsored proposals on one-year lagged options volume and a set of known determinants of shareholder support to management, for the subsample of firms with positive options trading volume. Column 1 contains the results for proposals on Directors, column 2 for Other proposals, and column 3 for All proposals. A detailed definition of all variables is provided in B.1. All regressions include year and industry (four-digit sic code) dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

2.3.2 Endogeneity

Having established that more active options markets are associated with higher shareholder activism and dissent voting, I turn now to explore possible biases in my results due to endogeneity or reverse causality. I mitigate these concerns by using an instrumental variable (IV) approach with a two-staged least squares (2SLS) regression model. The use of instrumental variables carries several benefits for assessing validity to my results. It will not only help with reverse-causality concerns, but also mitigate biases due to measurement error and omitted variables. Note that, because the construction of these instruments is only possible for firms with positive options trading volume, the instrumental variable analysis is restricted to those firm-year observations with positive options trading activity.[11]

[11] This restriction, however, should not pose a problem, since my hypothesis predicts the effect to be related to the liquidity of the options market rather to its mere existence.

A good instrument for my setting is a variable that is highly correlated with options volume (relevance condition), but uncorrelated with the probability of shareholder activism except through other independent variables (exclusion restriction). I make use of two good instruments used before in the literature (Roll, Schwartz, and Subrahmanyam, 2009; Blanco and Wehrheim, 2017; Blanco and García, 2017). The first is open interest, which consists on the total number of put and call contracts that remain open on a given stock. I average this daily number (provided by Option Metrics) annually to construct *Open interest*$_t$. As shown by a correlation of 0.648, it is clear that this variable strongly relates to option volume (I provide results from the first stage regression on B.2). Moreover, as this number contains the sum of call and put contracts, it should not be linked to higher or lower firm quality (Roll, Schwartz, and Subrahmanyam, 2009) or activism level in any mechanical way.[12]

Table 2.7 displays the result of the 2SLS regression on the probability of a firm experiencing a proxy contest or a shareholder proposal using the natural log of open interest, *Ln(Open Interest)*, as an instrument and the full set of time dummies and independent variables from Eq 2.1. Coefficients for the instrumented *Ln(Opt Vol)*$_{(t-1)}$ are highly significant (p-value$<$0.01) for both the probability of proxy contest and of shareholder proposal (columns 1 and 3, respectively). For the case of instrumented *Ln(Opt Vol)*$_{(t-2)}$, statistical significance remains high for the probability of shareholder proposal (column 4) but p-values increase for the probability of proxy contest (column 2) although coefficient remains statistically significant at 10% level. The economic magnitude of the coefficients in the 2SLS is larger than for the baseline probit results, indicating that the main effect of options on the probability of activism suffers from downward bias and therefore the true coeffeficient is larger.[13]

Similarly, Table 2.8 shows the results of performing a 2SLS regression on the shareholder voting sample. Coefficients on instrumented one-year lagged options volume, *Ln(Opt Vol)*$_{(t-1)}$, are strongly significant (p-value$<$0.01) for the three specified elections. Again, economic magnitudes of the effects are quite larger than in the baseline case, pointing at the downward bias of the OLS coefficient also suggested by the probit regressions.

The second instrument I use is *Moneyness*. I calculate moneyness as in Roll, Schwartz, and Subrahmanyam (2009) (i.e. the average absolute difference between the stock's market price and the option's strike price aggregated across all options on a stock and averaged annually). Because different agents seek options with different strikes (e.g. volatility speculators would choose deep in-the-money options as their vega is close to zero, informed

[12] Higher or lower values of call or put contracts may correspond to better or poorer firm quality that may trigger shareholder activism, but not the sum of both option contracts.

[13] Discrepancies between 2SLS and OLS coefficients are normal and arise due to several factor related primarily with the mitigation of errors-in-variables biases. A comprehensive analysis of the relevant econometric issues on this topic can be found in Beaver, McAnally, and Stinson (1997) or Irwin and Terviö (2002).

Table 2.7: Options Volume and Activism: IV Open interest

	Proxy $Contest_t$		Shareholder $Proposal_t$	
	(1)	(2)	(3)	(4)
$Ln(OptVol)_{(t-1)}$	0.098***		0.102***	
(instrumented)	(0.036)		(0.014)	
$Ln(OptVol)_{(t-2)}$		0.062*		0.107***
(instrumented)		(0.034)		(0.013)
Controls	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Observations	19791	18689	19791	18689

Notes: This table presents instrumental variable (IV) probit regression estimates for firm-level shareholder activism events (proxy contest and shareholder proposal) on one and two-year lagged instrumented options volume and a set of control variables. Annual Options volume is instrumented through the average annual Open interest. A detailed definition of all variables is provided in B.1. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

Table 2.8: Voting with management: IV Open interest

	Average Vote for Management (%)		
	Directors	Other	All
	(1)	(2)	(3)
$Ln(OptVol)_{(t-1)}$	-0.186***	-0.457***	-0.210***
(instrumented)	(0.044)	(0.101)	(0.043)
Controls	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Observations	9428	4598	9478

Notes: This table presents 2SLS regression estimates of the average shareholder vote for management-sponsored proposals on instrumented one-year lagged options volume and a set of known determinants of shareholder support to management. Column 1 contains the results for proposals on Directors, column 2 for Other proposals, and column 3 for All proposals. Annual options volume is instrumented trhough average annual Open interest. A detailed definition of all variables is provided in B.1. All regressions include year and industry (four-digit sic code) dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

agents may trade out-of-the-money options that provide higher leverage, and uninformed traders would select less risky positions through at-the money options) and exchanges tend to list new options with strikes close to current stock price, there is no reason to expect that (unsigned) moneyness is directly related to firm quality or the probability of shareholder activism. However, the relevance condition is not as strong as with open interest. While the correlation between this variable and options volume is sufficiently strong prior to the financial crisis of 2007 (around 0.2), it has decreased dramatically since then. Throughout my whole sample period (2003-2014) the correlation of moneyness with options volume is just 0.03, suggesting that this instrument may not be as strong as open interest when I include more recent and financially unstable years. Tables B2.1 and B2.2 in B.2 provide the results of the 2SLS model using moneyness and open interest together as instruments for the direct activism and the shareholder voting samples, respectively. Results confirm the direction and significance of the effect for the baseline probit and OLS models.

Taken together, these results are consistent with the notion of a significant causality running from option markets to subsequent shareholder activism. Moreover, using an instrumental variable regression to mitigate biases yields a larger magnitude of the coefficients, revealing a stronger economic significance of the effect.

2.3.3 Number of activist events

So far I have defined the event of activism by a shareholder as the probability of firm i experiencing either a proxy contest or a shareholder proposal in year t. This metric, however, does not disentangle firms experiencing several activism events a year from those that suffer only one. Nonetheless, if active options markets truly encourage shareholder governance in the form of voice, investors in stocks with more actively traded options should be more prone to exert governance efforts resulting in a higher number of activist events. In this section I deal with this issue by exploring the effect of option market liquidity on the number of proxy contests and shareholder proposals experienced by a firm in a given year. Using the same direct shareholder activism sample as before, I run the regression specified in Eq. 2.3 under three different models: ordinary least squares, Poisson, and negative binomial.

$$\#\ Activism\ events = \gamma_t + \beta_1 Ln(OptVol)_{i,t-1} + \beta_2 X_{i,t-1} \tag{2.3}$$

where γ_t accounts for time fixed effects, $X_{i,t-1}$ contains the same vector of control variables used in the baseline probit regressions, and $Ln(OptVol)_{i,t-1}$ measures option market activity. Table 2.9 displays the results of this regression specification. Columns 1 to 3 use the number of proxy contests received by a firm in a given year as a dependent variable, whereas columns 4 to 6 use the number of proposals registered by shareholders.

Because of the nature of the data, I extend the classic OLS specification (in columns 1 and 4) to include Poisson (columns 2 and 5) and negative binomial (columns 3 and 6) regression estimation. Coefficients for $Ln(OptVol)_{i,t-1}$ across all specifications have high statistical significance (p-value<0.01, except for the OLS regression on the number of proxy contests with p-value<0.05) and positive sign, supporting the notion of liquid options market encouraging several shareholder activism events.

2.4 Possible mechanisms

Having explored the robustness of the effect on various dimensions, I turn now to disentangle the possible mechanisms by which liquid option markets encourage shareholder activism. My main hypothesis argues that active option markets make shareholders more prone to activism by increasing the net benefits from intervention and voting. This is, because options allow investors to access extra trading gains, while the costs associated with activism (e.g., research) remain equal, shareholders' incentives to seek value-increasing projects for the firm increase. Whereas observing this is impossible in practice, I can analyze the effect of options in several situations in which my hypothesis has clear predictions. Providing definite proof is, of course, challenging and hence my tests are only suggestive.

I start by considering the role of options in promoting trading among investors. Similar to the effect of liquidity in theories like Kahn and Winton (1998) if options markets truly facilitate investors trading[14], their positive impact on shareholder activism should be lower (even negative) in cases where investors' incentives to exit clearly outweigh potential gains from intervention. One specific example of such a case are overvalued firms. When a firm is highly overvalued, a privately informed investor observing the firm is overvalued may find optimal to exit the firm and abstain from initiating a value-enhancing (but costly) intervention.

Next, I investigate the influence of options toward shareholder voting behaviour. Shareholders dedicate effort to research a proposal based on their net benefits from voting (Iliev and Lowry, 2014). This is, as shareholders have higher incentives to become privately informed about firm fundamentals, they will assess the effect of a proposal for firm value with higher accuracy. Consistent with my hypothesis of options serving as a venue for additional gains from private information, the presence of an active options market should motivate more active shareholder voting behaviour.

Lastly, I focus on the stock market reaction to shareholders proposals forerun by larger

[14] Notice that by facilitating investor trading I refer to both initiating a new position, as well as exiting an existing one. For example, investors may mitigate the harmful effect of price impact when selling a large stake by trading on derivative markets.

Table 2.9: Number of activist events

	#Proxy Contests$_t$			#Shareholder Proposals$_t$		
	OLS	Poisson	Neg.Binom.	OLS	Poisson	Neg.Binom.
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(OptVol)$_{(t-1)}$	0.010**	0.200***	0.489***	0.065***	0.150***	0.169***
	(0.004)	(0.077)	(0.082)	(0.007)	(0.028)	(0.029)
Ln(Illiquidity)$_{(t-1)}$	-0.008*	-0.209	-0.525***	0.009	-0.245***	-0.223***
	(0.005)	(0.141)	(0.124)	(0.006)	(0.065)	(0.071)
Ab. Performance$_{(t-1)}$	-0.247	-4.228	4.772	-0.112	-3.459***	-2.974**
	(0.171)	(3.245)	(4.205)	(0.120)	(1.043)	(1.295)
Ab. Performance$_{(t-2)}$	-0.252***	-6.507***	-15.079***	-0.489***	-6.929***	-7.206***
	(0.091)	(2.518)	(3.671)	(0.093)	(0.909)	(1.112)
Insitutional HHI$_{(t-1)}$	-0.023	-1.566	-6.275***	0.216***	-0.479	-0.632
	(0.025)	(1.179)	(1.304)	(0.031)	(0.610)	(0.667)
Institutional Ownership$_{(t-1)}$	0.083***	2.085***	4.944***	-0.062	1.156***	1.100***
	(0.025)	(0.590)	(0.781)	(0.040)	(0.199)	(0.227)
Analyst Coverage$_{(t-1)}$	-0.000	-0.003	0.013	0.017***	0.006	0.015**
	(0.002)	(0.026)	(0.027)	(0.003)	(0.005)	(0.006)
Volatility$_{(t-1)}$	0.038	-0.734	-1.942	-0.239***	-1.232	-2.310***
	(0.086)	(2.117)	(2.182)	(0.071)	(0.846)	(0.872)
Nasdaq$_{(t-1)}$	0.025	0.462	0.374	0.009	0.042	0.071
	(0.018)	(0.322)	(0.318)	(0.016)	(0.118)	(0.117)
Ln(Mkt Cap)$_{(t-1)}$	-0.026***	-0.649***	-1.673***	0.019	-0.070	-0.181**
	(0.009)	(0.210)	(0.207)	(0.013)	(0.070)	(0.082)
Tobin's $Q_{(t-1)}$	-0.004	-0.129	-0.451***	-0.022***	-0.068	-0.041
	(0.005)	(0.164)	(0.138)	(0.006)	(0.041)	(0.043)
Ln(Sales)$_{(t-1)}$	0.008	0.124	-0.128	0.055***	0.363***	0.355***
	(0.007)	(0.121)	(0.140)	(0.009)	(0.048)	(0.057)
Dividend yield$_{(t-1)}$	0.075	1.500	-2.764	0.817***	4.339***	4.361***
	(0.210)	(3.237)	(4.001)	(0.216)	(1.082)	(1.358)
Cash$_{(t-1)}$	0.016	0.141	1.468	0.018	-0.385	-0.781*
	(0.048)	(0.916)	(1.134)	(0.037)	(0.432)	(0.446)
R&D$_{(t-1)}$	0.031	0.552	-1.005	0.249***	0.149	1.275
	(0.079)	(1.249)	(1.731)	(0.071)	(1.372)	(1.089)
Observations	33736	33736	33736	33736	33736	33736

Notes: This table presents the regression estimates of firm-level shareholder activism events (proxy contest and shareholder proposal) on one-year lagged options volume and a set of determinants of shareholder activism. Columns 1 and 4 present results from OLS model while columns 2 and 5 provide estimates from a Poisson model. Finally, columns 3 and 6 provide results from Negative Binomial regression. A detailed definition of all variables is provided in B.1. All regressions include year dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

options trading volume. So far, my results point at shareholders using option markets as an alternative trading venue. However, trading in two markets that allow for taking opposite positions in eachother facilitates the decoupling of voting and economic interests for shareholders. This, in turn, can promote empty voting behaviour that leads to value-decreasing activities for the firm. I evaluate whether shareholder proposals motivated by larger trading in option markets lead to higher or lower subsequent stock prices. Specifically, to mitigate concerns related to stock market anticipation of a pass of the proposal, I focus on those proposals that pass or fail by a small margin (Cuñat, Gine, and Guadalupe, 2012).

2.4.1 Direct activism in overvalued firms

Firm overvaluation is impossible to observe with precision. However, extensive literature supports the validity of proxies that build on the theories by Miller (1977) and Harrison and Kreps (1978), which point to short-sale constraints and difference of opinion as determinants of firm overvaluation. As argued by Nagel (2005), stocks with low institutional ownership tend to have more sparse loan supply. Similarly, I follow Baker and Wurgler (2007) and use stock return volatility as a proxy for difference of opinion. Consequently, I define two measures that proxy for firm overvaluation: *Ln(1/Institutional Ownership)* and the standard deviation of monthly stock returns over one year (*Volatility*), as in Norli, Ostergaard, and Schindele (2015). Table 2.10 contains the results of interacting these two variables with options trading volume.

Columns 1 and 3 in Table 2.10 contain the results from the probit regression in Eq. 2.1 and the interaction term of options volume, $Ln(OptVol)_{t-2}$, and the overvaluation proxy, $Ln(1/Inst.Own)_{t-1}$, for the probability of a firm experiencing a proxy contest and a shareholder proposal, respectively. Columns 2 and 4 include the same analysis, but using $Volatility_{t-1}$ as a proxy for firm overvaluation. As shown by the negative coefficients resulting from the interactions with firm overvaluation proxies, the effect of options trading volume on shareholder activism is lower for highly overvalued stocks. Although when computing the average interaction effect it is not statistically significant for the event of a proxy contest (although still negative), it remains highly significant (p-value<0.01) for the case of shareholder proposal.

In sum, these results are consistent with the notion of options trading volume easing investors trading activities, which facilitates exit rather than intervention when a firm is highly overvalued.

Table 2.10: Options Volume and Activism in Overvalued firms

	Proxy Contest$_t$		Shareholder Proposal$_t$	
	(1)	(2)	(3)	(4)
Ln(OptVol)$_{(t-2)}$× Ln($1/Inst.Own.$)$_{(t-1)}$	-0.067***		-0.118***	
	(0.023)		(0.009)	
Ln(OptVol)$_{(t-2)}$× Volatility$_{(t-1)}$		-0.126		-0.288***
		(0.155)		(0.100)
Ln(OptVol)$_{(t-2)}$	0.079***	0.066**	0.141***	0.117***
	(0.027)	(0.029)	(0.010)	(0.013)
Ln($1/Inst.Own.$)$_{(t-1)}$	-0.473***		-0.704***	
	(0.183)		(0.120)	
Volatility$_{(t-1)}$	-0.213	-0.072	-1.180***	-0.828**
	(0.504)	(0.518)	(0.329)	(0.401)
Controls	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Avg. interaction effect	-0.001	-0.001	-0.019***	-0.042***
(average z-value)	(-1.138)	(-0.180)	(-5.102)	(-3.417)
Observations	33736	33736	33736	33736
Pseudo R^2	0.080	0.074	0.342	0.324

Notes: This table presents probit regression estimates of firm-level shareholder activism events (proxy contest and shareholder proposal) on one and two-year lagged options volume and a set of determinants of shareholder activism, as well as the interaction term of options volume with two overvaluation proxies, Ln(1/Inst.Own)$_{t-1}$ and Volatility$_{t-1}$. A detailed definition of all variables is provided in B.1. All regressions include year dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

2.4.2 Active shareholder voting

Shareholders do not always have the incentives to perform a deep assessment of all the different proposals available for voting in meetings. Because the allocation of resources to research the effects and consequences of each agenda item is limited, it is not surprising that an industry has grown to service this requirement. Proxy advisory firms gather information about millions of companies and provide with voting recommendations for each item on the voting agenda. The increasing use of this recommendations by shareholders has motivated a depper study of the behaviour of proxy advisers, which have been widely accused of issuing arbitrary guidance. Iliev and Lowry (2014) study the use of ISS (a well-known proxy adviser) services by mutual fund shareholders. Their results link shareholder voting behavior to their net benefits from voting. Mutual funds with higher net benefits of voting are less likely to rely on ISS recommendations and follow one-size-fits-all approach. Moreover, these funds that vote more actively earn a higher risk-adjusted return from their investments. Additionally, Coles, Daniel, and Naveen (2006) and Johnson, Karpoff, and Yi (2015) emphasize how the one-size-fits-all approach is unlikely to be optimal for firm governance.

