How Informed Are Hedge Fund Option Strategies?

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Abstract

We employ a comprehensive disclosure set of hedge fund option strategies and examine their performances. Our study outcome offers no affirmation of hedge fund speculation skills. A liquid quarterly tracking portfolio of options earns significant negative returns ranging between −1.59% and −0.89% per month. These results are robust against assumptions on option's moneyness, time-to-maturity, performance evaluation methodologies, and stock characteristics. We also reveal that there is little performance differential between hedge funds and other institutional investors. Taken together, our results do not support the existing views on hedge funds are skilled in using options to speculate.

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1 Introduction

> ‘‘*The seminal work of Black and Scholes (1973) and Merton (1973) generated an explosion of research into methods for computing theoretical option prices and hedge ratios. By contrast, more than three decades after the beginning of listed option trading much less is known about the trading of this important class of securities.*" (see Lakonishok et al. (2007) p. 813)

How options are traded is a subject of widespread interest. Theoretical works by both Black (1975) and Easley et al. (1998) predict informed investors are more likely to trade in the options market to take advantage of the embedded leverage and liquidity features of options. Building on the preceding notions, a growing literature presents evidence on how various market participants engage in options trading and the related impact on portfolio performance. These studies span different types of investors, including mutual funds (Koski and Pontiff (1999), Deli and Varma (2002), Almazan et al. (2004), Fong et al. (2005), Frino et al. (2009), Cici and Palacios (2015), Natter et al. (2015)), hedge funds (Chen (2011), Aragon and Martin (2012)), and retail investors (Bauer et al. (2009)). Yet, there is no conclusive evidence on this topic to date, either due to the use of seemingly different data sources or empirical methodologies. For instance, Chen (2011) finds no material evidence that hedge funds' use of derivative securities is associated with superior fund performance. In contrast, Aragon and Martin (2012) show hedge fund option holdings can predict both future stock returns and volatility, leading to the conclusion that hedge funds are skilled in using options for speculative purposes. In this paper, we target the hedge fund industry and provide additional evidence on whether hedge funds' long option positions show skill in speculating about the underlying stocks.

We assemble a large sample of 932 hedge fund managers and extract their option holdings directly from 13F filings for the period between 1999 and 2012. Using a performance evaluation approach aimed directly at their option trading strategies, we infer hedge fund managers' skills at the individual hedge fund firm level. For each manager, on a monthly basis we form a tracking portfolio

of options based on their previous quarter-end's disclosed option positions. Using assumptions about option strike prices and time-to-maturity, we form the tracking portfolios using short-term at-the-money (ATM) options, defined, following Christoffersen et al. (2014) and Xing and Zhang (2013), as options whose time-to-maturity is between 45 and 90 days and absolute delta is between 0.4 and 0.6. Empirically, these option contracts are both liquid and actively traded in the exchange. Over the whole sample period, we find negative median tracking portfolio monthly returns of -1.483% for the bull strategies, -1.765% for the bear strategies, and -1.244% for the straddle strategies. We also stress test our results by varying the options' time-to-maturity and moneyness assumptions used in forming the tracking portfolios but find no material evidence in support of managerial speculative skills.

Next, we implement an alternative performance evaluation approach at the aggregate industry level. We focus on all hedge funds' option holdings at the end of each quarter, effectively treating the entire hedge fund industry as one giant investor (see Chen et al. (2000), Gompers and Metrick (2001), Griffin and Xu (2009) for similar applications in the mutual fund industry). Our results show a tracking portfolio formed based on the aggregate hedge fund option holdings earns significant negative monthly return of between -1.588% and -0.877% per month, depending on the specific option strategies. Chen et al. (2000) show mutual fund manager's buy trades outperform their sell trades, as proxied by the quarterly changes in their reported holdings. Thus, it is plausible that managerial investment skills are better captured by their trade decisions instead of their passive holdings. [1] Adopting a similar approach as in Chen et al. (2000), we however find no evidence in support of the above conjecture. A tracking portfolio formed based on positive changes in option holdings does not outperform a tracking portfolio formed based on negative changes in option holdings.