In order to investigate whether the presence of an active options market is related to increasing benefits from active governance, I study how likely are shareholders to vote in line with ISS recommendations when the firm has larger options trading activity. With this aim, and making use of the shareholder voting data used before, I construct a variable, *Average vote with ISS (%)*, that measures the degree in which shareholder votes align with ISS recommendation. Specifically, this variable accounts for the average percentage of votes following ISS recommendation over the voting base, in a similar fashion to the *Average vote for management* variable used before. Using this metric as a measure for shareholder support to ISS guidance I run the following regression model, similar to that of Eq. 2.2:

$$Avg.\ vote\ with\ ISS\ (\%)_{i,t} = \alpha + \beta_1 Ln(OptVol)_{i,t-s} + \beta_2 X_{i,t} + \gamma_t + \theta_d \qquad (2.4)$$

where i and t index firm and year, respectively. The average percent of votes with ISS is regressed on s-period lagged annual options trading volume, and a set of control variables, as well as time (γ_t) and industry (θ_d) fixed-effects. The set of control variables is exactly the same in Eq. 2.2 (and defined in B.1), with the exception of *Average ISS recommendation*, which is now substituted by *Average management recommendation*.

Columns 1 and 2 in Table 2.11 contain the result from this regression for contemporaneous and one-year lagged options volume, respectively. As evidenced by the negative and highly significant (p-value$<$0.01) coefficients of -0.270 and -0.291, shareholders in firms with more active options markets are less likely to follow the passive approach from ISS.

Taken together, these results are in line with the conjecture of options increasing

Table 2.11: Voting with ISS

	Average Vote with ISS(%)			
	(1)	(2)	(3)	(4)
Ln(OptVol)_t	-0.270***		-0.238**	
	(0.097)		(0.098)	
$\text{Ln(OptVol)}_{(t-1)}$		-0.291***		-0.263***
		(0.093)		(0.094)
Ln(OptVol)_t × Avg. ISS Blanket Rec			-0.025**	
			(0.011)	
$\text{Ln(OptVol)}_{(t-1)}$ × Avg. ISS Blanket Rec				-0.021*
				(0.011)
Avg. ISS Blanket Rec			-0.054	-0.067
			(0.050)	(0.052)
Illiquidity	0.028	0.028	0.028	0.027
	(0.056)	(0.056)	(0.056)	(0.056)
Ln(Mkt Cap)	1.554***	1.581***	1.543***	1.572***
	(0.199)	(0.195)	(0.199)	(0.195)
Tobin's Q	0.004	-0.012	0.006	-0.011
	(0.168)	(0.168)	(0.168)	(0.167)
$\text{Ab. Performance}_{(t-1)}$	24.696***	22.974***	24.414***	22.823***
	(6.247)	(6.226)	(6.248)	(6.226)
E-Index	-0.484***	-0.486***	-0.420***	-0.423***
	(0.147)	(0.146)	(0.148)	(0.148)
CEO compensation	-1.929***	-1.927***	-1.870***	-1.877***
($ thousands)	(0.306)	(0.306)	(0.311)	(0.311)
Board size	0.235***	0.234***	0.233***	0.232***
	(0.084)	(0.084)	(0.084)	(0.084)
Board shares held	-0.006***	-0.006***	-0.006***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
Independent directors(%)	23.031***	23.051***	23.063***	23.073***
	(1.550)	(1.551)	(1.549)	(1.550)
Avg. Mgmt. Rec.	45.943***	45.963***	42.210***	42.301***
	(2.037)	(2.035)	(2.206)	(2.205)
Unequal voting dummy	-6.752***	-6.758***	-6.807***	-6.817***
	(1.194)	(1.197)	(1.195)	(1.198)
Confidential voting dummy	0.332	0.339	0.246	0.249
	(0.395)	(0.395)	(0.395)	(0.395)
Institutional HHI	-26.196***	-25.544***	-26.341***	-25.678***
	(6.576)	(6.570)	(6.563)	(6.559)
Institutional Ownership	1.156	1.130	1.112	1.092
	(1.244)	(1.241)	(1.243)	(1.241)
Observations	12042	12042	12042	12042
Adjusted R^2	0.192	0.192	0.193	0.193

Notes: This table presents OLS regression estimates of the average shareholder vote with ISS recommendations on contemporaneous and one-year lagged options volume and a set of known determinants of shareholder voting behavior. Columns 3 and 4 extend the specification by including the interaction term of options volume with the average proportion of blanket issues for voting on that year. A detailed definition of all variables is provided in B.1. All regressions include year and industry (four-digit sic code) dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

shareholders net benefits from active governance. When there exists a liquid option market that shareholders can exploit to their own trading gains, they are more likely to dedicate higher efforts to the assessment of proposals, which, ultimately, results in more active governance.

Blanket recommendations

While voting patterns different to those of ISS evidence active efforts from shareholders to assess the value of a proposal, there are specific issues in which voting against ISS is specially relevant. ISS has been repeatedly accused of issuing empty recommendations in an effort to minimize costs. In these so-called blanket recommendations, ISS always recommends against certain issues without considering the specifics of the company. If options truly make shareholders more prone to active activism, shareholder support to ISS recommendations should be specially low when the firm has a more active options trading volume and the percentage of blanket recommendations in the agenda is higher.

In order to identify those blanket (or near-blanket) recommendations by ISS I follow the approach in Iliev and Lowry (2014). Specifically, I focus on the agenda items with lowest historical support of ISS to management. I obtain five different issues in which ISS always (or nearly always) recommends voting against management. These issues are proposals to *declassify the board of directors*, *require majority vote for an election of directors*, *stock retention*, *advisory vote to ratify executive's compensation* and *double trigger on equity plans*. The first four issues are also considered as blanket in Iliev and Lowry (2014) analysis[15], consistent with ISS consistently issuing blanket recommendations in the same items. Next, I calculate the average number of blanket recommendations, *Avg. ISS Blanket Rec*, per firm and year. A larger value of this variable indicates that a higher proportion of the issues voted on that year were affected by blanket recommendations from ISS.

Columns 3 and 4 in Table 2.11 display the results of the regression in Eq. 2.4, but this time including the results from incorporating an interaction term between the average number of blanket recommendations and contemporaneous and one-year-lagged options volume, respectively. Coefficients for the interaction terms are negative (-0.025 and -0.021) and statistically significant (p-value<0.05 and p-value<0.1). The coefficients on options volume remain highly significant and negative.

Overall, these results are consistent with the view of option markets enhancing shareholder incentives for active governance by increasing net benefits from activism.

[15] Excluding the last issue from the blanket classification does not change the nature of the results.

2.4.3 Stock market reaction to proposals

Lastly, I investigate the stock market reaction to shareholder proposals preceded by larger options trading volume. The intuition behind this analysis is the following. While option markets seem to encourage shareholder proposals and activism, it is not clear that such activism has always value-increasing goals. One specific concern is that more active option markets promote empty voting behavior among investors. When shareholders are able to separate economic from voting interests in a firm, as a more liquid options market enables, their incentives to undertake value-increasing projects for the firm may be undermined. For example, a large shareholder may tilt the result of a vote on a positive firm-value issue towards 'No' because his economic interest is placed on lower future firm value (e.g., by being long on put options).

Cuñat, Gine, and Guadalupe (2012) study stock market reactions to governance proposals that pass or fail by a small margin (5%). Because stock markets may discount the effect of proposals that have high expectations of pass or fail by a large margin, this identification allows for a cleaner causal estimate. They find that passing a proposal leads to positive abnormal returns, specially in firms with more anti-takeover provisions and higher institutional ownership. Additionally, Iliev and Lowry (2014) investigate how the presence of more active voting influences the stock market reaction to a shareholder proposal. Shareholder proposals that are supported by more active voting have larger (lower) abnormal returns when they pass (fail).

In order to assess whether option markets promote empty voting behavior by shareholders I analyze the effect of options trading volume, *Ln(OptVol)*, on firm abnormal returns for shareholder proposals that pass or fail by a close margin. I calculate options trading volume for the quarter prior to that of the voting. I follow Cuñat, Gine, and Guadalupe (2012) and Iliev and Lowry (2014), and define close votes on proposals as those that pass or fail by a margin of five percent or less. Overall, I identify 518 cases in which a firm has a shareholder proposal that passes or fails by a small margin. Following the literature, I compute the abnormal return on the meeting day the proposal is voted as the alpha from the Fama-French four-factor model. I also create two dummy variables that equal one if the proposal is passed, *Pass dummy*, and if the ISS recommendation is 'For', *ISS rec. 'For'*, and zero otherwise. Using this set of variables, I proceed to investigate the stock market reaction to proposals forerun by larger options trading volume.

Table 2.12 contains the results from two different regression models. In column 1, abnormal returns are regressed on options volume, *Ln(OptVol)*, a *Pass dummy*, the interaction of these two, and the *ISS recommend 'For'* dummy. The coefficient on the interaction term, *Ln(OptVol)*×*Pass dummy*, is positive (0.052) but exhibits no statistical significance at conventional levels. While this result discards, on average, any harmful

Table 2.12: Options volume and voting: Close votes

	Ab.Return(%) meeting day	
	(1)	(2)
Ln(OptVol)	0.006	0.848***
	(0.039)	(0.123)
Pass dummy	-0.168	-5.707***
	(0.625)	(1.789)
Ln(OptVol) × Pass dummy	0.052	0.567**
	(0.072)	(0.243)
ISS rec. 'For'	0.309	4.570***
	(0.500)	(1.066)
Ln(OptVol) × ISS rec. 'For'		-0.856***
		(0.130)
Pass dummy × ISS rec. 'For'		5.644***
		(1.899)
Ln(OptVol) × Pass dummy × ISS rec. 'For'		-0.520**
		(0.253)
Constant	-0.412	-4.590***
	(0.519)	(1.011)
Observations	518	518
R^2	0.008	0.048

Notes: This table presents the results from regressing abnormal returns on the meeting day on options trading volume, a passed proposal dummy, and a dummy variable equal one if ISS recommends voting 'for' in that proposal and zero otherwise. Model in column 1 includes options volume, a pass dummy, the interaction between these two, and the dummy for ISS recommending 'for'. Model in column 2 includes the triple interaction between these three variables. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

effect on equity values from the pass of proposals preceded by larger options volume, it deserves more attention.

Motivated by previous results that point to more active option markets inducing shareholders to disagree more often with ISS, I extend the previous regression model by incorporating the triple interaction term of options volume, *Ln(OptVol)*, *Pass dummy*, and *ISS recommend 'For'* dummy. Intuitively, if options promote shareholder empty voting behavior, this should manifest strongly in those proposals where ISS does not recommend in favor. These results are shown in column 2 in Table 2.12. Notice that now, the coefficient on *Ln(OptVol)×Pass dummy*, corresponds to the effect of options volume on abnormal returns when a proposal passed and ISS did not recommend 'For'.[16] Alternatively, the interaction term *Ln(OptVol)×Pass dummy×ISS rec.'For'* corresponds to the effect of options trading on abnormal returns for proposals passed and recommended 'For' by ISS. As evidenced by the positive and significant (p-value$<$0.05) coefficient of 0.567, higher options trading volume prior to the meeting associates with larger abnormal returns on the meeting day when ISS does not recommend in favor of the passed proposal. However, this situation is reversed when ISS recommends 'For' a proposal. The coefficient on the triple interaction is negative and statistically significant (p-value$<$0.05) with a smaller magnitude (-0.520).

These results are not consistent with the view that more active option markets, on average, promote empty voting behavior by investors. Options trading volume impacts positively abnormal returns when a proposal in which ISS is not in favor is passed, which provides compelling evidence against the empty voting argument. It is puzzling, though, that when ISS recommends for a proposal and it is passed, more active options markets associate with lower abnormal returns. One potential explanation for this negative association may lie in the higher ability of stock markets to predict the impact on firm value of a proposal when it is recommended by ISS, and therefore investors expectations may be already incorporated into prices.

Overall, larger trading activity in options market does not have a significant effect (neither positive nor negative) on firm value when a shareholder proposal is passed. While this (lack of) effect refers to the average shareholder proposal, unveiling the specific situations in which this effect takes one direction or the other constitutes an interesting and important venue for future research.

[16]By construction, the ISS recommendation variable takes values zero or one. However, a value of zero does not automatically mean that ISS recommended against the proposal.

2.5 Discussion and conclusion

Derivative contracts have reached a substantial importance in the contemporary financial world. Despite their first-order use among investors worldwide, their effects have been hardly studied from a corporate perspective. With this paper, I contribute to fill this gap in the literature by studying the real effects of option markets on shareholder activism. I find that higher trading volume in option markets leads to stronger subsequent shareholder activism. This activism manifests in higher probability and larger number of proxy constests and shareholder proposals in meetings, as well as in the form of dissent voting with management.

These results challenge the view that higher price informativeness, conveyed by more liquid option markets, always reduce shareholder incentives for governance in the form of 'voice' in favor of the 'exit' mechanism. Liquid option markets encourage activism in the form of 'voice' even after controlling for the degree of information asymmetries in a firm, as proxied by analyst coverage. However, I do not argue that the informational enhancement embedded in liquid option markets does not play a role. In particular, the 'exit' mechanism may dominate in specific scenarios, such as in the case of highly overvalued firms.

To the extent that the presence of an active market for options over the stock facilitates investors trading, my results resemble those of Norli, Ostergaard, and Schindele (2015) on the role of stock liquidity on shareholder activism. Nonetheless, I show that option markets have an effect on activism beyond that of stock liquidity. I further discuss the mechanisms behind these results and provide suggestive evidence that points to investors using option markets to gather additional trading gains from their information, which, ultimately, results in higher net benefits from activism. The presence of a more liquid options market induces shareholders to take a stronger attitude towards activism, which manifests in lower reliance on ISS voting recommendations, specially in blanket issues (Iliev and Lowry, 2014).

Lastly, motivated by growing concerns regarding the use of derivatives by investors to decouple economic and control rights, I study the effects on firm value of proposals forerun by larger activity in option markets. While empty voting theories predict that when investors have the ability to separate voting and economic interests their proposals may be detrimental to firm value, I do not find any significant effect on stocks abnormal returns when a proposal preceded by larger options trading volume is passed. Moreover, when a proposal in which the ISS is not in favor is passed, larger activity in option markets associates with higher abnormal equity returns.

Overall, this paper provides novel insights for the ongoing debate on derivatives regulation. Because, opposite to the case of stock market listing, exchanges make the exogenous decision of option market listing, the conclusions drawn by this study are highly relevant not only on the academic front, but from a regulatory perspective. I show that, on average, the positive impact (by stimulating) of option markets on shareholder activism outweighs the perverse effect associated with providing increasing incentives to shareholders for speculative trading and empty voting. However, I do not conclude that investors do not find option markets as a good trading venue that promotes empty voting behavior under certain conditions. Unveiling which are these conditions and how to prevent detrimental situations to firm value from happening are particularly important and interesting venues for future research.

Chapter 3

Size Matters: The Case of Merger Arbitrage Hedge Funds

3.1 Introduction

'Over a ten-year period commencing on January 1, 2008, and ending on December 31, 2017, the S&P 500 will out perform a portfolio of funds of hedge funds, when performance is measured on a basis net of fees, costs and expenses.'

Warren Buffett,

During the 2006 Berkshire Hathaway shareholders annual meeting Warren Buffett offered any taker to bet $1 million that over a 10-year period, after fees, the S&P 500 would give a higher return than any 10 hedge funds anyone might choose. Not short after, Protégé Partners, LLC, a New York-based hedge fund firm accepted the challenge. As of May, 2015, with less than 3 years to deadline, the hedge funds selected by Protégé were 63.5 to 19.6 percent behind S&P 500 index. Buffett's main argument for the bet lied not only in the colossal fees hedge funds charge (and specially funds of hedge funds, who double-charge fees on a regular hedge fund), but also on the tremendous trading costs and expenses investors suffer from. It is important to note that the return hedge fund investors perceive is already discounted for fund fees, as well as any internal costs the fund has such as payments for electronic platforms, salaries, or even funding money raising events. This papers is one of the firsts to explore the extent to which the magnitude of these costs can affect not only fund performance but a manager's strategic decisions in the fund's internal structure. Specifically, I confront delivered performance by large and small merger arbitrage hedge funds. I find that large funds outperform in periods where arbitrage opportunities in the market are larger (merger wave periods), whereas their performance falls behind in periods of low merger frequency. These results suggest fund managers from larger funds take advantage of their size to acquire superior resources that entail an investment advantage but, in turn, drag their performance when the marginal advantage of these resources is lower or negative.

For years, most active portfolio managers have been considered by academics as just lucky-winners. From Jensen (1968) paper, who first draw attention on the inability of active mutual fund managers to outperform passive benchmarks, several other studies have argued that mutual fund outperformance is merely attributable to luck (e.g., Malkiel, 1995; Stephen, Randolph, and Jeffrey, 2002). More recent empirical findings however raise serious doubts on the managerial inability hypothesis. Investors in mutual funds chase past performance (Chevalier and Ellison, 1997; Sirri and Tufano, 1998), allocating their money in recent winners, provoking that funds that have performed well over one period experience a huge growth in size (as measured by assets under management) and subsequently under-perform in the next period[1]. Lack of long-term persistence and a perverse effect of inflows on performance has been documented by several studies in both the mutual fund (Grinblatt, Titman, and Wermers, 1995; Carhart, 1997; Daniel, Grinblatt, Titman, and Wermers, 1997; Bollen and Busse, 2005) and hedge fund indsutries (e.g., Brown, Goetzmann, and Ibbotson, 1999; Agarwal and Naik, 2000; Barès, Gibson, and Gyger, 2003; Fung, Hsieh, Naik, and Ramadorai, 2008; Agarwal, Daniel, and Naik, 2009).

On the theoretical front, various studies have modeled the equilibrium of this industry under different specifications and assumptions. First models like Ippolito (1992) or Lynch and Musto (2003) accounted for the endogeneity of inflows, but produce as a result an equilibrium in which managerial ability levels lead to persistent differences in performance. Other models as Nanda, Narayanan, and Warther (2000) just assume managerial ability is known by investors. The conclusions drawn by these studies, however, are not in line with empirical findings. Berk and Green (2004) is one of the closest to explain empirical findings. In their model, managers have different skill, which is unknown to investors. Investors will choose to allocate flows in the best performing fund each period therefore increasing the size of it. Managers suffer from decreasing returns to scale, so as the fund's Assets Under Management (AuM) increase, their delivered performance is lower. In equilibrium, all funds produce the same *alpha* (risk-adjusted return) before costs, and larger funds will be managed by more skilled managers.

Debate surrounding the effect of scale in the active portfolio management industry has been long also on the empirical front. Liang (1999) and Koh, Koh, and Teo (2003) document a positive relationship between size and performance in the hedge fund industry. However, using more accurate techniques, a number of studies conclude the presence of strong diminishing returns to scale in both mutual and hedge fund industries. Chen, Hong, Huang, and Kubik (2004) document that mutual fund returns, both before and after fees, decline with lagged fund size. More recently, Pástor and Stambaugh (2012) and Pástor, Stambaugh, and Taylor (2015) provide evidence on the presence of industry and mutual fund decreasing returns to scale. In the hedge fund side, Agarwal, Daniel, and Naik (2009) find a negative relationship between lagged size and subsequent returns. Consistent with the industry increased competition and performance, Jetley and Ji (2010) find a decline in the average merger arbitrage spread of more than 400 bps from 2002. Getmansky (2012) also point at a concave relationship between fund size and performance. These findings are not limited to the academic scope. Larger funds have been traditionally outperformed by smaller funds also when using more descriptive data, as shown by recent industry reports [2].

[1] Some studies (Gruber, 1996; Carhart, 1997; Zheng, 1999; Bollen and Busse, 2005) pointed out that funds that received higher inflows subsequently outperform. This effect is however short-lived and concentrated in low-liquidity sectors.

[2] See for example the 2011 PerTrac report on the 'Impact of Fund Size and Age on Hedge Fund

The present study will build up on the scale and performance literature by analyzing the role of fund size in merger arbitrage hedge funds performance across the merger wave cycle. Hedge funds are one of the most flexible investment partnerships that exist. If managers are aware of the harmful effect of scale on their performance, they should optimally decide their size (e.g. by closing the fund to new subscriptions) to maximize their returns. The potential perverse effect of oversize on performance is an special concern for hedge funds managers, given their compensations structures. For instance, the main component of a mutual fund manager compensation involves a fixed management fee over the fund's total AuM. Such an structure introduces perverse incentives in the managerial contract, where the manager may find oversizing as privately optimal. Whereas performance-based compensation is a minor concern for most mutual funds managers, it is one of the main sources of income in the hedge fund industry. Hedge fund managers typically get compensated through the commonly-refer-to as '2 and 20' structure. Mangers salary is composed by a 2% fee on AuM, and a 20% incentive or performance fee. To earn the 20% fee on gains, a hedge fund manager may have to overperform either a predefined benchmark (if the fund has a *hurdle rate*) and/or the fund's previous highest net asset value or NAV (if the fund has a *high-water mark* provision). Unlike mutual funds, hedge fund managers have clear incentives to seek maximizing investors money by setting up an optimal scale.

According to existing research, funds face diminishing returns to scale as a consequence of two different, and probably complementary, effects. First, at the industry level, increasing competition for arbitrage opportunities makes it harder to engage in profitable trades. Second, at the fund level, trading large stakes may result in self-provoked price movements that harm performance. Both stories have to do with the availability of arbitrage opportunities (i.e. liquidity) in the market. As existing trading opportunities increase, the expected penalty for scale a fund is subject to suffer is lower. Hedge fund managers are really specialized and qualified individuals researching the market looking for profitable trades. Generally, is hard to measure the trading opportunity set for any fund manager. Fortunately, this is not the case with merger arbitrage funds, whose trading opportunities are subject to the well-established phenomena of merger waves (e.g., Brealey and Myers, 2003; Mitchell and Mulherin, 1996; Andrade, Mitchell, and Stafford, 2001). Consequently, the present framework constitutes a perfect opportunity for the researcher to study the behavior of hedge fund performance across different levels of fund size, as well as different degrees of severity of the scale problem.

Mergers and acquisitions continue to be a central topic in the corporate finance literature. There is however still no consensus on the determinants of merger waves. Neoclassical theories (Coase, 1937; Maksimovic and Phillips, 2001; Harford, 2005) point at economic disturbance (such as a technology shock). On the other hand, behavioral the-

Performance'.

ories (Shleifer and Vishny, 2003; Rhodes-Kropf, Robinson, and Viswanathan, 2005) call attention to the positive correlation between takeover activity and stocks valuation. Despite the debate surrounding the determinants of waves, merger arbitrage has been proven a very profitable activity for players in the market, specially for hedge funds. One of the first studies on the subject, Larcker and Lys (1987), concludes that there exists clear incentives for traders to acquire costly information on mergers, as *'arbs earn substantial positive returns on their equity positions'*. Dukes, Frohlich, and Ma (1992) document excess annual returns for cash tender offers as high as 117% for arbitrageurs. Also in the case of cash deals, Jindra and Walkling (2004) report annualized returns of 46.5%. Mitchell and Pulvino (2001) analyze 4,750 mergers in the period 1963 to 1998. They find that, after transaction costs, a typical risk arbitrageur (or merger arbitrageur) would make an excess return of four percent per year. Baker and Savaşoglu (2002) report an average annualized excess return of 9.6% for a sample of stock and cash mergers in the period 1981-1996. Most of these studies argue that arbitrageurs play a passive role, either by using their superior skill to select deals (Larcker and Lys, 1987) [3], or, more generally, by naively investing in deals that would generate a profit as a consequence of *'the limits to arbitrage'*(Shleifer and Vishny, 1997). Passive arbitrageurs do not alter merger outcomes. Theoretical models by Gomes (2001) and Cornelli and Li (2002) first introduced an active role for arbitrageurs. One of the main features in both models is the ability of arbitrageurs to help overcome the *'free-rider problem'* described in Grossman and Hart (1980). Hsieh and Walkling (2005) use a simultaneous equation framework to study the extent to which passive and active theories are mutually exclusive. They found evidence supporting the existence of both roles, as well as substantial positive returns earned by arbitrageurs, and their key role in the market for corporate control.

In this framework, I study hedge fund size and performance interrelations within the merger arbitrage investment style. Specifically, I analyze the performance of different size portfolios (as proxied by fund's AuM) in the context of the merger wave cycle. Given the vast empirical evidence on the harmful effect of size on performance and the absolute discretion of hedge fund managers in accepting new subscriptions, there must be a good reason why large funds exist in practice. These potential benefits of large funds must arise more prominently when the harmful effect of scale is lower. This is, when the number of arbitrage opportunities in the market is higher, namely, during merger waves. My baseline empirical results are consistent with these idea. Large funds deliver higher raw and risk-adjusted performance during waves, but perform poorly when corporate activity becomes lower. The magnitude of this outperformance with respect to small funds is around 2.2% to 3.3% annually for equal and value weighted portfolios, respectively, and

[3] Some studies, as Cornett, Tanyeri, and Tehranian (2011), document a certain degree of predictability in merger outcomes, specially for bidder candidacy that may be explained by the superior information arbitrageurs employ.

of 1.5% to almost 3% with respect to a portfolio containing the universe of all hedge funds, evaluated under the Fung and Hsieh (2004) 7-factor model.

While the empirical observation of poor performance from large funds (relative to small) when scale problems are aggravated is in line with the capacity constraints story, the fact that these funds deliver exceptional performance during merger waves poses an interesting question as to which are the benefits or advantages of larger funds. Specifically, I discuss two potential explanations for this outperformance. First, consistent with theories in Berk and Green (2004), larger funds may be managed by more skilled managers. Because merger arbitrage hedge fund returns closely follow the merger cycle, temporary deviations from the equilibrium (where all funds deliver the same alpha) may arise. Under this hypothesis, managerial incentives for oversizing come solely from the increase in fixed compensation (management fee) as a percentage of AuM. Second, larger funds may be able to access higher skill in the form of superior resources (e.g., a complex quant department, cutting edge research, etc.). By *'purchasing'* skill managers enhance their performance over their peers. The large and fixed nature of these investments, however, makes them only affordable to larger funds, thereby providing managers with incentives for size growth. By growing large, hedge fund managers can boost their performance by acquiring extra resources, but, in turn, underperform with respect to other funds when the number of trading opportunities in the market is lower.

As with every other empirical work, the validity of the hypothesis is conditional on the rejection of alternative explanations. Unfortunately, the present project presents an undesirable characteristic towards the main variable of interest. We only observe a funds' net performance. Therefore, the amount of investment in fund resources that each manager uses is untraceable. The *'purchased skill'* hypothesis explains the puzzling empirical evidence but can only be strengthen by discarding alternative feasible explanations. Some additional tests show that the hypothesis is robust to other mechanisms such as funds dynamically shifting in size (which could indicate some degree of superior managerial skill), database biases in liquidated and not reporting funds or alternative performance models. Additionally, Agarwal, Daniel, and Naik (2009) highlighted the importance of fund and manager characteristics and their impact in returns. In this setting, the main concern is that the differences in performance across large and small funds would be due to distinct fund and manager characteristics. Robustness test shows that disparity in delivered alpha to investors cannot be explained by these characteristics.

This paper contributes to different strands of the literature on size and performance. First, to the best of my knowledge, I introduce a novel scenario where managerial incentives to become oversize, even in the hedge fund industry, exist. When trades are highly scalable, managerial strategic behavior may arise as consequence of new technology (extra resources) only available to larger funds. Second, I show how these managerial incentives have a direct effect on delivered performance. Investors should be aware of the dynamic equilibrium in the industry before allocating their funds, as the optimal allocation changes along the trading opportunity set. Lastly, the results of this study are also relevant to policy makers. Hedge funds have long been on the spotlight of a rough regulatory debate. Regulators must be aware of these practices that, for example, may justify the existence of large management companies.

The remainder of the paper is organized as follows. Section 3.2 describes the data used in this study. Section 3.3 provides a description of the different methodologies to assess performance and a summary of results. Section 3.4 describes the main hypothesis and discuss the validity of each. Section 3.5 includes different robustness tests, and Section 3.6 concludes.

3.2 Data

Data on hedge fund performance and characteristics is provided by Hedge Fund Research Inc.(HFR). The HFR database is based on surveys to managers under voluntary disclosure. As hedge funds are prohibited from public advertising, reporting to the database becomes important for two main reasons. First, managers can disclose for marketing purposes. Second, as a growing number of funds report, not doing it can be interpreted as a bad signal (managers only reporting when good performance to attract flows). HFR comprises information on fund performance, assets under management (AuM), fund fees or age. Unfortunately, it does not include the Net Assets Value (NAV) figure for all funds. I will follow the procedure used by the TASS database [4] to backfill NAVs. Fund performance information is covered from 1992, keeping track of dead funds from 1994 onwards. By May 17, 2010, HFR covered 10,931 hedge funds [5], 4,427 of them *active*, 6,504 *dead*. I impose a number of filters in this sample. First, I only keep funds that report performance net of all fees (99.79%), report returns in US Dollars (96.36%), report assets under management for all periods and report on a monthly basis.

I further restrict the sample by dropping the years 1992 and 1993, when HFR did not keep track of dead funds. Additionally, HFR Inc. warns that "the trailing four months of performance are subject to revision as HFR revises updates from lagged funds". For this reason I also drop the year 2010. Given the 1994-2009 period, I demand each fund to have 3 lags of annual variables to stay in the sample. This last requirement introduces a multi-period sampling bias that is, however, a need for researchers(Agarwal and Naik, 2005). Fung and Hsieh (2000) results show that this bias is smaller when using the 3 year

[4]TASS assigns some hypothetical initial NAV (most often 1000, which is the one I use) to backfill missing information. A detailed study on the different databases is provided in Liang (2000).

[5]Not included in this figure are 4,102 Funds of funds present in HFR.

requirement.

The final sample of hedge funds in the period 1994 to 2009 include 3,543 funds, with 1,645 *active funds*, 879 *not reporting* and 1,019 *liquidated*[6]. Out of these funds, only 81 (30 *active*, 39 *liquidated* and 12 *not reporting*) classify themselves into the merger arbitrage strategy. Table 3.1 summarizes information on fund performance.

Table 3.1: Summary statistics: Hedge Fund returns

Variable	**Mean**	**Std. Dev.**	**Sharpe**
HFR (Equal weigths)	0.75	1.92	0.40
HFR (Value weights)	0.63	1.68	0.38
Equally Weighted portfolio	0.59	1.83	0.32
Value Weighted portfolio	0.53	1.76	0.30
Big (pctile 80) Equally weighted	0.50	1.71	0.29
Small (pctile 20) Equally weighted	0.69	1.98	0.35
Big (pctile 80) Value weighted	0.52	1.78	0.29
Small (pctile 20) Value weighted	0.68	1.99	0.34
Big (>$500m) Equally weighted	0.54	1.88	0.29
Small (<$100m) Equally weighted	0.62	1.89	0.33
Big (>$500m) Value weighted	0.57	2.05	0.28
Small (<$100m) Value weighted	0.55	1.84	0.30
Number of observations		192	

Notes: This table summarizes the main statistics for Hedge Funds returns under the merger arbitrage style. HFR corresponds to a portfolio formed with all funds (see data section) in the HFR Database. The rest are all funds under the merger arbitrage strategy. Disentangle between big and small is done according to the overall distribution of merger arbitrage AuM (percentiles 20 and 80) and according to the industry standard values for this definitions (less than $100m and more than $500m). Time period is 1994-2009.

To proxy for the number of trading opportunities available in the market, I use a variable based on mergers and acquisitions frequency. Unlike in the case of hedge fund performance, filtering is not a major concern for this sample. As I am only interested in the peaks and valleys of the merger wave, this is, the merger and acquisition frequency by month, I withdraw from Thompson Reuters SDC Platinum every worldwide transaction in the period 1994-2009. The monthly variable accounting for merger frequency will be defined as the sumation of all deals occurring effectively each month [7]. Table 3.2 summarizes the main information for merger and acquisitions data by year, and Fig.3.1 provides graphical evidence of the wave phenomena.

[6]HFR makes a distinction between dead funds: liquidated and not reporting. Those may be equivalent in many cases

[7]For robustness purposes, I run the analysis with two other variables capturing trading opportunities: announced deals and deal dollar value. Neither of them lead to a qualitative nor quantitative change of results.

Table 3.2: Summary statistics: M&A deals

year	Mean	25th	Median	75th	Maximum	Minimum
1994	632.58	604.5	619	663.5	882	448
1995	728.08	675.5	736	751	909	619
1996	841.08	762.5	846.5	871	996	718
1997	961.75	841	928.5	1047.5	1346	759
1998	1055.33	975	1071	1158	1228	797
1999	1084.17	977.5	1068	1168.5	1406	901
2000	1176.67	1108	1149.5	1213.5	1479	982
2001	941.42	859.5	975	992.5	1069	805
2002	827.92	750.5	853	889.5	1000	683
2003	892.08	792	863.5	949	1283	716
2004	1003.83	875.5	968	1043	1373	843
2005	1089.75	1017.5	1118	1144.5	1335	868
2006	1183.33	1104.5	1194	1233.5	1378	1006
2007	1332.92	1245.5	1307	1444.5	1589	1062
2008	1267.5	1143.5	1253.5	1368	1598	1055
2009	1017	892	974.5	1105	1436	810
All	1002.21	843.5	993	1148.5	1598	448

Notes: This table shows the summary statistics for the variable of monthly number of deals. This is, the number of deals aggregated at the month level.

3.3 Measuring performance

To accurately asses hedge fund performance, I rely on the Fung and Hsieh (2004) 7-factor model.[8] In this seven-factor model, excess returns are regressed over seven different factors that are considered to have large explanatory power of hedge fund returns. From its publication, the different factors used have been subject to modifications. One of the main critics to the original model is in Sadka (2010), mainly due to the untradability of some factors. Following Jagannathan, Malakhov, and Novikov (2010) I replace the non-tradable factors for tradable ones.

The final seven factors used in this analysis are the excess return of the S&P 500 index (*SnP*); a *Size* factor as the difference in returns between the Wilshire Small Cap 1750 Index and the Wilshire Large Cap 750 Index; the returns of a portfolio of lookback straddles on currencies futures (*PTFSFX*), on commodities futures (*PTFSCOM*) and on bond futures (*PTFSBD*); the excess return of the Fama Treasury Bond portfolio with maturities higher than 10 years (*Bd10yr*); and a *Credit Spread* factor, calculated as the difference between the returns of the CitiGroup BBB 10+ year Index and the Fama Treasury portfolio. The main measure of performance therefore will be the *alpha* of the following model in Eq. 3.1:

$$\begin{aligned} R_{i,t} = \alpha_i + \beta_{i,1} SnP_t + \beta_{i,2} Size_t + \beta_{i,3} PTFSFX_t + \beta_{i,4} PTFSCom_t \\ + \beta_{i,5} PTFSBd_t + \beta_{i,6} 10yrTB_t + \beta_{i,7} CreditSpread_t + \epsilon_{i,t} \end{aligned} \quad (3.1)$$

[8] In the robustness section, I drop from this model the trend following factors, as argued in Jetley and Ji (2010), with no significant change in results. These trend-following factors consist on the return of three portfolios of lookback straddles on foreign exchange futures, commodities futures and bond futures, respectively.

Table 3.3 shows the risk-adjusted performance of merger arbitrage funds, as well as the HFR portfolio, over the period 1994-2009. First thing to notice is how the merger arbitrage strategy does not outperform the portfolio containing all of the strategies (HFR). The equally weighted portfolio of merger arbitrage funds (MA henceforth) produces a monthly risk-adjusted return in the period 1994-2009 of 0.43%, the HFR portfolio generates 0.65%. When we compare the value weighted portfolios however the abnormal return is similar and close to 0.53%. Interestingly, the value-weighted MA portfolio outperforms the equally-weighted by 0.1% a month, suggesting large funds (by AuM) perform slightly better in the overall period.

To further assess the size-performance relationship I conform two portfolios of big and small funds. This performance is also reported in Table 3.3. Specifically, I study the performance of equal and value weighted portfolios of big funds (defined as those above the 80th percentile of the distribution by AuM) in columns 3 and 5 of Table 3.3, respectively. Similarly, I show the results from performance evaluation of equal and value weighted portfolios of small funds (those within the 20th percentile of the distribution of AuM) in columns 4 and 6, respectively. All portfolios are re-balanced monthly. Similar to the results from raw returns in Table 3.1, there are no significant differences in performance for the whole sample period between big and small funds when looking at equally weighted portfolios. In the case of value-weights, big funds exhibit an overperformance over small funds in terms of alpha (0.54% vs. 0.46%). Combining all these preliminary results, it seems that, contrary to the classic result, MA hedge funds suffer less than funds under other investment styles from diseconomies of scale. I will explore this finding in detail in forward sections.

Table 3.3: Risk-adjusted performance Merger Arbitrage funds and HFR portfolio.