We conduct additional robustness tests. First, we control for hedge fund investment preferences. Griffin and Xu (2009) show hedge funds generally prefer small, opaque value securities compared

[1] Subsequent studies utilize better datasets that capture the granularity of managers' trade decisions. For instance, Puckett and Yan (2011) examine the institutional managers' interim trading skills and conclude such trades earn significant abnormal returns and tend to persist over time.

to mutual funds. Thus, we examine whether hedge fund managers are skilled in using options to speculate in different segments of the market by dividing their option holdings into different subgroups based upon the underlying stock's characteristics. Next, we test whether or not these managers' option holdings contain private information for the next quarter earnings events. Ali et al. (2004); Ke and Petroni (2004); Yan and Zhang (2009); Baik et al. (2010); and others find that changes in institutional manager holdings can predict subsequent earnings announcement abnormal returns. In this regard, we carry out an event study based approach and assess the returns achieved by these option strategies during various earnings announcement windows. Lastly, we also compare the performance of these hedge fund option holdings with other institutional investors. If hedge fund managers are deemed to be more sophisticated in using options to speculate, we should at least observe greater degree of outperformance in hedge fund options when compared to other institutional investors. Despite all these further tests, we find similar insignificant evidence of hedge fund option investment capabilities across all cases.

Our paper joins the abundance literature on hedge fund performance research. In one strand, studies by Ackermann et al. (1999), Brown et al. (1999) suggest hedge funds deliver at least some abnormal returns. On the other, Asness et al. (2001), Amin and Kat (2003), and Kat and Palaro (2006) find that hedge funds do not deliver alpha. More recently, using 13F hedge fund holdings, Griffin and Xu (2009) also conclude there is little differential ability between hedge funds and mutual funds. While both Aragon and Martin (2012) and ours contribute to the literature by examining performance of hedge fund option holdings, we differ from Aragon and Martin (2012) in two dimensions. First, we alleviate the issue of self-reporting biases in hedge fund databases as documented in Aiken et al. (2012) and Agarwal et al. (2013a). Second, for inference purposes, instead of tracking the returns of option's underlying as in Aragon and Martin (2012), we directly construct hypothetical copycat option portfolios to investigate the performance of these hedge funds' option positions as discussed.

More importantly, the overarching evidence we present in this paper is emphatically showing these hedge funds' disclosed option positions does not depict the story of informed trading as

suggested in Black (1975) and Easley et al. (1998). Although the overall evidence rejects the hypothesis of hedge fund are skilled in executing informed trades in the options market, one caveat in our approach is that it does not allow us to determine whether these hedge fund managers are truly exhibiting "no skills" in their option investments, or merely using options to hedge their portfolios. Nonetheless, we point out one piece of evidence in favor of the hedging argument can be found in Chen (2011), who observes hedge funds that use derivatives tend to have lower fund risks, engage less in risk-shifting, and are less likely to be liquidated.

The rest of the paper is organized into three sections. We devote Section 2 for data descriptions. Section 3 examines the performance of hedge fund option strategies. Section 4 concludes the paper.

2 Data

2.1 Institutional Holdings

Section 13(f) of the Securities Exchange Act of 1934 mandates all institutional investment managers who exercise investment discretion over 100 million or more are legally required to report the details of holdings of more than $\$200,000$ or $10,000$ shares using Form 13F. Past researchers often gain access to this ownership information via data vendors like Thomson Reuters and CDA/Spectrum. One major limitation is that they only contain long institutional equity positions. According to the Securities Exchange and Commission (SEC), managers are also required to report option positions if the options themselves are securities in the Official List of 13(f) Securities for that quarter. In light of this data incompleteness, we directly extract institutional option positions from the SEC Electronic Data Gathering, Analysis, and Retrieval (EDGAR) database. Given that the Form 13F is generally not available in the early years, we restrict our sample to be between 1999:Q1 and 2012:Q3. There are 139,264 Form 13Fs filed over the sample period. [2]

Based on the Form 13F reporting formats, we implement a series of computer algorithms to extract the relevant option positions by locating keywords like "CALL" and "PUT". For each

[2] The filings can be accessed via the following website: `http://www.sec.gov/edgar/searchedgar/ftpusers.htm`.

observation, we obtain the following information: (1) issuer/security's name; (2) security's CUSIP; (3) notional value of the options (in thousands); (4) quantity held; and (5) type of option (call or put). [3] In total there are $1,839,387$ option positions, of which $951,352$ are call options and $888,035$ are put options. Institutional managers can report on behalf of several funds operating under the family umbrella. Thus, it is possible to observe multiple positions on an exact same security being reported. We aggregate these multiple option positions to the manager level for each date-security-call/put combination. This is consistent with Thomson Reuters' approach in compiling their institutional equity positions.