	Equally Weighted (1)	Value Weighted (2)	E-W Big (5th quintile) (3)	E-W Small (1st quintile) (4)	V-W Big (5th quintile) (5)	V-W Small (1st quintile) (6)l	HFR (Equal weights) (7)	HFR (Value weights) (8)
S&P	0.0860***	0.0572*	0.0648*	0.121***	0.0579*	0.114***	0.260***	0.182***
	(5.66)	(2.54)	(2.42)	(4.48)	(2.01)	(4.32)	(11.95)	(7.89)
Size	0.0453*	0.0421	0.0585	0.0241	0.0599	0.0166	0.211***	0.159***
	(2.34)	(1.46)	(1.71)	(0.70)	(1.63)	(0.49)	(7.60)	(5.41)
PTFSFX	0.00164	0.00460	0.000682	-0.00917	0.00183	-0.00888	0.00572	0.00600
	(0.50)	(0.94)	(0.12)	(-1.57)	(0.29)	(-1.55)	(1.21)	(1.20)
PTFSCOM	-0.00341	0.00368	0.00190	-0.000752	0.00464	-0.00111	0.0159*	0.0198**
	(-0.72)	(0.52)	(0.23)	(-0.09)	(0.52)	(-0.14)	(2.36)	(2.77)
PTFSBD	-0.0103*	-0.0166**	-0.0219**	-0.00721	-0.0210**	-0.00566	-0.00407	-0.0124
	(-2.42)	(-2.64)	(-2.93)	(-0.96)	(-2.61)	(-0.77)	(-0.67)	(-1.94)
Bd10Yr	0.0275	0.0488	0.0426	-0.0190	0.0516	-0.0160	0.0290	0.0730
	(1.06)	(1.27)	(0.94)	(-0.41)	(1.05)	(-0.36)	(0.78)	(1.86)
Credit Spread	0.0560	0.0324	-0.00608	0.0313	-0.00528	0.0291	0.151**	0.135**
	(1.72)	(0.67)	(-0.11)	(0.54)	(-0.09)	(0.51)	(3.24)	(2.74)
α	0.428***	0.522***	0.475***	0.478***	0.530***	0.468***	0.650***	0.533***
	(7.12)	(5.84)	(4.48)	(4.48)	(4.65)	(4.47)	(7.55)	(5.85)
N	192	192	192	192	192	192	192	192
R^2	0.312	0.113	0.106	0.183	0.083	0.169	0.643	0.476

Notes: This table shows the excess return of different portfolios of hedge funds regressed over Fung and Hsieh (2004) 7-factors. The *Equally* and *Value weighted* portfolios comprises all Merger Arbitrage Funds. The *Small* and *Big* portfolios are build using the top and bottom 20% funds by AuM, with monthly rebalance. HFR portfolios contain the equal and value weighted returns for all funds on the HFR database. See the Data section for an accurate description of the factors. α is the intercept of the model. Sample period is 1994-2009. t statistics in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

3.3.1 Merger Wave and Performance

Recent literature (see Pástor and Stambaugh, 2012; Pástor, Stambaugh, and Taylor, 2015) on active management funds' size argues two complementary hypothesis characterizing scale and performance links: fund-level and industry-level decreasing returns to scale. Both hypothesis are explained by liquidity issues. The trading performed by a larger fund can result in the fund self-eroding its performance due to the size of the stakes traded. At the industry level, more money chasing investment opportunities (more competition) results in a greater difficulty to engage in profitable trades. The liquidity story explains how a big fund can be less profitable when trades are not easy to execute optimally (because a lot of players move prices faster, or because selling a larger stake quickly drops the price at which to execute the next trade). There is however no consideration for an outperformance by larger funds. The way in which decreasing returns to scale damage fund performance is a question closely related to the existence of arbitrage opportunities potentially exploited. The more restricted allocation for investments, the more harmful the size effect on fund performance is. The main difficulty for the average fund is how to measure the availability of trading opportunities, as it is largely unobservable.

Fortunately this is not the case with merger arbitrage funds. The main goal of these funds is to profit from the so-called merger arbitrage spread. Their trades typically consists on a long position in a target firm and a short position on a bidder firm during a takeover process. There is no reason to think these funds are profiting (at least not as a major source of their gains) from other type of investments. First, funds self-select into this category, which is homogeneous to other investment styles in all kind of observable variables [9]. Second, most of the funds under this style are part of larger asset management companies, each one with a number of funds in other strategies.

The fact that merger and acquisitions occur in waves (see Figure 3.1) provides a perfect setting for evaluating the performance of these funds controlling for the available investment opportunities in the market. Given the distribution of mergers and acquisitions in the period 1994-2009 (see Table 3.2), I define periods of high merger frequency as those months with more than 1148.5 deals (75th percentile) taking place. Similarly, months with less than 843.5 deals (25th percentile) occurring are defined as low merger frequency periods. To explore the extent to which fund size affects performance in a setting with variable number of arbitrage opportunities I construct four portfolios containing big and small (by AuM) funds respectively. I classify funds into the big and small categories by first considering the top and bottom quintiles of the size distribution. I extend this classification, following industry standards [10], by considering big funds as those who

[9] By self-selecting into the merger arbitrage strategy funds do not have any advantage (tax treatment, capital requirements, ...) whatsoever.

[10] See the PerTrac report on 'Impact of Fund Size and Age on Hedge Fund Performance'.

manage more than $500 million in assets and small those with investment discretion below $100 million. For each of these methods I construct a value and an equally-weighted portfolio that are re-balanced monthly.

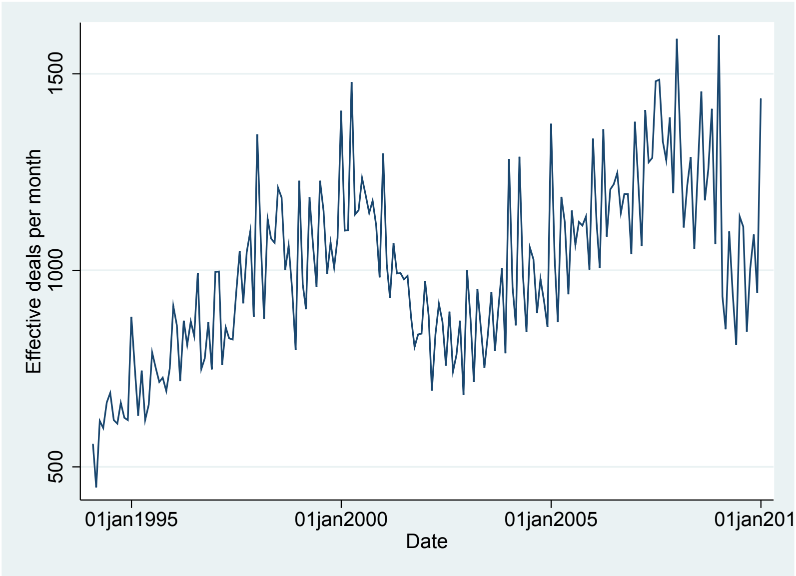

Figure 3.1: The Merger Wave Cycle 1994-2009

If a funds' performance truly depends on the available trading opportunities, expectedly, the performance of big funds will improve from low M&A periods to high. Small funds should also react to changes in arbitrage opportunities, but the effect is expected to be insignificant if its size is sufficiently small. As it requires a lower number of investment opportunities to constrain a small fund investments, the marginal benefit of an increase in the size of the investment opportunity set should be smaller. To evaluate this hypothesis I perform a performance analysis for the low and high M&A subperiods. Table 3.4 contains the results from portfolio analysis on raw returns for in and out-wave periods.

Table 3.4: Summary statistics: Raw returns and merger wave

Portfolio	Mean	Std.Dev.	Min.	Max.	Obs.
Big (5th Quintile) In-Wave	1.05%	2.54	-10.03%	24.32%	462
Small (1st Quintile) In-Wave	0,69%	1.73	-10.16%	15.49%	462
Big (5th Quintile) Out-Wave	0.40%	1.37	-5.68%	6.87%	265
Small (1st Quintile) Out-Wave	0.45%	2.03	-8.5%	14.00%	265
Big (>$500 million) In-Wave	0.94%	3.00	-10.03%	23.62%	216
Small (<$100 million) In-Wave	0.72%	1.71	-10.16%	15.49%	1617
Big (>$500 million) Out-Wave	0.48%	1.52	-2.14%	5.02%	20
Small (<$100 million) Out-Wave	0.47%	1.71	-9.4%	14.00%	1091

Notes: This table shows the raw performance of size-sorted portfolios for different levels of corporate activity. See section on performance and portfolio construction for details on portfolio description.

Results on Table 3.4 for raw returns are in line with the notion of large funds suffering from decreasing returns to scale out-wave. In addition, large funds appear to outperform during in-wave periods. However, to the extent that these results can be driven by higher risk-taking or market conditions, conclusions must be taken carefully. In order to assess whether this differences are reduced (or amplified) by differences in exposure to known risk factors, I proceed to analyze risk-adjusted performance in the next sections.

Out-wave performance

Consistent with decreasing returns to scale, I expect small funds to outperform in times where the existence of arbitrage opportunities is limited (lower m&a frequency). Big funds should underperform in these times, as their larger size erodes their performance. Tables 3.5 and 3.6 show the performance of the different portfolios of funds for those periods of low merger activity for different classifications of funds into the small and big portfolios.

Table 3.5: Portfolio performance MA funds and HFR portfolio. Out-wave periods.

	Equally Weights (1)	Value Weights (2)	Big Eq. Weights (3)	Big Val. Weights (4)	Small Eq. Weights (5)	Small Val. Weights (6)	HFR Eq. Weights (7)
S&P	0.117**	0.142*	0.211*	0.208*	0.179	0.175	0.222***
	(2.44)	(1.92)	(1.94)	(1.87)	(1.40)	(1.45)	(4.38)
Size	0.0816	0.119	0.248**	0.240**	0.0452	0.0347	0.249***
	(1.64)	(1.55)	(2.20)	(2.08)	(0.34)	(0.28)	(4.74)
PTFSBD	-0.00645	-0.0173	-0.0345*	-0.0333*	-0.00513	-0.00144	0.00261
	(-0.81)	(-1.41)	(-1.91)	(-1.80)	(-0.24)	(-0.07)	(0.31)
PTFSFX	-0.00604	-0.00137	-0.00923	-0.00801	-0.0368**	-0.0365**	0.00809
	(-1.06)	(-0.16)	(-0.72)	(-0.61)	(-2.44)	(-2.56)	(1.34)
PTFSCOM	-0.0123	-0.00989	-0.0181	-0.0165	0.0142	0.0179	0.0385***
	(-1.19)	(-0.62)	(-0.77)	(-0.69)	(0.52)	(0.69)	(3.53)
Bd10Yr	0.0507	0.0815	0.0828	0.0811	0.00172	0.0210	0.130**
	(0.83)	(0.87)	(0.60)	(0.58)	(0.01)	(0.14)	(2.03)
CreditSpread	-0.00398	0.000493	-0.131	-0.101	-0.0246	-0.00822	0.236**
	(-0.04)	(0.00)	(-0.60)	(-0.45)	(-0.10)	(-0.03)	(2.31)
α	0.379***	0.352*	0.252	0.272	0.550	0.481	0.697***
	(2.85)	(1.72)	(0.84)	(0.88)	(1.56)	(1.45)	(4.96)
N	48	48	48	48	48	48	48
R^2	0.359	0.271	0.305	0.285	0.200	0.211	0.724

Notes: This table shows the excess return of different portfolios of hedge funds regressed over the 7 factors in Fung and Hsieh (2004), for out-wave periods. The Equally and Value weighted portfolios comprises all Merger Arbitrage Funds. The Small and Big portfolios are build using the top and bottom 20% funds by AuM, with monthly rebalance. See the Data section for an accurate description of the factors. α is the intercept of the model. Sample period is 1994-2009. t statistics in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

As shown in columns 3 and 4 in Table 3.5, big funds do not deliver a significant risk-adjusted performance in periods of low corporate activity. Small funds abnormal return during this period is also not significant, but really close to the significance threshold of 10% (t-stat of 1.56), and doubling the performance by big (0.55 vs. 0.25 on monthly percentage points). As periods of low merger activity can most likely coincide with periods where there are less hedge funds operating, quintile selection may include a lot of median size funds (as define by industry standards [11]) into the small and big portfolios. Alternatively, I classify small and big funds attending to the absolute value of their AuM. Consequently, small (big) funds will be those with AuM below (above) $100 ($500) million. The results from the portfolio analysis under this classification are provided in Table 3.6.

Table 3.6: Portfolio performance MA funds and HFR portfolio. Out-wave periods.

	Equally Weights (1)	Value Weights (2)	Big Eq. Weights (3)	Big Val. Weights (4)	Small Eq. Weights (5)	Small Val. Weights (6)	HFR Eq. Weights (7)
S&P	0.117**	0.142*	0.0162	0.0160	0.116**	0.140*	0.222***
	(2.44)	(1.92)	(0.41)	(0.39)	(2.39)	(1.97)	(4.38)
Size	0.0816	0.119	0.0861**	0.0854**	0.0835	0.129*	0.249***
	(1.64)	(1.55)	(2.09)	(2.03)	(1.67)	(1.76)	(4.74)
PTFSBD	-0.00645	-0.0173	0.00680	0.00690	-0.00689	-0.0203*	0.00261
	(-0.81)	(-1.41)	(1.03)	(1.02)	(-0.86)	(-1.73)	(0.31)
PTFSFX	-0.00604	-0.00137	-0.000864	-0.000731	-0.00667	-0.00417	0.00809
	(-1.06)	(-0.16)	(-0.18)	(-0.15)	(-1.16)	(-0.50)	(1.34)
PTFSCOM	-0.0123	-0.00989	0.0140	0.0143	-0.0126	-0.0113	0.0385***
	(-1.19)	(-0.62)	(1.64)	(1.64)	(-1.21)	(-0.74)	(3.53)
Bd10Yr	0.0507	0.0815	0.0631	0.0629	0.0578	0.0947	0.130**
	(0.83)	(0.87)	(1.25)	(1.23)	(0.94)	(1.05)	(2.03)
CreditSpread	-0.00398	0.000493	0.260***	0.263***	-0.00666	-0.0589	0.236**
	(-0.04)	(0.00)	(3.24)	(3.23)	(-0.07)	(-0.41)	(2.31)
α	0.379***	0.352*	-0.322***	-0.319***	0.379***	0.336*	0.697***
	(2.85)	(1.72)	(-2.92)	(-2.84)	(2.83)	(1.71)	(4.96)
N	48	48	48	48	48	48	48
R^2	0.359	0.271	0.422	0.419	0.363	0.300	0.724

Notes: This table shows the excess return of different portfolios of hedge funds regressed over the 7 factors in Fung and Hsieh (2004), for out-wave periods. The Equally and Value weighted portfolios comprises all Merger Arbitrage Funds. The Small and Big portfolios are build with funds below $100 and above $500 million in AuM, respectively, with monthly rebalance. See the Data section for an accurate description of the factors. α is the intercept of the model. Sample period is 1994-2009. t statistics in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

The classification according to absolute value of AuM also has its drawbacks. Lack of representativeness and an unbalanced panel are the most important ones. Nonetheless, selecting funds according to standalone values for their AuM does a more accurate job in terms of disentangling median funds from extremes. When using this methodology the overperformance exhibit by small funds is more clear (see columns 5 and 6 in Table 3.6). [12]. During periods when trading opportunities are more restricted, small funds deliver a positive and highly significant risk-adjusted return. Lastly, in line with returns to scale evidence, equal weighted portfolio performs better than value weighted (0.379% vs

[11]Henceforth, by using the expression 'industry standards' to refer to size definition I mean the classification by PerTrac in their report 'Impact of Fund Size and Age on Hedge Fund Performance'.

[12]In this case, only the performance by the small portfolios can be taken as robust enough. Given the time period analyzed there are some months in which only one or none big funds exist/report. For this reason the performance under this methodology for big funds may not be representative enough.

0.336%).

In-wave performance

As available opportunities for profit increase so should the performance delivered by hedge funds. During periods of high corporate activity both large and small funds should increase their performance relative to low merger frequency periods. Once scale is not a major concern (relative to investment opportunities) managers from big and small funds can deliver their *true* alpha in terms of the Berk and Green (2004) model. Similarly to the out-wave case, Table 3.7 contain the results from performance analysis of equal and value-weighted portfolios of small and big funds according to the distribution of AuM.[13]

Table 3.7: Portfolio performance MA funds and HFR portfolio. In-wave periods.

	Equally Weights (1)	Value Weights (2)	Big Eq. Weights (3)	Big Val. Weights (4)	Small Eq. Weights (5)	Small Val. Weights (6)	HFR Eq. Weights (7)
S&P	0.0791**	0.000711	0.0240	-0.0147	0.108***	0.0940**	0.285***
	(2.18)	(0.01)	(0.31)	(-0.17)	(2.96)	(2.64)	(3.91)
Size	-0.0108	-0.0306	-0.0274	-0.0333	-0.0158	-0.00923	0.106
	(-0.31)	(-0.45)	(-0.38)	(-0.42)	(-0.46)	(-0.28)	(1.55)
PTFSBD	-0.000514	-0.00465	-0.0149	-0.00719	0.00904	0.0116	0.00743
	(-0.04)	(-0.19)	(-0.58)	(-0.25)	(0.74)	(0.97)	(0.30)
PTFSFX	0.00782	0.0135	0.0122	0.0154	0.0130	0.0110	-0.0189
	(1.00)	(0.87)	(0.74)	(0.84)	(1.66)	(1.44)	(-1.21)
PTFSCOM	0.00154	0.00646	0.00492	0.00697	-0.00863	-0.00891	0.00841
	(0.18)	(0.39)	(0.27)	(0.35)	(-1.02)	(-1.08)	(0.50)
Bd10Yr	-0.0331	0.0288	0.0143	0.0443	-0.0339	-0.0456	-0.168
	(-0.63)	(0.28)	(0.13)	(0.36)	(-0.65)	(-0.89)	(-1.59)
CreditSpread	0.244***	0.188	0.143	0.159	0.235***	0.218***	0.187
	(3.40)	(1.32)	(0.94)	(0.95)	(3.27)	(3.10)	(1.30)
α	0.585***	0.796***	0.737***	0.838***	0.555***	0.562***	0.611**
	(5.07)	(3.48)	(3.01)	(3.11)	(4.81)	(4.98)	(2.64)
N	48	48	48	48	48	48	48
R^2	0.588	0.074	0.062	0.043	0.637	0.609	0.668

Notes: This table shows the excess return of different portfolios of hedge funds regressed over the 7 factors in Fung and Hsieh (2004), for in-wave periods. The Equally and Value weighted portfolios comprises all Merger Arbitrage Funds. The Small and Big portfolios are build using the top and bottom 20% funds by AuM, with monthly rebalance. See the Data section for an accurate description of the factors. α is the intercept of the model. Sample period is 1994-2009. t statistics in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

As predicted, all portfolios increase their risk-adjusted performance relative to out-wave periods (except the HFR portfolio, which reports similar performance across all periods). More specifically, the equally (value) weighted portfolio of big funds delivers

[13]For the sake of space, and given that the results are really similar, I do not include the performance analysis of portfolios classified under the absolute values of AuM. These results are available upon request.

a highly significant monthly alpha of 0.74% (0.84%). This number entails a sizable outperformance with respect to the portfolios containing small funds. The magnitude of this overperformance ranges from 0.2% to 0.28% monthly for equally and value weighted portfolios, respectively. Large funds also outperform the HFR portfolio by 0.13 and 0.23 monthly percentage points, as well as portfolios containing all merger arbitrage funds.