Next, we merge the option positions and the Thomson Reuters equity positions. For each name appears in the SEC EDGAR database, we identify the corresponding manager in the Thomson Reuters. We use a combination of algorithm name matching technique and manual screening process. [4] This gives us $3,104$ unique institutional investors together with their complete portfolio allocation decisions between stocks and options. For ease of exposition, we refer this merged ownership database as 13F/Thomson Reuters hereafter. [5] At this stage, we point out that the SEC does not require the managers to disclose options' strike price and time-to-maturity. While undesirable, we will discuss the steps taken to address these limitations (see Section 3).

2.2 Hedge Fund Classifications

Since regulatory constraints are not uniformly imposed across institutions, it is thus important for us to control for investor heterogeneity issues in our analyses. For instance, hedge funds display several unique features that distinguish them from other institutional managers. These include

[3] While the managers should consider only the value of such options for the purpose of 100 million thresholds, they must report the market value and quantity in terms of the underlying securities. Readers are referred to the Division of Investment Management of SEC who provides a list of comprehensive frequently asked questions about form 13F in `http://www.sec.gov/divisions/investment/13ffaq.htm`.

[4] For instance, Thomson Reuters contains a manager called "T.H. Fitzgerald and Company." (MGRNO = 38250) whereas the corresponding manager in the EDGAR database is "Fitzgerald Thomas H JR /CT/" (CIK = 1019509). Upon checking the holdings from both the Thomson Reuters and the original SEC filings, we confirm that these two seemingly different institutions are indeed the same.

[5] Using the same data source, Agarwal et al. (2013b) has 3,134 unique institutional managers in their sample for the period between 1999 and 2007.

flexible investment strategies (e.g. short selling, leverage, derivative trading), strong managerial incentives (e.g. compensation structure and high watermark feature), and opaque information environment. In a similar spirit of Agarwal et al. (2013a) and Shive and Yun (2013), to identify hedge fund managers from the 13F/Thomson Reuters we rely on three hedge fund commercial databases: TASS, Hedge Fund Research (HFR), and Morningstar. These databases contain a list of individual hedge fund names and their management companies. For each disclosed management company, we look up to the corresponding institutional manager from the 13F/Thomson Reuters. However, as pointed out by Agarwal et al. (2013a), these commercial databases are subjected to self-reporting biases, hence may not reflect the universe of hedge fund industry. For instance, hedge funds may self-select themselves into one of the reporting databases in order to advertise their funds to attract clients. Likewise, funds may also choose not to enter themselves into the database to conceal their profitable trading strategies from the public.

We mitigate the issue of self-reporting bias by using information in Form ADVs in our hedge fund identification process. We follow past literature to classify a manager as hedge fund if more than 50% of its clients are high-net-worth individuals or other pooled investment vehicles and it imposes a performance-based fee on its clients. [6] In addition, we eliminate hedge funds that have side-by-side mutual fund business or are affiliated with banks. [7] This yields a final sample of 932 unique "pure play" hedge funds, a number that is sufficiently close to what is reported in past studies (see Agarwal et al. (2013a)). The remaining non-hedge fund institutional manager sample primarily consists of commercial banks, insurance companies, mutual fund management companies, asset management companies, investment banks, brokers, private wealth management companies, pension funds, endowments, etc.

[6] These information are located in Form ADV under Question D(2) and E of Item 5: Information About Your Advisory Business. As pointed by Jame (2014), the Form ADVs contain information of nearly all investment advisors including hedge funds as required by the Dodd-Frank Act starting in March 2012. Such mandatory nature is essential to minimize any form of selection bias in our hedge funds sample. Form ADVs are available to download at `http://www.adviserinfo.sec.gov/IAPD/Content/Search/iapd_Search.aspx`.