These results are, first, consistent with the predictions of decreasing returns to scale theory. Managers do a better job allocating funds when they are not constrained by limited availability of opportunities in the market. While this evidence reinforces the view on the concave relationship between fund size and performance, a more interesting result emerges from the outperformance of big funds in times where their size does not pose a problem to performance. There are two main stories that may explain this overperformance over other funds. I discuss them in the next section.

3.4 Hypotheses Development

In this section I discuss potential sources from the observed over-performance of large funds in times when their size does not drag their performance. Specifically, I will consider two possible explanations. First, managers from larger funds may simply be, as in Berk and Green (2004) model, more skilled. Whereas, on average, the negative association between scale and performance impedes that superior skill leads to superior performance, in times when the harmful effect of scale is mitigated, managers are able to reveal their exceptional abilities. Alternatively, I argue that managers with higher investment discretion as measured by AuM are able to bear higher internal fixed costs, which enables them to 'purchase' skill in the form of superior resources. As before, superior performance manifests when scale problems are not an issue, as trading opportunities in the market are sufficiently high.

3.4.1 Are managers from larger funds more skilled?

In their model Berk and Green (2004) predict that larger mutual funds are managed by more skilled managers who earn higher fees. Large funds however suffer from diseconomies of scale so that investors returns chasing behavior produce an equilibrium in which all managers have the same expected return [14]. Although this explanation is in line with my empirical results, there are some key aspects in which my setting differs from Berk and Green (2004). These differences basically lie in the distinction between mutual fund

[14] Investors will allocate flows to the best performing fund until its size reaches a point in which diseconomies of scale make expected return from best manager equal to the second best manager's return. Consequently, flows will be allocated equally in best and second best funds so that their expected return equals the one from the third best fund. The result of this continuous process will end up with all funds delivering same expected return. For details check Berk and Green (2004)

and hedge funds. Berk and Green (2004) use mutual funds as their benchmark for active management in their model. Therefore, there are two key features from the hedge fund world that gain prime importance in my setting: managerial discretion over incoming flows (the manager can close the fund to new subscriptions with full discretion) and compensation structure.

One of the key differences between mutual fund and hedge funds lie in the managerial compensation structure. Mutual fund managers have smaller (or even no fee at all) performance-based fee. This translates into a primary concern to deliver good performance to their investors just in order to attract flows and maximize their dollar compensation amount through the fixed management fee over AuM. Instead, hedge fund managers are typically rewarded through the well-known 2 (as percentage of AuM, i.e. management fee) and 20 (percentage over gains, i.e. incentive fee) structure fee. An incentive fee of 20% seems enough for the hedge fund manager to not so willingly sacrifice return for size (AuM), and therefore optimally deciding to close new subscriptions once a certain fund size is reached. In this sense, hedge fund managers' incentives to overreach the fund's optimal size, and consequently suffer severely decreasing returns to scale, are diminished when the manager is truly skilled. To this extent, talented managers appear to be better off in a medium size fund, where they can still collect large amounts in fixed fees over AuM, while mitigating the harmful effect of size on delivered performance.

Ideally, skilled managers would like to shift from a small fund in times of low corporate activity to a larger fund during a merger wave, managing investors flows to maximize expected return. The occurrence of this optimal shifting however is unlikely. First, for gaining size, managers need the ability to collect millions of dollars in a relatively short time span. Second, once the merger wave is over, reducing the fund size in a drastic manner is also problematic due to allocation issues, as well as investors redemption and lockup periods. One possible way that would facilitate this shifting is the existence of a 'parent' fund that optimally allocates flows among the different funds it owns. As most of these MA funds belong to larger investment companies, size shifting could occur in practice. I check for the presence of such size shifting in the robustness section (see Section 3.5.1 and results in Table 3.8). Overall, optimal size-shifting does not occur very often, pointing at alternative explanations for managerial overperformance.

A second prediction to investigate from Berk and Green (2004) is that managers from larger funds charge higher fees. In practice, managerial compensation in the hedge fund framework is the result of a bargaining between managers and investors, based on, among others, past performance (see Agarwal and Ray, 2012; Lim, Sensoy, and Weisbach, 2016). The result of this process should lead to more skilled managers charging higher fees, as they have higher bargaining power. I investigate whether managerial compensation structure (i.e., fees), as well as other fund characteristics, diverge between large and small funds, as well as its impact on delivered performance. These results are developed in depth in Section 3.5.2 and Table 3.9. In my sample, managerial compensation structure in large funds exhibits no significant difference with respect to that of smaller funds.

Taking all these considerations into account, evidence presented on merger arbitrage hedge funds is not explained by the sole assertion of higher managerial skill.

3.4.2 The 'purchased skill' hypothesis

If good managers seem to be better off in a medium-size fund, the question that remains is why large funds, who suffer from important diseconomies of scale, exist is practice. In this section, I propose an alternative explanation that is not only in line with empirical observations, but also incorporates managerial incentives for growing into a larger fund. This hypothesis provides a simple answer, large funds 'purchase skill'. Managers from large funds may optimally decide to undertake some within fund investments that help them in their investment decision process. To put this in simple terms think of a large fund with an important, state-of-the-art, research department. Managers will profit from better information quality (e.g. in terms of assessing deal completion risk, or merger anticipation) [15] with a direct positive impact on the profitability of their trades. In turn, these resources imply high fixed costs [16].

Managers charge management and incentive fees over gross returns of the fund. Management fees serve to cover a funds' costs (in terms of employees, brokerage fees, etc.) as well as managers' salary. As these fees are collected over AuM, the larger the fund is, the more the manager collects in dollar amount, and therefore the more is able to dedicate to *purchase skill* without sacrificing her own salary. Unfortunately, net returns reported are already discounted for fund every expense (including brokerage or accounting fees, among others). Although we do have information regarding the fees each fund charges, this data is percentage terms (over AuM) rather than in total money value. This implies that (1) we are unable to trace the amount of these costs, but (2) constitutes a direct incentive for managers to grow in size, creating a direct impact in fund returns.

Although investing in such resources can be highly profitable for funds, it also involves some pitfalls. First, these resources are extremely costly. Hiring a bunch of experts in the area to do quality research requires a high compensation for these individuals. Acquiring cutting-edge technology that entails a real advantage is similarly expensive. Independently of these resources being technological or human capital advantages, the investment made on them will have an important effect on funds profitability. Second,

[15]Several studies have shown how merger and acquisition processes are subject to be anticipated. This is the most straight-forward way to think of the advantages for the manager. See for example Harford (2005), Cornett, Tanyeri, and Tehranian (2011) or Duchin and Schmidt (2013) for recent studies on predicting merger outcomes.

[16]These costs could, for example, be related to technological capabilities, as well as higher salaries for more specialized employees.

these costs are fixed (or have a sizable fixed component) across time periods so the manager cannot dynamically change the investment on them. Human resources will demand job stability through relatively long-term contracts, whereas technological advantages are fixed by definition. Despite these drawbacks, investing in superior resources can be specially profitable in the merger arbitrage industry, where trades are highly scalable. Given these features, the acquisition of these resources is an investment limited to the pool of large funds as the high costs make them unaffordable for small funds.

Managers decide on the fund strategic investments according not only to the return they can generate, but on their private benefits. By increasing the benefits from the fixed fee (via higher AuM), they jeopardize the collection of their incentive fee. These trade-off will determine whether an individual manager decides to grow in size (AuM), or, rather, close to new investments. Managers maximize their discounted expected gains from both management and incentive fees across time. The maximization problem is mathematically define in Eq. 3.2, where *ManagFee* is a function of AuM, and *IncFee* is a function of current and past performance (that depends on AuM as well).

$$\underset{AuM}{\text{argmax}} \quad E_0\ (\sum_{t=0}^{n} ManagFee_t)\ +\ E_0\ (\sum_{t=0}^{n} IncFee_t) \tag{3.2}$$

In equilibrium, by maximizing private benefits, managers will simultaneously decide on size and, to some extent, future performance [17]. In order for the manager to 'purchase skill', Eq. 3.3 must meet. This is, the expected private gains for the manager must be higher by investing in these resources (*I=1*) than without them (*I=0*).

$$\begin{aligned} E_0\ (\sum_{t=0}^{n} ManagFee_t^i \mid I=0)\ +\ E_0\ (\sum_{t=0}^{n} IncFee_t^i \mid I=0)\ \leqslant \\ E_0\ (\sum_{t=0}^{n} ManagFee_t^i \mid I=1)\ +\ E_0\ (\sum_{t=0}^{n} IncFee_t^i \mid I=1) \end{aligned} \tag{3.3}$$

For an equilibrium where large funds choose to exist, Eq. 3.4 must meet. The expected value of private benefits for the manager if she chooses small size ($i \in S$) must be lower

[17]Notice that another equilibrium can meet if managers bargain on the level of fees, as pointed out in Agarwal and Ray (2012) and Lim, Sensoy, and Weisbach (2016). However, in this specific setting, may not be viable. Adjusting size through negotiation on fees takes time, as you depend on investors decisions to allocate flows. On top of that, many investors will face lockup or restriction periods that may invalidate this mechanism. Also, there is no evidence of variation in fees in the current sample.

or equal than the expected value of private benefits when funds grow large ($i \in L$) and decide to undertake internal investments. Notice that funds being small or large (and purchasing skill) are just the two extreme cases. Empirically, medium size funds will not match neither of these cases. However, they will be better off in either of them. Medium size funds suffer from less scale issues than larger funds (still outperformed by small in out-wave periods), but they will not be able to undertake internal investments and therefore will not be able to outperform in-wave.

$$\begin{aligned} E_0\ (\sum_{t=0}^{n} ManagFee_t^{i\in S} \mid I=0)\ +\ E_0\ (\sum_{t=0}^{n} IncFee_t^{i\in S} \mid I=0) \leqslant \\ E_0\ (\sum_{t=0}^{n} ManagFee_t^{i\in L} \mid I=1)\ +\ E_0\ (\sum_{t=0}^{n} IncFee_t^{i\in L} \mid I=1) \end{aligned} \tag{3.4}$$

These two discussed hypotheses explain the observed overperformance of large funds when scale problems are mitigated. However, the existence of superior managerial talent in larger funds does not easily explain why managers fail to close the fund to new subscriptions once a certain optimal size is reached. On the other hand, the 'purchased skill' hypothesis derives predictions in line with managers' increasing incentives for higher investment discretion, as larger size permits the acquisition of extra resources which, ultimately, lead to outperformance. One main drawback in this analysis is the impossibility to actually trace these costs in order to take a more definite stand towards one hypothesis or the other. However, in the next section I analyze the robustness of the results, and investigate whether the empirical observations suggest in favor of any of the hypotheses.

3.5 Robustness

In this section I perform different robustness tests to ensure that the results are not produced by alternative drivers of the effect. Specifically, I start by considering the possibility that funds change their size dynamically along the merger wave cycle. The presence of this size-shifting would be consistent with managers from larger funds being more skilled, hence deciding optimally the size of the fund given market conditions. Second, I investigate whether differences in fund characteristics such fees, age, flows, or leverage can explain the observed heterogeneity in returns from small and big funds. Third, I extend the performance evaluation analysis by considering different models, including CAPM, as well as Fama-French models with three, four, and 5 factors. Finally, I check whether fund liquidation affect my results in any manner.

Overall, the results from these robustness tests confirm my initial results, and suggest that differences in managerial skill or fund characteristics are not enough to explain the empirical evidence.

3.5.1 Size Shifting

Best hedge fund managers may be able to squeeze merger arbitrage returns in every point of the merger wave cycle by dynamically changing fund size. Although in practice this shifting seems difficult to achieve (unless a parent investment company is allocating flows discretionary among the family of funds), it is a potential counter-argument for the 'purchased skill' hypothesis and deserves some attention.

This alternative hypothesis predicts that managers have the discretionary power over flows so as to achieve a time-varying optimal fund size. Managerial decisions seeking optimal size will result in funds falling into the large category when high corporate activity, while remaining small in times of low merger and acquisition frequency. If my results were driven by more skilled managers that adapt their size to market conditions, I should observe this size-shifting as funds successfully taking the 'right side'.

In order to account for the possible change in size I define 2 different measures of fund success when determining their size:

$$\text{Success In-Wave}_i = \frac{\text{Number of Periods 'Big'}_i}{\text{Number of In-Wave periods}_i} \tag{3.5}$$

Where the in-wave success is just the ratio of the number of periods (months) fund i is classified as Big during a merger wave, over the number of in-wave periods during which fund i if alive. Similarly, success in the valley will be defined as the number of months fund i falls into the Small category during valleys of the wave, over the number of valley periods in fund's i lifetime.

$$\text{Success Valley}_i = \frac{\text{Number of Periods 'Small'}_i}{\text{Number of 'Valley' periods}_i} \tag{3.6}$$

In the sample, only 13 funds shift their size at some point in time. As this is a relatively small amount of data (1,664 observations) I individually check for the level of success. Table 3.8 shows the results from success measures of the 13 funds. Only 5 of these funds exhibit positive success rate for both sides of the market. Among these, only fund with code #0010 shows a high enough success rate so as to considered it driven by managerial skill. For this fund I specifically check the dates for changes in size. It turns out that this fund only changed size once, November 2003, when the fund started growing and become large enough to enter into the Big sample.

Table 3.8: Success rate for funds that shift size.

Fund #	Success Wave	Obs.Wave	Success Valley	Obs. Valley
#0001	22.91%	48	27.08%	48
#0002	0.00%	46	4.00%	25
#0003	72.91%	48	12.5%	24
#0004	68.75%	48	38.01%	42
#0005	0.00%	14	0.00%	22
#0006	11.90%	42	0.00%	36
#0007	0.00%	45	4.76%	21
#0008	38.46%	13	0.00%	16
#0009	0.00%	11	40.00%	15
#0010	100.00%	34	56.25%	16
#0011	25.00%	48	3.84%	26
#0012	65.91%	44	0.00%	16
#0013	28.57%	21	0.00%	1
Mean	36.79%	48	16.23%	48

Notes: This table shows the rate of 'Success' for each of the funds that change size in the sample period. 'Success' is measured as being small in size during out-wave periods and large in-wave. For a more accurate description of the variables and further analysis see the text. Time period spans 1994-2009.

Overall, even though most of my funds are part of larger investment companies, which can act in favor of the size-shifting hypothesis, empirical findings do not back the existence of such strategic changes in sizer.

3.5.2 Fund Characteristics: Fees, Age, Flows, Leverage, ...

Next, I investigate whether differences in fund characteristics can explain the differences in performance. Fund characteristics such as fees, age, flows or leverage have been shown to significantly impact performance (see Liang, 2000; Getmansky, 2012; Agarwal, Daniel, and Naik, 2009). Regarding this matter, I check that both samples (big and small) do not content critical differences in characteristics that may explain the distinct performance. The main concern relies not on the impact of characteristics, but on how different characteristics across fund size levels can lead to different raw and risk-adjusted returns. To address this potential problem, I perform two different robustness tests. First, I regress fund performance on the set of different characteristics to analyze the extent to which these differences affect performance, and the direction of the effect. Second, I perform a t-test for differences in means between large and small funds on those characteristics that significantly impact performance.

Table 3.9 contains the results from the Fama and MacBeth (1973) regression analysis and the difference in means test. The observable variables linked to fund characteristics are fund Age (measure from fund inception), Size (measure as AuM), Monthly Flow [18], Restriction and Lock-up periods, Hurdle rate, High-water mark (binary variable), Management and Incentive fees, and Leverage (binary).

[18] Following Agarwal, Daniel, and Naik (2009), monthly flow is defined as the net dollar flow into the

Table 3.9: Regression Analysis and t-test.

	Fama-MacBeth (1973) $Return_t$ (1)	*T-test* Differences in means *(Small - Large)* *(2)*
Age_{t-1}	0.0000999 (1.28)	*** (-8.51)
$Return_{t-1}$	0.137*** (3.88)	** (-2.18)
$Assets_{t-1}$	-0.00429** (-2.04)	*** (-32.27)
Monthly Flow	-0.0465** (-2.54)	- (-0.43)
Restrict	0.00113 (0.58)	*** (-3.32)
Lockup Period	0.0154** (2.04)	*** (6.01)
Hurdle Rate	0.0415 (0.46)	*** (-9.22)
High-water Mark	0.0935 (1.11)	*** (-6.82)
Management Fee	0.125* (1.81)	- (1.25)
Incentive Fee	0.0114* (1.83)	- (0.84)
Leverage	0.103* (1.93)	*** (7.23)
Intercept	-0.113 (-0.40)	
No. obs.	8084	8084

Notes: This table shows the results from regressing fund return on a set of observable characteristics under the Fama and MacBeth (1973) procedure. Age_{t-1} accounts for time since fund's inception; $Return_{t-1}$ controls for serial correlation of 1 month; $Assets_{t-1}$ refer to fund size last month; *Monthly Flow* is the flow the fund received last month (see the robustness section for an accurate calculation of flow); *Restrict* and *Lock-up* accounts for days the restriction and lockup periods of each fund lasts; *Hurdle Rate*, *High-water Mark* and *Leverage* are variables with value 1 if a fund has each of the mention characteristic and 0 otherwise; and *Management* and *Incentive* fees are variables containing the value of these fees. Sample period is 1994-2009. t statistics in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

Column 1 in Table 3.9 reports the results of the Fama and MacBeth (1973) regression. Column 2 shows the results of a t-test for difference in means between groups of large and small funds. A positive (negative) and significant t-statistic in this column will imply that the mean value for variable X for small funds is significantly higher (lower) than the mean value for variable X for big funds. As expected, variables *Monthly Flow*, *Management Fee* and *Incentive Fee* are relevant in explaining fund performance, but there exist no significant difference between the mean values of those variables for large and small funds, therefore not supporting the alternative hypothesis for this specific characteristics. Mean values for *Restriction period* and *Hurdle Rate* are significantly higher for Big funds (as denoted by a negative *t-stat*), however none of them impact returns significantly enough so to give support to alternative hypotheses. *Lock-up period* and *Leverage* are both important determinants of performance that are significantly different in small and big funds. Nonetheless, they both have positive regression coefficients and positive values for the t-stats in the t-test, meaning small funds should in any case benefit from these two. *Age* and *High-water Mark* are both significantly higher in big than small funds (t-stat of -8.58 and -6.82 respectively). The two of them are however not significant enough to explain differences in performance for our subsample of merger arbitrage funds. The remaining variables, lagged *Assets under management* and lagged *Returns*, account for size and serial correlation.