[7] By analyzing a sample of management firms that simultaneously run both hedge funds and mutual funds, Cici et al. (2010) show that these mutual funds generally underperform their peers, suggesting management firms may strategically transfer performance from mutual funds to hedge funds

2.3 Hedge Fund Summary Statistics

Table 1 shows the summary statistics of our hedge funds sample and the prevalence role that options play in these managers' portfolio allocation strategies. The number of hedge fund manager increases from 204 in 1999 to 871 in 2012. At any quarter, we define a hedge fund manager as option user if it discloses at least one option position in its portfolio. We observe the percentage of hedge funds that trade in the options market increases substantially over the years, approaching 30% in 2012. The total number of hedge fund option positions relative to their total portfolio positions ranges between 6.84% and 19.49%.

Our 13F/Thomson Reuters database also provides a rich framework on how hedge fund managers formulate their option investment strategies in conjunction with the underlying equity holdings. In particular, we can classify any option positions held by investors into one of the following six distinct type of strategies: (1) a call only position; (2) a simultaneous holding of both stock and call positions; (3) a put only position; (4) a simultaneous holding of both call and put positions; (5) a simultaneous holding of stock, call, and put positions; and (6) a simultaneous holding of stock and put positions. Following Aragon and Martin (2012), we group these option strategies into four categories: (1) bull, (2) bear, (3) protective put, and (4) straddle. We classify the observed option position as bull strategy if the manager reports a call option with or without an existing equity position; bear strategy if the manager reports a put option only; protective put strategy if the manager reports a put option with an existing equity position; and, straddle if the manager reports both call and put options simultaneously, with or without an existing equity position. Table 1 reveals that volatility speculation strategies like straddles are most popular among hedge fund managers: approximately 5% of total portfolio positions are initiated as straddles. This is followed by bull strategies and protective put strategies. Bear strategies (pure put option strategies) are the least popular among managers.

As mentioned earlier, although the absent of further information on the option's strike price and time-to-maturity precludes us to compute the option holdings value relative to the total portfolio value, we can use option's rational bound to estimate the maximum exposure a manager has in

the option market. It is well-known from basic option pricing theory that a call option's value is worth no more than the underlying stock and a put option is worth no more than its strike price. If a manager discloses a call position, we use the call option's underlying stock price as the maximum value the call option can attain. Similarly, if a manager discloses a put position, we use the maximum strike price of the option class (i.e. the set of all the put options for the stock) as the maximum value the put option can attain. Information on all exchange-traded equity options including prices and returns are obtained from OptionMetrics. We report the time series median of the estimated maximum option exposure across all managers. Table 1 shows, for a typical hedge fund, the estimated maximum exposure it has to the options market is standing only at 12.87%. Overall, the summary statistics suggest hedge funds options usage and exposure are rather low by expectations.

[Insert Table 1 here]

3 Performance of Hedge Fund Option Strategies

3.1 Individual Hedge Fund Option Holdings and Returns

In this section, we empirically investigate whether hedge fund managers are informed traders in the options market. For a start, we follow commonly used approach in the performance evaluation method by forming a tracking portfolio of options based on the manager's option holdings. Since it is not compulsory for hedge fund managers to reveal their options' strike price and time-to-maturity, we overcome this issue by imposing certain assumptions on our portfolio formation process.

As an example, we will illustrate how to form the tracking portfolio on hedge fund bull strategies (i.e. long call position) but similar procedures apply to hedge fund bear strategies. At the beginning of each month and for each manager, we form a hypothetical mimicking short-term ATM call option portfolio based on the manager's last quarter-end 13F disclosure. To be included in this option portfolio, we require the call option's time-to-maturity to be between 45 and 90 days and its absolute delta to be between 0.4 and 0.6 at the beginning of each formation month. The second

condition is the definition we adopt for ATM options in line with past studies. [8] We use the reported market value of these call option positions (i.e. the product of option prices and the number of option holdings) to construct the manager-specific portfolio weights. We then track the monthly raw returns of these tracking portfolios of all hedge fund managers over the subsequent months. It is noted, though, that the asymmetric nature of options leads to returns that are decidedly not normally distributed. For this reason, we report the time series median of these tracking portfolios across all hedge fund managers. We use the non-parametric one-sample sign test to assess whether the reported median returns are significantly different from zero. Unlike the t-test, sign test is known to be robust against both non-normality and non-symmetric distributional assumptions.