Taken together, these results suggest that heterogeneous performance between large and small funds is not solely explained by differences in observable fund characteristics.

3.5.3 Alternative models for assessing risk-adjusted performance

Even though Fung and Hsieh (2004) 7-factor model is standard in the literature, returns produced by merger arbitrageurs may differ considerably from traditional investments of hedge funds. In order to account for any possible bias emerging from the usage of an specific performance model, I check how the different portfolios of hedge funds perform under different performance evaluation models.

Table 3.10 contains the results for the complete period under four different models. These specifications include a CAPM model with the S&P500 index as the measure for market return; a four-factor model (4-factors) equivalent to the Fung and Hsieh 7-factor model without the 3 factors of lookback straddles on bonds, commodities and foreign

fund at month t, scaled by AuM of the fund at the end of month t-1,

$$Flow_{i,t} = \frac{AUM_{i,t} - AUM_{i,t\ 1}(1 + Return_{i,t})}{AUM_{i,t\ 1}} \tag{3.7}$$

exchange (PTFS factors); the traditional Fama-French 3-factor model (F-F 3); a Fama-French-Momentum 4-factor model (F-F 4); and the recent Fama-French 5-factor model (F-F 5)[19]. Results in Table 3.10 show no significant difference than those produced when evaluated returns under the Fung and Hsieh (2004) 7-factor model (see Table 3.3).

Table 3.10: Performance MA funds and HFR portfolio for different performance models

	Equally Weights (1)	Value Weights (2)	Big Eq. Weights (3)	Big Val. Weights (4)	Small Eq. Weights (5)	Small Val. Weights (6)	HFR Eq. Weights (7)
CAPM	0.459***	0.565***	0.528***	0.583***	0.487***	0.474***	0.683***
	(7.49)	(6.35)	(4.99)	(5.15)	(4.61)	(4.60)	(6.68)
4-Factors	0.447***	0.548***	0.511***	0.563***	0.491***	0.478***	0.648***
(no PTFS)	(7.42)	(6.11)	(4.79)	(4.93)	(4.62)	(4.60)	(7.46)
F-F 3	0.426***	0.551***	0.512***	0.573***	0.455***	0.446***	0.597***
	(7.07)	(6.18)	(4.83)	(5.05)	(4.27)	(4.29)	(7.27)
F-F 4	0.409***	0.528***	0.481***	0.543***	0.444***	0.435***	0.563***
	(6.76)	(5.88)	(4.52)	(4.76)	(4.12)	(4.13)	(6.91)
F-F 5	0.378***	0.544***	0.493***	0.562***	0.368***	0.357***	0.596***
	(5.99)	(5.74)	(4.39)	(4.67)	(3.32)	(3.30)	(6.84)

Notes: This table shows the risk-adjusted performance (*alpha*) of different portfolios of hedge funds according to different performance models. The *Equally* and *Value weighted* portfolios comprises all Merger Arbitrage Funds. The *Small* and *Big* portfolios are build using the top and bottom 20% funds by AuM, with monthly rebalance. HFR portfolios contain the equal and value weighted returns for all funds on the HFR database. See the Data section for an accurate description of the factors. α is the intercept of the model. CAPM is constructed using the S&P500 as market factor; 4-factors refers to the Fung and Hsieh (2004) 7-factor model without the 3 factors with lookback straddles; F-F 3 is the Fama-French 3-factor model; F-F 4 is the Fama-French 3-factor model plus the Carhart Momentum factor; and F-F 5 the Fama-French 5-factor model. Sample period is 1994-2009. t statistics in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

Next, I check whether the use of different performance models affects the observed heterogeneity in performance between large and small funds across different moments of the merger wave cycle. Table 3.12 include results on the risk-adjusted performance, namely *alpha*, for out-wave periods under the different performance models. Overall, the results confirm the outperformance of small funds over big when the number of arbitrage opportunities in the market is low across all different performance models. For example, when performance is evaluated under the CAPM model, a portfolio of equally weighted small funds delivers a significant risk-adjusted performance (p-value<0.1) of 0.622% monthly. The equivalent portfolio of big funds delivers an alpha of 0.249% monthly, with no statistical significance.

Similarly, Table 3.11 contains the performance evaluation results under different models of the same portfolios for periods for periods of high corporate activity. Across all

[19]The Fama and French (2015) model extends the traditional 3-factor model with two extra factors: profitability and investment patterns.

Table 3.11: MA funds and HFR portfolio performance under different performance models. In-wave periods

	Equally Weights (1)	Value Weights (2)	Big Eq. Weights (3)	Big Val. Weights (4)	Small Eq. Weights (5)	Small Val. Weights (6)	HFR Eq. Weights (7)
CAPM	0.463***	0.751***	0.730***	0.823***	0.410***	0.412***	0.407*
	(3.95)	(3.87)	(3.54)	(3.64)	(3.60)	(3.70)	(1.74)
4-Factors (no PTFS)	0.578***	0.799***	0.783***	0.849***	0.506***	0.505***	0.600***
	(5.58)	(3.90)	(3.59)	(3.52)	(4.72)	(4.82)	(2.89)
F-F 3	0.420***	0.761***	0.738***	0.848***	0.348***	0.358***	0.354*
	(3.77)	(3.92)	(3.58)	(3.76)	(3.15)	(3.35)	(1.96)
F-F 4	0.422***	0.720***	0.678***	0.795***	0.393***	0.395***	0.183
	(3.40)	(3.33)	(2.97)	(3.17)	(3.22)	(3.34)	(0.96)
F-F 5	0.368***	0.694***	0.676***	0.780***	0.294**	0.309***	0.352***
	(3.22)	(3.38)	(3.09)	(3.25)	(2.53)	(2.77)	(1.80)

Notes: This table shows the risk-adjusted performance of different portfolios of hedge funds according to different performance models for in-wave periods. The *Equally* and *Value weighted* portfolios comprises all Merger Arbitrage Funds. The *Small* and *Big* portfolios are build using the top and bottom 20% funds by AuM, with monthly rebalance. HFR portfolios contain the equal and value weighted returns for all funds on the HFR database. See the Data section for an accurate description of the factors. α is the intercept of the model. CAPM is constructed using the S&P500 as market factor; 4-factors refers to the Fung and Hsieh (2004) 7-factor model without the 3 factors with lookback straddles; F-F 3 is the Fama-French 3-factor model; F-F 4 is the Fama-French 3-factor model plus the Carhart Momentum factor; and F-F 5 the Fama-French 5-factor model. Sample period is 1994-2009. t statistics in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

models large funds exhibit a higher alpha than their smaller counterparts with high statistical significance (p-value<0.01). For example, a portfolio of equally weighted large funds outperforms an equivalent portfolio of small funds by 0.32% monthly (0.73% vs. 0.41%).

Taken together, these results strengthen my findings by showing that the observed overperformance of larger funds during merger waves does not depend on the chosen performance evaluation model.

3.5.4 Liquidated Funds

I turn now to consider biases related to the data sample. Even though I mitigate concerns related to fund survivorship by requiring a fund to report uninterruptedly for a minimum of 3 years in order to be included in my sample, there are several reasons why a fund may stop reporting. Whereas some funds withdraw from the HFR database because they are liquidated, other may just stop reporting to HFR while remain alive. Fortunately, HFR distinguishes between 'liquidated' and 'not reporting' cases.

For those funds under the 'not reporting' category, there is not much I can do and probably the best choice is to leave them as they are. However, for those funds that are classified as 'liquidated', I follow Posthuma and Van der Sluis (2003), who add a -50%

Table 3.12: MA funds and HFR portfolio performance under different performance models. Out-wave periods

	Equally Weights (1)	Value Weights (2)	Big Eq. Weights (3)	Big Val. Weights (4)	Small Eq. Weights (5)	Small Val. Weights (6)	HFR Eq. Weights (7)
CAPM	0.398***	0.351*	0.249	0.267	0.622*	0.565*	0.765***
	(3.02)	(1.78)	(0.82)	(0.87)	(1.80)	(1.73)	(4.09)
4-Factors (no PTFS)	0.373***	0.316	0.196	0.216	0.629*	0.569	0.70***
	(2.81)	(1.58)	(0.64)	(0.70)	(1.75)	(1.67)	(4.33)
F-F 3	0.393***	0.316	0.222	0.242	0.629*	0.570*	0.713***
	(2.97)	(1.58)	(0.72)	(0.78)	(1.80)	(1.72)	(4.33)
F-F 4	0.354**	0.338*	0.099	0.130	0.522	0.471	0.747***
	(2.64)	(1.68)	(0.33)	(0.42)	(1.48)	(1.40)	(4.43)
F-F 5	0.441***	0.408*	0.175	0.206	0.616	0.579	0.741***
	(2.92)	(1.76)	(0.49)	(0.57)	(1.52)	(1.51)	(3.87)

Notes: This table shows the risk-adjusted performance of different portfolios of hedge funds according to different performance models for out-wave periods. The *Equally* and *Value weighted* portfolios comprises all Merger Arbitrage Funds. The *Small* and *Big* portfolios are build using the top and bottom 20% funds by AuM, with monthly rebalance. HFR portfolios contain the equal and value weighted returns for all funds on the HFR database. See the Data section for an accurate description of the factors. α is the intercept of the model. CAPM is constructed using the S&P500 as market factor; 4-factors refers to the Fung and Hsieh (2004) 7-factor model without the 3 factors with lookback straddles; F-F 3 is the Fama-French 3-factor model; F-F 4 is the Fama-French 3-factor model plus the Carhart Momentum factor; and F-F 5 the Fama-French 5-factor model. Sample period is 1994-2009. t statistics in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

return to the last reporting month of the fund. While this correction can be extreme (see Ackermann et al., 1999; Fung and Hsieh, 2006; Hodder et al., 2014) it will help in order to correctly assess whether fund liquidation is driving the results.

Table 3.13 reproduces the performance measure (namely *alpha*) under the 7-factor model of Fung and Hsieh (2004), for different portfolios and merger wave moments, including a -50% return correction for those funds that are considered as 'liquidated' by HFR. Large funds perform greatly during waves (0.736% and 0.837% for equally and value weighted portfolios, respectively) but fail to deliver significant performance out-wave. Small funds, on the other hand, do not deliver significant performance in any period, probably as a consequence of the extreme correction on returns imposed over liquidated funds, which are more likely to within the small category. In sum, the results are consistent with previous findings, discarding fund liquidation as a main driver for the observed difference in performance along the merger wave cycle.

Table 3.13: Portfolio performance Merger Arbitrage funds and HFR portfolio. Correction for liquidated funds

	Equally Weights (1)	Value Weights (2)	Big Eq. Weights (3)	Big Val. Weights (4)	Small Eq. Weights (5)	Small Val. Weights (6)
1994-2009	0.216***	0.491***	0.474***	0.529***	0.034	0.049
	(2.83)	(5.39)	(4.48)	(4.65)	(0.21)	(0.30)
In-Wave periods	0.213	0.711***	0.736***	0.837***	-0.127	0.042
	(1.22)	(2.90)	(3.01)	(3.11)	(-0.35)	(0.13)
Out-Wave periods	0.353**	0.351*	0.252	0.271	0.425	0.308
	(2.67)	(1.72)	(0.84)	(0.88)	(1.09)	(0.76)

Notes: This table reports the risk-adjusted performance (*alpha*) of different portfolios under the Fung and Hsieh (2004) 7-factor model for different periods. Performance of liquidated funds is corrected as in Posthuma and Van der Sluis (2003), by adding a -50% return in the last reporting month. The *Equally* and *Value weighted* portfolios comprises all Merger Arbitrage Funds. The *Small* and *Big* portfolios are build using the top and bottom 20% funds by AuM, with monthly rebalance. See the Data section for an accurate description of the factors. α is the intercept of the model. Sample period is 1994-2009. t statistics in parentheses. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

3.6 Conclusion

In this paper, I analyze the size-performance relationship for hedge funds under the merger arbitrage investment style. Traditional literature in the mutual fund industry finds that large funds face important decreasing returns to scale, but exist as a consequence of investors return chasing behavior and managers' incentives for earning fixed fees over assets under management. However, hedge fund managers based an important part of their compensation in performance fees, and are therefore not so willingly inclined to sacrifice future performance in exchange for a larger size. Therefore, larger funds must have some benefits in practice to exist. These benefits should arise more prominently when the harmful effect of size on performance is mitigated. Existing literature has linked the severity of the scale problem to the availability of trading opportunities in the market. Consequently, I link the performance of merger arbitrage funds to the merger wave cycle, as mergers and acquisitions are the main source of profit for these funds.

I find that larger merger arbitrage funds significantly outperform their small rivals during merger waves by around 3% annually in risk-adjusted terms when performance is evaluated under the Fung and Hsieh (2004) 7-factor model. In turn, large funds underperform during out-wave periods. I confront two possible hypotheses that explain this outperformance: managers from larger funds being more skilled, or larger funds 'purchasing skill' in the form of superior resources. Whereas the former does not fully explain why managers would choose to overreach their optimal size (beyond the collection of higher dollar amounts in management fees), the latter establishes direct incentives for managers to grow in size, as the acquisition of these resources requires a sizable fixed investment.

Next, I investigate the robustness of these results, as well as alternative sources of outperformance. The overperformance exhibited by large funds does not respond to managers shifting fund size along the merger wave cycle (which could point at some degree of managerial skill), or differences in fund characteristics such as age, flow, or fee structure. Additionally, I show how these results remain qualitatively unchanged when performance is evaluated under different performance models, including CAPM or Fama-French three, four, and five-factor models. Finally, I check that when fund returns are corrected for liquidation the observed overperformance continues to exist. Overall, these results are in line with the view of managers from larger funds benefitting from superior resources that entail an important advantage, but, in turn, suffer from the harmful effect of scale in performance when the number of arbitrage opportunities in the market is sufficiently low.

With this paper I extend the literature on size and performance in the active management industry by incorporating a novel hypothesis on a funds' internal investments. The 'purchase skill' story raises serious doubts on the traditional view of underperforming large funds, providing an alternative channel through which managers may find optimal to overreach their optimal size in order to be able to access superior resources. The results from this study are also relevant for investors chasing merger arbitrage returns, providing a better understanding of the industry and helping them to enhance their portfolio allocation in a dynamic setting. From a regulatory perspective, this paper contributes to a deeper understanding of the active management industry by providing a rational explanation on why large hedge funds exist in practice.

In this paper I have focused on a specific subset within the hedge fund industry. While this narrow scope entails an advantage in order to assess the number of trading opportunities in the market, it may impose some restrictions to the generalization of my results. For example, the high degree of scalability of trades in the merger arbitrage setting may not be common to other investment stlyes. In this regard, investing in superior technological resources may not pay off in other frameworks. How aware of the equilibrium in this industry, as well as the extent to which the hypothesis presented here is applicable to other investment styles are interesting and important questions for future research.

Appendix A

Appendix for "The Hidden Cost of Financial Derivatives: Options Trading and the Cost of Debt"

This Appendix provides additional material to the results presented in *"The Hidden Cost of Financial Derivatives: Options Trading and the Cost of Debt"*. In Section A.1, we provide definitions and sources for all variables used in this study. In Section A.2, we discuss and report robustness tests for the baseline results reported in the paper.

A.1 Variable definition

A.1.1. Bond variables

Variable	Definition
Yield spread (in basis points)	Difference in the bond yield to maturity at-issue (reported by SDC Global New Issues) and the yield of a Treasury bond (collected from the Federal Reserve H-15 Release) with the same maturity. In cases in which there is no maturity-equivalent Treasury, we use linear interpolation to calculate the yield of the risk-free bond.
Ln(Yield spread)	Natural logarithm of Yield spread.
S&P Rating	Bond rating by the agency Standard and Poor's (as reported by SDC Global New Issues). We transform the ordinal variable into a numerical scale in the following way: 1-CCC-, 2-CCC, 3-CCC+, 4-B-, 5-B, 6-B+, 7-BB-, 8-BB, 9-BB+, 10-BBB-, 11-BBB, 12-BBB+, 13-A-, 14-A, 15-A+, 16-AA-, 17-AA, 18-AA+, 19-AAA-, 20-AAA, 21-AAA+.
Public Bond Dummy	Dummy variable equal 1 if the bond is public (as reported by SDC Global New Issues) and zero otherwise.
Callable Dummy	Dummy variable equal 1 if the bond is callable (as reported by SDC Global New Issues) and zero otherwise.
Maturity (in years)	Time to maturity (in years) as reported by SDC Global New Issues.
Principal	Principal amount of the issue (in $ millions) as reported by SDC Global New Issues.
Junk Bond Dummy	Dummy variable that equals one if the bond is rated below B- by Standard and Poor's and zero otherwise.

A.1.2. Option variables

Variable	Definition
Options volume (millions)	Total daily trade in each option multiplied by end-of-day quote midpoint for that option. This number is then aggregated across all options for a single stock on all trading days for a given quarter. Following Roll, Schwartz, and Subrahmanyam (2009). Source: Option Metrics.
Ln(Option volume)	Natural logarithm of Options volume.
Open interest	Quarterly average of the daily Open interest (number of put and call contracts that remain open on a stock) provided by Option Metrics.
Ln(Open interest)	Natural logarithm of Open interest.
Moneyness	Quarterly average of the daily absolute deviation of the exercise price of each traded option from the closing price of the underlying stock. Following Roll, Schwartz, and Subrahmanyam (2009). Source: Option Metrics and CRSP-Compustat.
Ln(Moneyness)	Natural logarithm of Moneyness.
High option volume	Dummy variable that equals one if the firm's value for Options volume is above the median for that year and zero otherwise.

A.1.3. Firm variables

Variable	Definition
Ln(Total assets)	Natural logarithm of quarterly total assets for a firm reported by CRSP-Compustat.
Tobin's Q	Sum of the market capitalization of a firm's common equity (stock price times shares outstanding at the end of the quarter), liquidation value of its preferred shares and the book value of debt, divided by book value of assets. Calculated for each quarter based on CRSP-Compustat items. (Tobin's Q = (prccq×cshoq + atq - ceqq - txdb)/atq)).
ROA	Return on assets. Net income over total assets (quarterly). Source: CRSP-Compustat.
Leverage	Total debt over total assets (quarterly). Source: CRSP-Compustat.
Firm risk	Standard deviation of quarterly cash-flow from operations (income before extraordinary items plus depreciation and amortization, normalized by total assets) over the previous year. Source: CRSP-Compustat.
Ln(Firm risk)	Natural logarithm of Firm risk.
Bid-ask spread	Average of the daily relative bid-ask spread for a stock and quarter. Relative Bid-ask spread = 100×(Ask - Bid)/(0.5×(Ask + Bid)). Source: CRSP-Compustat.
Ln(Bid-ask spread)	Natural logarithm of Bid-ask spread.
K-Z index	Kaplan and Zingales (1997) Index for financial constraints build under the Lamont, Polk, and Saaá-Requejo (2001) specification: $KZ = -1.001 \times Cash-flow_t/PPE_{t-1} + 0.282 \times Q_t + 3.139 \times Debt_t/Capital_t - 39.367 \times Dividends_t/PPE_{t-1} - 1.314 \times Cash_t/PPE_{t-1}$. Data from Compustat.
Firm rating	Standard and Poor's rating for the firm in the year of bond issue converted to a numerical scale where higher values indicate better ratings. Data from Compustat.
Market Cap	Market capitalization of the firm in the quarter prior to bond issuance. Data from CRSP-Compustat.
Turnover	Share turnover for the quarter prior to bond issuance. Data from CRSP-Compustat.
CapX	Capital expenditures over sales. Data from Compustat.
Dividend dummy	Dummy variable equal one if the firm pays dividends. Data from Compustat.
Stock return volatility	Standard deviation of daily stock returns during the quarter (or year) prior to bond issuance. Data from CRSP.
Ln(Analyst Coverage)	Natural logarithm of the number of analysts covering a stock (firm) in a given year. Data from I/B/E/S.

A.1.3. Firm variables (continued)

Variable	Definition
PINL	Logistic transformation of the PIN measure (Probability of Informed Trading) as defined by Easley, Kiefer, O'hara, and Paperman (1996). Data from Professor Stephen Brown website: http://scholar.rhsmith.umd.edu/sbrown/pin-data.
ATI	Anti-takeover index from Cremers and Nair (2005) and Cremers, Nair, and Wei (2007). Data from ISS (formerly RiskMetrics).
Institutional ownership	Total shares held by institutional investors from the Thomson Reuters 13F quarterly filing over total shares outstanding from CRSP.
Ownership Dedicated/ Transient/ Quasi-Index	Total shares held by Dedicated/ Transient/ Quasi-index institutional investors from the Bushee (1998) classification and Thomson Reuters 13F filing over total shares outstanding from CRSP.
Ln(Amihud Illiq)	Natural logarithm of the Amihud (2002) illiquidity measure calculated as the ratio between absolute stock return and turnover from CRSP over a trading quarter.
Insiders ownership	Total shares held by insiders from Worldscope over total shares outstanding.
Intangibles	Measured as in Berger, Ofek, and Swary (1996): $Intangibles = 1 - (Cash + 0.715 \times Receivables + 0.547 \times Inventories + 0.535 \times PPE)/Assets$. Data from Compustat.

A.2 Additional tests

This Appendix provides additional material to the results in *'The hidden cost of financial derivatives: Options trading and the cost of debt'*. Specifically, we discuss various issues regarding instrumental variable analysis, the monotonicity of the main effect, robustness of the effect to different specifications and the addition of several controls.

We begin by including information regarding the instrumental variable analysis using an alternative instrument to *Open interest*, the results of which are presented in the core of the paper. Table A2.1 contains the results from performing a 2SLS regression of *Ln(Option volume)* and a set of control variables (defined in Section 1.2 of the paper and A.1) on our two measures of the cost of debt (bond yield spread and S&P rating) using *Moneyness* as an instrument. Similar to the case of *Open interest* (reported in Table 1.4 in the paper), *Moneyness* is highly relevant for explaining Option volume. Its coefficient in the first stage is large and highly significant (1.157, p-value<0.01), and the Kleibergen and Paap (2006) test rejects its irrelevancy (p-value<0.01). Moreover, the Cragg-Donald Wald F-statistic is not only well above the standard rule of thumb of 10, but it is also higher than the Stock and Yogo (2005) critical values, which rejects the null of a weak instrument. The coefficients for instrumented *Ln(Option volume)* are large, highly significant (p-value<0.01) and in the expected direction. The economic magnitudes of the coefficients, however, are significantly larger than those reported when using open interest as an instrument (e.g., 0.333 vs. 0.075 with bond yield spread as the dependent variable). Although these discrepancies can occur for a variety of reasons (from mitigating errors-in-variables biases to different instruments capturing different correlations with the instrumented variable), we extend our instrumental variable regression specification to simultaneously include both instruments. These results are reported in Table A2.2. The results reinforce the thesis of an effect of options volume on the cost of debt that is not driven by reverse causality. The coefficients for the instrumented option volume variable are, again, highly significant (p-value<0.01) and closer to the values achieved with open interest as an instrument. Instrument irrelevancy and weakness are again rejected, and the Hansen J-statistic also rejects overidentification problems. Overall, the results from this comprehensive instrumental variable analysis indicate strong causality running from more liquid options markets to a firm's cost of debt.

Next, we provide a set of different robustness tests to our baseline specification in Eq. 1.1 in the paper. Table A2.3 analyzes the monotonicity of the effect in two dimensions. First, columns 1 and 3 add to the regression model a squared term for option volume, *Ln(Option volume)*×*Ln(Option Volume)*, for bond yield spread and rating as dependent variables, respectively. Second, we include in columns 2 and 4 a dummy variable, *High Options Volume*, that equals one if a firm's option volume is above the median in a given year and zero otherwise, as well as its interaction with *Ln(Option volume)*.

Table A2.4 contains the results of the baseline regression model after the inclusion of two additional controls, the *Principal* amount of the bond issued and the percentage of *Institutional ownership* of the firm. Because institutional ownership data (which we obtain from Thomson Reuters 13F filing) are not available for all firms in our sample, we lose some observations when adding this control.

Table A2.5 considers different regression models when using S&P bond rating as the dependent variable. Using the same variables as in the baseline specification, we first modify the ordinal measure of bond rating to the natural log of one plus the rating, *Ln(1+Rating)*. Second, we fit ordered logit and negative binomial models to the main rating variable.

Table A2.6 considers the case of four-digit SIC (Standard Industry Classification code) fixed effects. We extend the classic two-digit industry dummies (which we use in the remaining analyses) to consider four-digit industry fixed effects. Columns 1 and 3 include four-digit SIC and time fixed effects, while columns 2 and 4 contain industry (four-digit SIC) by time fixed effects.

Although we carefully control for time effects in our baseline regressions, to alleviate concerns related to financially turbulent time periods driving our results, we run our baseline regression model for the financial crisis of 2007. Specifically, Table A2.7 contains the baseline regression models for the crisis period (columns 1 and 3), defined as the years 2007 thorugh 2010, and outside crisis (columns 2 and 4) with bond yield spread and credit rating as the dependent variable, respectively.

We then discuss the role of liquidity in our results in Tables A2.8 and A2.9. We begin by replacing our primary measure of liquidity, stock *bid-ask spread*, for another common measure in the literature, Amihud (2002) liquidity. We report these results in Table A2.8. Then, we estimate the baseline regression in Eq. 1.1 for the subsamples of high and low liquidity, defined as being below and above the median bid-ask spread. The results for the high (low) subsample correspond to columns 1 and 3 (2 and 4) in Table A2.9.

Finally, we report the analysis of the effect of *Transient* owners (as defined in Bushee, 1998) on our main results. Whereas the impact of *Dedicated* and *Quasi-index* owners (reported in Tables 1.16 and 1.17 of the paper) is important and aligns with our predictions, we leave the least interesting case of transient owners to the appendix. Columns 1 and 3 in Table A2.10 contain the baseline regression model with the percentage of institutional ownership and transient ownership as controls for bond yield spread and bond rating, respectively. In columns 2 and 4, we also incorporate the interaction term of ownership by transient investors and *Ln(Option volume)*.

Table A2.1: Options Volume and Cost of Debt: Moneyness as Instrument

	First stage	Second stage	
	Ln(Option Volume)	Ln(Yield Spread)	S&P Rating
	(1)	(2)	(3)
Ln(Moneyness)	1.157***		
	(0.109)		
Ln(Option Volume) (instrumented)		0.333***	-1.361***
		(0.043)	(0.164)
Ln(Total Assets)	1.377***	-0.697***	3.119***
	(0.036)	(0.062)	(0.249)
Tobin's Q	0.871***	-0.551***	2.332***
	(0.057)	(0.049)	(0.183)
ROA	5.713***	-6.054***	26.903***
	(2.180)	(1.098)	(4.512)
Leverage	-0.914***	1.055***	-6.823***
	(0.305)	(0.133)	(0.534)
Ln(Firm risk)	0.167***	-0.027	0.173***
	(0.037)	(0.017)	(0.067)
Ln(Bid-Ask Spread)	-0.150*	0.155***	-0.255*
	(0.086)	(0.043)	(0.149)
Public Bond Dummy	-0.293	-0.076	0.123
	(0.490)	(0.321)	(1.160)
Ln(Maturity)	-0.008	0.236***	0.169***
	(0.031)	(0.025)	(0.063)
Callable Dummy	0.298*	0.200***	
	(0.157)	(0.056)	
Observations	4328	4328	4328
R^2	0.775		

Notes: This table presents 2SLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables with average absolute moneyness (Moneyness) as the instrumental variable. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table A2.2: Options Volume and Cost of Debt: Both Instruments

	First stage	Second stage	
	Ln(Option Volume)	Ln(Yield Spread)	S&P Rating
	(1)	(2)	(3)
Ln(Open Interest)	0.872***		
	(0.041)		
Ln(Moneyness)	0.360***		
	(0.095)		
Ln(Option Volume)		0.090***	-0.462***
(instrumented)		(0.015)	(0.065)
Ln(Total Assets)	0.591***	-0.355***	1.863***
	(0.050)	(0.023)	(0.106)
Tobin's Q	0.559***	-0.341***	1.559***
	(0.059)	(0.026)	(0.112)
ROA	4.676**	-5.522***	24.961***
	(2.131)	(0.892)	(3.752)
Leverage	-0.802***	0.874***	-6.213***
	(0.241)	(0.098)	(0.422)
Ln(Firm risk)	0.075**	0.023**	-0.013
	(0.030)	(0.011)	(0.044)
Ln(Bid-Ask Spread)	-0.252***	0.149***	-0.230**
	(0.076)	(0.031)	(0.104)
Public Bond Dummy	0.034	-0.193	0.555
	(0.360)	(0.202)	(0.725)
Ln(Maturity)	-0.030	0.231***	0.188***
	(0.027)	(0.022)	(0.051)
Callable Dummy	0.119	0.287***	
	(0.115)	(0.039)	
Hansen J-statistic		63.56	49.49
(p-value)		(0.00)	(0.00)
Observations	4328	4328	4328
R^2	0.861		

Notes: This table presents 2SLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables with average quarterly open interest (Open interest) and average absolute moneyness (Moneyness) as instrumental variables. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table A2.3: Options Volume and Cost of Debt: Monotonicity

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.042***	0.044***	-0.284***	-0.257***
	(0.013)	(0.012)	(0.060)	(0.055)
Ln(Option Volume) × Ln(Option Volume)	-0.001		0.015*	
	(0.002)		(0.009)	
High Options Volume		-0.017		-0.174
		(0.058)		(0.299)
Ln(Option Volume) × High Options Volume		-0.006		0.078
		(0.015)		(0.076)
Ln(Total Assets)	-0.278***	-0.278***	1.491***	1.505***
	(0.018)	(0.018)	(0.087)	(0.088)
Tobin's Q	-0.295***	-0.294***	1.346***	1.353***
	(0.023)	(0.023)	(0.103)	(0.104)
ROA	-5.283***	-5.312***	23.242***	23.447***
	(0.902)	(0.897)	(3.741)	(3.760)
Leverage	0.828***	0.828***	-5.984***	-6.004***
	(0.100)	(0.100)	(0.420)	(0.423)
Ln(Firm risk)	0.036***	0.035***	-0.081*	-0.077
	(0.012)	(0.012)	(0.046)	(0.047)
Ln(Bid-Ask Spread)	0.150***	0.150***	-0.242**	-0.235**
	(0.030)	(0.030)	(0.097)	(0.098)
Public Bond Dummy	-0.215	-0.216	0.612	0.634
	(0.177)	(0.176)	(0.599)	(0.603)
Ln(Maturity)	0.230***	0.231***	0.196***	0.193***
	(0.022)	(0.021)	(0.050)	(0.050)
Callable Dummy	0.310***	0.308***		
	(0.041)	(0.042)		
Observations	4330	4330	4330	4330
R^2	0.706	0.706	0.743	0.742

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume), its squared term, a dummy variable for high options volume (*High options volume*), its interaction with Options volume, and a set of control variables. *High options volume* equals one if the options volume for firm is above the median in a given year and zero otherwise. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table A2.4: Options Volume and Cost of Debt: Additional Controls

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.033***	0.032***	-0.214***	-0.212***
	(0.010)	(0.010)	(0.045)	(0.046)
Ln(Total Assets)	-0.321***	-0.318***	1.605***	1.526***
	(0.017)	(0.018)	(0.091)	(0.094)
Tobin's Q	-0.300***	-0.307***	1.372***	1.307***
	(0.022)	(0.023)	(0.103)	(0.110)
ROA	-5.455***	-5.757***	23.910***	25.875***
	(0.845)	(0.838)	(3.792)	(3.905)
Leverage	0.824***	0.867***	-6.020***	-6.229***
	(0.094)	(0.101)	(0.419)	(0.424)
Ln(Firm risk)	0.028**	0.030**	-0.060	-0.088*
	(0.012)	(0.012)	(0.047)	(0.049)
Ln(Bid-Ask Spread)	0.144***	0.136***	-0.216**	-0.199**
	(0.029)	(0.033)	(0.096)	(0.101)
Public Bond Dummy	-0.301	-0.549***	0.837	1.124**
	(0.195)	(0.058)	(0.657)	(0.519)
Ln(Maturity)	0.221***	0.199***	0.210***	0.214***
	(0.021)	(0.022)	(0.050)	(0.053)
Callable Dummy	0.291***	0.309***		
	(0.040)	(0.043)		
Principal	0.245***	0.248***	-0.486***	-0.467***
	(0.029)	(0.031)	(0.128)	(0.129)
Intitutional Ownership		0.067		-1.010***
		(0.070)		(0.309)
Observations	4330	3852	4330	3852
R^2	0.709	0.714	0.744	0.750

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables that additionally include the bond principal amount (*Principal*) and total *Institutional ownership*. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table A2.5: Options Volume and Cost of Debt:
Alternative distributions for bond rating

	Ln(1+Rating)	S&P Rating	
	OLS	Ordered Logit	Neg.Binomial
	(1)	(2)	(3)
Ln(Option Volume)	-0.019***	-0.237***	-0.019***
	(0.005)	(0.051)	(0.004)
Ln(Total Assets)	0.130***	1.701***	0.130***
	(0.008)	(0.108)	(0.008)
Tobin's Q	0.101***	1.657***	0.100***
	(0.010)	(0.147)	(0.009)
ROA	2.479***	25.767***	2.345***
	(0.380)	(4.374)	(0.365)
Leverage	-0.614***	-6.269***	-0.611***
	(0.046)	(0.475)	(0.046)
Ln(Firm risk)	-0.013***	-0.049	-0.010**
	(0.004)	(0.052)	(0.004)
Ln(Bid-Ask Spread)	-0.036***	-0.159	-0.032***
	(0.011)	(0.103)	(0.011)
Public Bond Dummy	0.051	0.945**	0.066
	(0.060)	(0.458)	(0.050)
Ln(Maturity)	0.024***	0.155***	0.020***
	(0.004)	(0.056)	(0.004)
Observations	4330	4330	4330

Notes: This table presents OLS regression estimates of firms-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of industry and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table A2.6: Options Volume and Cost of Debt: SIC4 Dummies

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.030***	0.072***	-0.203***	-0.419***
	(0.010)	(0.016)	(0.042)	(0.069)
Ln(Total Assets)	-0.303***	-0.377***	1.641***	1.909***
	(0.017)	(0.028)	(0.088)	(0.123)
Tobin's Q	-0.275***	-0.328***	1.068***	1.104***
	(0.025)	(0.043)	(0.113)	(0.198)
ROA	-4.460***	-3.595**	21.292***	20.149***
	(0.792)	(1.418)	(3.483)	(6.835)
Leverage	0.753***	0.932***	-5.386***	-6.012***
	(0.092)	(0.172)	(0.452)	(0.739)
Ln(Firm risk)	0.032***	0.032	-0.055	-0.046
	(0.012)	(0.021)	(0.045)	(0.085)
Ln(Bid-Ask Spread)	0.140***	0.131***	-0.240***	-0.655***
	(0.028)	(0.039)	(0.084)	(0.152)
Public Bond Dummy	-0.312**	-0.557***	0.846	1.761***
	(0.147)	(0.128)	(0.815)	(0.418)
Ln(Maturity)	0.227***	0.267***	0.143***	0.056**
	(0.020)	(0.013)	(0.043)	(0.026)
Callable Dummy	0.234***	0.148***		
	(0.043)	(0.048)		
Fixed effects	Time & Industry	Industry-by-Time	Time & Industry	Industry-by-Time
Observations	4330	4330	4330	4330
R^2	0.756	0.597	0.811	0.655

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables. A detailed definition of all variables is provided in A.1. Robust standard errors are in parentheses. Industry is defined at the four-digit SIC code level. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table A2.7: Options Volume and firm distress: Financial crisis