[Insert Table 2 here]

Table 2 Panel A reports the baseline results. With the exception in 2009, a quarterly tracking portfolio of short-term ATM options on hedge fund bull strategies either generates insignificant returns or significant negative monthly returns in all other years. Over the whole sample period, the tracking portfolio returns -1.722% per month. In the next two columns, we modify our tracking portfolio formation procedures: we use ATM call options but with longer time-to-maturity. For the medium-term (long-term) ATM tracking portfolio, we include all ATM call options whose maturity is between 90 and 135 (136 and 180 days). While the magnitude of underperformance is reduced, a medium-term ATM tracking portfolio still earns a negative monthly return of -0.121%. The median returns from a long-term ATM tracking portfolio, on the other hand, are not materially different from zero. In Panel B, the outcomes for a quarterly tracking portfolio of options on hedge fund bear strategies are even more dismal. For instance, a long-term ATM option portfolio gives significant negative monthly returns of -0.365%. Taken together, our results hardly suggest any evidence on hedge fund superior managerial speculative skills in the options market.

[8] Both short-term and at-the-money options are the most liquid and actively traded by market participants. In unreported table we observe approximately 78% of options traded have maturity less than 3 months. Using intraday option prices, Christoffersen et al. (2014) estimate that out-the-money options have the highest effective spreads, followed by at-the-money options and then in-the-money options. According to their estimates, effective spreads for out-the-money options could be twice as large as at-the-money options, on average.

Next, for completeness, we replicate the results documented in Aragon and Martin (2012). Like ours, in that paper the authors use the disclosed option positions to form a stock portfolio for each hedge fund manager at each quarter. Specifically, in a bullish tracking portfolio, the stock's portfolio weight equals the market value underlying the call positions on that stock divided by the aggregated market value underlying all reported call positions. Likewise, in a bearish portfolio the stock's portfolio weight equals the market value underlying the put positions on that stock divided by the aggregated market value underlying all reported put positions. We follow their approach and report the median bullish tracking stock portfolio returns in Table 2 Panel A. Consistent with Aragon and Martin (2012), we observe this tracking bullish portfolio is able to generate significant positive raw returns of 0.575% per month. While the tracking bearish portfolio is insignificant (Table 2 Panel B), the 0.576% difference between is highly significant (not reported). In the last column we decompose the performance of these tracking stock portfolios as in Daniel et al. (1997) (DGTW). The characteristic-adjusted measures for the bullish and bearish stock portfolio are -0.003% and -0.382% per month, respectively, and the difference of -0.379% is highly significant, in line with the findings by Aragon and Martin (2012).

Although the use of stock portfolios in Aragon and Martin (2012) bypasses the issue of unobservable options' strike price and time-to-maturity in the data, we argue such approach inevitably overlook many features, which are uniquely pertained to options. On one hand, since options are inherently leveraged securities, an increase (decrease) in the underlying stock price should increase the call (put) option value by a larger percentage. The implication of this statement is that we should observe a similar (or stronger) result if one forms a tracking option portfolio instead of a tracking stock portfolio. On the other hand, the nature of decaying time value component embedded in most options implies that option holders will lose money on average, ceteris paribus. The tracking option portfolio will perform worse than the tracking stock portfolio if the stock price remains about the same. While it is not clear which of these opposing forces will dominate on an ex-ante basis, empirically from the results in Table 2 we observe the quarterly tracking option portfolios of all maturities are inevitably struggling against the ravages of time value.

Next, we examine to what extent the results documented in Table 2 are influenced by the choice options' moneyness assumptions. Let Δ be the option's hedge ratio. In additional to ATM options, we define four other moneyness groups: (1) deep-out-of-the-money (DOTM) where $|\Delta| \in [0, 0.2)$, (2) out-of-the-money (OTM) where $|\Delta| \in [0.2, 0.4)$, (3) in-the-money (ITM) where $|\Delta| \in (0.6, 0.8]$, and (4) deep-in-the-money (DITM) where $|\Delta| \in (0.8, 1]$. Together with the previous three categories of option's maturity, we construct a total of 15 quarterly tracking portfolio of options based on hedge fund option strategies. We report the results in Table 3. Overall, we contend that our baseline conclusions are not significantly affected by the choice of option's moneyness. With the exception of long-term ITM and DITM tracking portfolios, we observe all other bullish tracking portfolios generate significant negative monthly returns. Perhaps even worst, neither any of the 15 bearish tracking portfolios demonstrates hedge fund managers' speculative skills in downside market.