	Ln(Yield Spread)		S&P Rating	
	Crisis (1)	No crisis (2)	Crisis (3)	No crisis (4)
Ln(Option Volume)	0.034**	0.044***	-0.171***	-0.255***
	(0.014)	(0.011)	(0.066)	(0.052)
Ln(Total Assets)	-0.232***	-0.303***	1.514***	1.564***
	(0.026)	(0.020)	(0.118)	(0.102)
Tobin's Q	-0.305***	-0.296***	1.643***	1.317***
	(0.040)	(0.027)	(0.180)	(0.114)
ROA	-3.409***	-6.153***	15.918***	27.561***
	(1.192)	(1.114)	(5.705)	(4.471)
Leverage	0.579***	0.927***	-5.649***	-6.220***
	(0.152)	(0.120)	(0.636)	(0.496)
Ln(Firm risk)	0.034**	0.028*	-0.088	-0.050
	(0.017)	(0.014)	(0.080)	(0.055)
Ln(Bid-Ask Spread)	0.284***	0.109***	-0.224*	-0.206*
	(0.052)	(0.033)	(0.132)	(0.114)
Public Bond Dummy	0.319	-0.400***	-0.610	1.009***
	(0.512)	(0.058)	(1.930)	(0.272)
Ln(Maturity)	0.069***	0.284***	0.163**	0.205***
	(0.022)	(0.025)	(0.068)	(0.060)
Callable Dummy	0.294***	0.332***		
	(0.060)	(0.051)		
Observations	1231	3099	1231	3099
R^2	0.709	0.693	0.774	0.738

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables. The crisis period is defined as the years 2007, 2008, 2009 and 2010. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table A2.8: Options Volume and Cost of Debt: Amihud Illiquidity

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.049***	0.048***	-0.251***	-0.249***
	(0.012)	(0.011)	(0.048)	(0.048)
Ln(Total Assets)	-0.258***	-0.249***	1.447***	1.442***
	(0.023)	(0.023)	(0.096)	(0.096)
Tobin's Q	-0.298***	-0.284***	1.330***	1.334***
	(0.028)	(0.027)	(0.112)	(0.112)
ROA	-5.150***	-5.553***	24.825***	24.223***
	(0.911)	(0.909)	(3.924)	(3.899)
Leverage	0.951***	0.876***	-6.102***	-6.128***
	(0.107)	(0.104)	(0.420)	(0.417)
Ln(Firm risk)	0.041***	0.043***	-0.099**	-0.096**
	(0.013)	(0.013)	(0.048)	(0.048)
Ln(Amihud Illiq)	0.075***	0.079***	-0.151**	-0.150**
	(0.024)	(0.024)	(0.070)	(0.070)
Public Bond Dummy		-0.221		0.663
		(0.191)		(0.639)
Ln(Maturity)		0.220***		0.207***
		(0.022)		(0.050)
Callable Dummy		0.318***		
		(0.041)		
Observations	4185	4185	4185	4185
R^2	0.666	0.701	0.742	0.743

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables including Amihud (2002) as a measure of liquidity. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table A2.9: Options Volume and Cost of Debt: Liquidity subsamples

	Ln(Yield Spread)		S&P Rating	
	High Liq. (1)	Low Liq. (2)	High Liq. (3)	Low Liq. (4)
Ln(Option Volume)	0.036**	0.049***	-0.294***	-0.219***
	(0.015)	(0.011)	(0.058)	(0.053)
Ln(Total Assets)	-0.274***	-0.292***	1.638***	1.481***
	(0.024)	(0.021)	(0.107)	(0.115)
Tobin's Q	-0.248***	-0.354***	1.329***	1.486***
	(0.029)	(0.029)	(0.124)	(0.133)
ROA	-4.916***	-3.900***	24.564***	18.523***
	(1.343)	(0.917)	(5.100)	(4.680)
Leverage	0.795***	0.826***	-5.806***	-5.825***
	(0.175)	(0.101)	(0.693)	(0.496)
Ln(Firm risk)	0.017	0.040***	-0.015	-0.084
	(0.019)	(0.014)	(0.064)	(0.064)
Ln(Bid-Ask Spread)	0.071	0.104***	0.189	-0.258**
	(0.086)	(0.029)	(0.180)	(0.114)
Public Bond Dummy	-0.468***	-0.296***	1.352***	0.645**
	(0.061)	(0.077)	(0.296)	(0.306)
Ln(Maturity)	0.301***	0.136***	0.049	0.390***
	(0.025)	(0.026)	(0.046)	(0.090)
Callable Dummy	0.460***	0.230***		
	(0.087)	(0.045)		
Observations	2146	2141	2146	2141
R^2	0.653	0.711	0.706	0.735

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables by subsamples of liquidity according to the median. A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table A2.10: Options Volume and Cost of Debt: Transient Owners

	Ln(Yield Spread)		S&P Rating	
	(1)	(2)	(3)	(4)
Ln(Option Volume)	0.027**	0.032**	-0.166***	-0.175***
	(0.011)	(0.015)	(0.045)	(0.058)
Own. Transient	0.970***	1.025***	-6.159***	-6.256***
	(0.188)	(0.188)	(0.870)	(0.951)
Ln(Option Volume) × Own. Transient		-0.032		0.057
		(0.049)		(0.243)
Intitutional Ownership	-0.152*	-0.147*	0.414	0.405
	(0.078)	(0.078)	(0.359)	(0.360)
Ln(Total Assets)	-0.252***	-0.254***	1.290***	1.293***
	(0.019)	(0.020)	(0.092)	(0.092)
Tobin's Q	-0.287***	-0.288***	1.204***	1.204***
	(0.024)	(0.024)	(0.109)	(0.109)
ROA	-6.061***	-6.088***	27.288***	27.334***
	(0.877)	(0.879)	(3.884)	(3.867)
Leverage	0.836***	0.837***	-5.993***	-5.994***
	(0.105)	(0.105)	(0.419)	(0.418)
Ln(Firm risk)	0.031**	0.031**	-0.076	-0.075
	(0.013)	(0.013)	(0.049)	(0.048)
Ln(Bid-Ask Spread)	0.137***	0.138***	-0.192*	-0.193*
	(0.032)	(0.032)	(0.099)	(0.099)
Public Bond Dummy	-0.525***	-0.532***	0.981	0.995
	(0.057)	(0.058)	(0.627)	(0.632)
Ln(Maturity)	0.210***	0.210***	0.191***	0.191***
	(0.023)	(0.023)	(0.053)	(0.053)
Callable Dummy	0.299***	0.297***		
	(0.043)	(0.043)		
Observations	3649	3649	3649	3649
R^2	0.716	0.716	0.757	0.757

Notes: This table presents OLS regression estimates of firm-level measures of the cost of debt (bond yield spread and bond rating) on options trading volume (Option volume) and a set of control variables, as well as the interaction of Options volume with ownership by Transient institutions as defined in Bushee (1998). A detailed definition of all variables is provided in A.1. Robust standard errors are clustered at the firm level (in parentheses). All regressions include a full set of two-digit SIC code dummies and time dummies. The sample period is 1996-2014. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Appendix B

Appendix for "The Role of Option Markets in Shareholder Activism"

This Appendix provides additional material to the results presented in *"The Role of Option Markets in Shareholder Activism"*. In Section B.1, we provide definitions and sources for all variables used in this study. In Section B.2, we discuss and report robustness tests for the baseline results reported in the paper.

B.1 Variable definition

B.1.1. Variables

Variable	Definition
Options Volume (Millions)	Total daily trade in each option multiplied by end-of-day quote midpoint for that option. This number is then aggregated across all options for a single stock on all trading days for a given year. Following Roll, Schwartz, and Subrahmanyam (2009). Source: Option Metrics.
Ln(Option Volume)	Natural logarithm of Options Volume.
Open Interest	Annual average of the daily Open interest (number of put and call contracts that remain open in a stock) provided by Option Metrics.
Ln(Open Interest)	Natural logarithm of Open Interest.
Moneyness	Annual average of the daily absolute deviation of the exercise price of each traded option from the closing price of the underlying stock. Following Roll, Schwartz, and Subrahmanyam (2009). Source: Option Metrics and CRSP-Compustat.
Ln(Moneyness)	Natural logarithm of Moneyness.
Proxy Contest	Binary variable that equals 1 if the firm experienced a proxy contest during year t and zero otherwise. Data from ISS (formerly RiskMetrics).
Shareholder Proposal	Binary variable that equals 1 if the firm experienced a shareholder proposal during year t and zero otherwise. Data from ISS (formerly RiskMetrics).
Abnormal Performance	Firm stock return during year t minus the return of a value-weighted market portfolio (CRSP Value-weighted) during the same period. Data from CRSP.
Ln(MarketCap)	Natural logarithm of end-of-December firm market capitalization (price $\times$ shares outstanding) from CRSP-Compustat.
Tobin's Q	Sum of the market capitalization of a firm's common equity (stock price times shares outstanding at the end of the quarter), liquidation value of its preferred shares and the book value of debt, divided by book value of assets. Based on CRSP-Compustat items. (Tobin's Q = (prccq$\times$cshoq + atq - ceqq - txdb)/atq)).
Ln(Illiquidity)	Natural logarithm of the Amihud (2002) illiquidity measure calculated as the ratio between absolute stock return and turnover from CRSP over a trading quarter.
Nasdaq	Dummy variable equal one if the firm is traded on the Nasdaq market and zero otherwise. Data from CRSP.
Ln(Sales)	Natural logarithm of sales obtained from Compustat.
Dividend yield	Total dividend (common and preferred) over market value of common equity plus book value of preferred equity. Data from Compustat and CRSP.

B.1.1. Variables (continuation)

Variable	Definition
Cash	Cash plus marketable securities divided by total assets. Data from Compustat.
Volatility	Standard deviation of monthly returns from CRSP during year t.
R&D	Research and development expenses over total assets. R&D expenses are substituted by zero when missing. Data from Compustat.
Bid-Ask Spread	Average of the daily relative bid-ask spread for a stock and quarter. Relative Bid-Ask Spread = 100×(Ask - Bid)/(0.5×(Ask + Bid)). Source: CRSP-Compustat.
Ln(Bid-Ask Spread)	Natural logarithm of Bid-Ask Spread.
Institutional Ownership	Total shares held by institutional investors from the Thomson Reuters 13F quarterly filing over total shares outstanding from CRSP.
Institutional HHI	Herfindahl-Hirschman concentration index for Insitutional investors holdings on firm i in year t. Data from Thomson Reuters 13F fillings.
Analyst Coverage	Number of analyst following a stock on year t. Data from I/B/E/S.
Avg. vote for management	Shareholder votes 'for' management-sponsored proposals over the voting base. Data from ISS (formerly RiskMetrics).
E-index	Index measuring managerial entrenchment following Bebchuk, Cohen, and Ferrell (2009). Data from ISS (formerly RiskMetrics).
CEO compensation	Data on CEO total compensation obtained from Execucomp.
Board size	Number of directors in the board of a firm. Data from ISS (formerly RiskMetrics).
Board shares held	Number of firm shares in hands of board members. Data from ISS (formerly RiskMetrics).
Independent directors	Ratio of independent directors over total directors in the board of a firm. Data from ISS (formerly RiskMetrics).
Avg. ISS recommendation	Average recommendation from ISS on all issues considered for vote in a firm in a given year. Data from ISS (formerly RiskMetrics).
Unequal voting dummy	Dummy variable equal one if a firm has different classes of shares with different voting power and zero otherwise. Data from ISS (formerly RiskMetrics).
Confidential voting dummy	Dummy variable equal one if the firm's policies prevents management from knowing how shareholders vote with their proxy cards and zero otherwise. Data from ISS (formerly RiskMetrics).

B.2 Additional tables

Table B2.1: Options Volume and Activism: IV
Moneyness & Open interest

	Proxy $Contest_t$		Shareholder $Proposal_t$	
	(1)	(2)	(3)	(4)
$Ln(OptVol)_{(t-1)}$	0.098***		0.102***	
(instrumented)	(0.036)		(0.013)	
$Ln(OptVol)_{(t-2)}$		0.093**		0.126***
(instrumented)		(0.041)		(0.015)
Controls	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
Observations	19791	18689	19791	18689

Notes: This table presents instrumental variable (IV) probit regression estimates for firm-level shareholder activism events (proxy contest and shareholder proposal) on one and two-year lagged instrumented options volume and a set of control variables. Annual Options volume is instrumented through the average annual Open interest and annual Moneyness. A detailed definition of all variables is provided in B.1. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

Table B2.2: Voting with management: 2SLS regressions: IV Moneyness & Open interest

	Average Vote for Management (%)		
	Directors	Other	All
	(1)	(2)	(3)
$\text{Ln(OptVol)}_{(t-1)}$	-0.200***	-0.406***	-0.220***
(instrumented)	(0.044)	(0.093)	(0.043)
Controls	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Observations	9428	4598	9478

Notes: This table presents 2SLS regression estimates of the average shareholder vote for management-sponsored proposals on instrumented one-year lagged options volume and a set of known determinants of shareholder support to management. Column 1 contains the results for proposals on Directors, column 2 for Other proposals, and column 3 for All proposals. Annual options volume is instrumented trhough average annual Open interest and annual Moneyness. A detailed definition of all variables is provided in B.1. All regressions include year and industry (four-digit sic code) dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

Table B2.3: Options Volume and Activism:
First-stage regressions

	$Ln(OptVol)_{(t-1)}$	
	(1)	(2)
$Ln(Open)_{(t-1)}$	1.011***	
	(0.006)	
$Ln(Moneyness)_{(t-1)}$		1.368***
		(0.030)
$Ln(Illiquidity)_{(t-1)}$	-0.364***	-0.856***
	(0.009)	(0.013)
Ab. $Performance_{(t-1)}$	0.234	-0.859**
	(0.244)	(0.356)
Ab. $Performance_{(t-2)}$	3.677***	3.733***
	(0.193)	(0.281)
Institutional $HHI_{(t-1)}$	-0.319**	0.124
	(0.136)	(0.197)
Institutional $Ownership_{(t-1)}$	0.246***	-0.473***
	(0.038)	(0.056)
Analyst $Coverage_{(t-1)}$	0.013***	0.048***
	(0.001)	(0.002)
$Volatility_{(t-1)}$	4.180***	7.896***
	(0.147)	(0.224)
$Nasdaq_{(t-1)}$	0.082***	-0.013
	(0.018)	(0.026)
Ln(Mkt $Cap)_{(t-1)}$	0.165***	0.286***
	(0.013)	(0.018)
Tobin's $Q_{(t-1)}$	0.134***	0.147***
	(0.007)	(0.010)
$Ln(Sales)_{(t-1)}$	-0.002	0.002
	(0.008)	(0.011)
Dividend $yield_{(t-1)}$	-0.435	-1.153***
	(0.303)	(0.440)
$Cash_{(t-1)}$	0.328***	0.862***
	(0.064)	(0.092)
$R\&D_{(t-1)}$	-0.969***	0.162
	(0.097)	(0.141)
Observations	19791	19791
Adj. R^2	0.869	0.724

Notes: This table presents the results from the first-stage of the intrumental variable probit regression. Options volume is regressed on each of the two instruments (Open interest and Moneyness), as well as a set of known determinants of shareholder activism. All regressions include time dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

Table B2.4: Options volume and voting: first-stage regressions

	Ln(OptVol)		
	(1)	(2)	(3)
Ln(Open)	1.096***		1.065***
	(0.010)		(0.010)
Ln(Moneyness)		1.423***	0.270***
		(0.043)	(0.031)
Illiquidity	-0.007**	-0.007*	-0.006*
	(0.003)	(0.004)	(0.003)
Ln(Mkt Cap)	0.485***	1.376***	0.512***
	(0.013)	(0.016)	(0.013)
Tobin's Q	0.182***	0.084***	0.184***
	(0.011)	(0.015)	(0.011)
Ab. Performance$_{(t-1)}$	3.800***	2.619***	3.930***
	(0.364)	(0.543)	(0.360)
E-Index	0.011	-0.013	0.013
	(0.009)	(0.014)	(0.009)
CEO compensation	0.066***	0.135***	0.067***
($ thousands)	(0.016)	(0.027)	(0.016)
Board size	-0.001	-0.008	-0.001
	(0.006)	(0.008)	(0.006)
Board shares held	0.000***	0.000	0.000***
	(0.000)	(0.000)	(0.000)
Independent directors(%)	0.031	-0.016	0.015
	(0.092)	(0.134)	(0.092)
Avg. ISS Recommen.	0.023	0.004	0.030
	(0.048)	(0.072)	(0.048)
Unequal voting dummy	0.093	0.170*	0.106*
	(0.059)	(0.094)	(0.059)
Confidential voting dummy	-0.058**	-0.002	-0.062**
	(0.027)	(0.041)	(0.027)
Institutional HHI	-1.555***	-4.403***	-1.896***
	(0.566)	(0.830)	(0.578)
Institutional Ownership	0.945***	0.946***	0.965***
	(0.085)	(0.131)	(0.084)
Observations	11267	11267	11267
Adjusted R^2	0.902	0.767	0.903

Notes: This table presents the results from instrumental variable (2SLS) regression. Shareholder support to ISS is regressed on contemporane, as well as a set of known determinants of shareholder voting behavior. All regressions include time and industry dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

Table B2.5: Voting with ISS: 2SLS

	Average Vote with ISS(%)	
	(1)	(2)
Ln(OptVol)_t (instrumented)	-0.433***	
	(0.118)	
$\text{Ln(OptVol)}_{(t-1)}$ (instrumented)		-0.261**
		(0.126)
Illiquidity	0.068**	0.065**
	(0.030)	(0.029)
Ln(Mkt Cap)	1.935***	1.704***
	(0.231)	(0.247)
Tobin's Q	-0.037	-0.008
	(0.169)	(0.189)
$\text{Ab. Performance}_{(t-1)}$	23.601***	25.939***
	(6.208)	(6.955)
E-Index	-0.472***	-0.724***
	(0.148)	(0.165)
CEO compensation ($ thousands)	-1.904***	-1.860***
	(0.302)	(0.320)
Board size	0.185**	0.196**
	(0.084)	(0.093)
Board shares held	-0.006***	-0.005**
	(0.002)	(0.002)
Independent directors(%)	23.073***	22.128***
	(1.550)	(1.726)
Avg. Mgmt. Rec.	46.899***	49.307***
	(2.024)	(2.063)
Unequal voting dummy	-8.492***	-9.251***
	(1.290)	(1.376)
Confidential voting dummy	0.393	0.281
	(0.398)	(0.435)
Institutional HHI	-19.688***	-17.343**
	(6.790)	(7.490)
Institutional Ownership	1.395	1.873
	(1.292)	(1.410)
Observations	11196	9478

Notes: This table presents instrumental variable (2SLS) regression estimates of the average shareholder vote with ISS recommendations on contemporaneous and one-year lagged instrumented options volume and a set of known determinants of shareholder voting behavior. Options volume is instrumented through average annual Open interest and annual Moneyness. A detailed definition of all variables is provided in B.1. All regressions include year and industry (four-digit sic code) dummies. Robust standard errors are in parentheses. The sample period is 2003-2014. ***, ** and * denote significance at the 1%, 5% and 10%, respectively.

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