[Insert Table 3 here]

An additional advantage in using exchange-traded options to form the tracking portfolio is we can investigate the hypothetical returns generated from mimicking hedge fund straddles strategies. Unlike directional strategies such as bulls and bears, straddles stand to earn the most should the underlying stock price moves unexpectedly large. To see whether hedge fund straddle strategies are profitable, we first retain all paired call and put options that share the same time-to-maturity and strike price. As in Table 2, we apply the same steps to construct short-term ATM quarterly tracking portfolios of options for each manager at each quarter. We report the time series median of the portfolio returns in Table 4. The short-term ATM option portfolio earns median raw returns of -1.265% per month from 1999:Q1 to 2012:Q3. Similar conclusions can be reached when we look at medium-term and long-term ATM option portfolios, albeit with slight improvement in returns. The bottom line is that we interpret this evidence as against the assertion that hedge fund managers are skilled in engaging volatility speculation activities.

[Insert Table 4 here]

3.2 Robustness Test 1: Aggregate Hedge Fund Holdings and Trading

In this section, we implement the performance evaluation approach used in Chen et al. (2000) with mutual funds. At the beginning of each month, we aggregate the option holdings for each underlying stock across all hedge fund managers according to their last quarter-end disclosed option strategies. For each strategy, we form a short-term ATM option portfolio and tracks the return earned from following these hedge fund aggregate positions. This approach naturally reflects the overall opinion or consensus of the hedge fund industry on their option investments.

As with previous section, the individual position's weight within the portfolio is based on the reported market value of option holdings at the beginning of each month. This will give us a time series return of the portfolio over 55 quarters or 165 monthly returns. We report the median returns and utilize sign test for statistical testing purposes. We repeat the portfolio construction process using both medium-term ATM and long-term ATM options.

[Insert Table 5 here]

If hedge fund managers have option selectivity skills, then stock option strategies widely used by managers should earn positive returns. Otherwise we should observe little or even negative relation between the returns and hedge fund option holdings. Panel A of Table 5 presents the median returns of our aggregate holding-based approach. The quarterly tracking portfolio of options generates significant negative returns across all strategy types. For example, a buy-and-hold bear strategy portfolio returns -1.241% per month and it is statistically significant at the 5% level. On the other hand, a buy-and-hold straddle strategy portfolio generates -0.887% per month. In addition, we also report the standard deviations of portfolio returns in brackets. Consistent with intuition, option returns are highly volatile. For instance, the estimated returns volatility for a short-term bullish portfolio is standing at 6% per month. These results cannot be explained by the choice of moneyness assumptions we imposed on the tracking option portfolios, as evidence from Table 5 Panel B in which we present the case for both bullish and bearish option strategies.

Chen et al. (2000) advocate the formation of tracking portfolios based on manager trades.

They argue trades reflect stronger manager's view on the market as compared to passive holding decisions, hence are better at capturing the managerial investment abilities in a more succinct manner. Intuitively, portfolios that track the manager's buy decisions (i.e. the net change in option position from the previous quarter is positive) should outperform portfolios that track the manager's sell decisions (i.e. the net change in option position from the previous quarter is negative). Similar approach has also been adopted in Yan and Zhang (2009) and Baik et al. (2010) among others.

To this end, we construct two separate portfolios: the buy portfolio and the sell portfolio. For each quarter-end and each disclosed option position, we compute the net change in the number of contracts held by hedge funds from the previous quarter. If the net change is positive we assign this position to the buy portfolio, otherwise we assign it to the sell portfolio. We then compute the buy-and-hold returns on these two trade portfolios by mimicking the changes in number of contracts during each quarter using long positions only. Under this approach, we expect that if hedge fund managers possess superior trading skills, options that are newly purchased should outperform while options that are newly sold or closed out should not outperform. The opposite of our expectation is that there is no relation between option returns and the trade directions i.e. there is no substantial return differentiations between the buy and sell portfolios. A non-parametric Wilcoxon two-sample test is used to gauge the statistical significance of the results.

Table 5 Panel C indicates that there is no substantial evidence on performance differentiation between the buy and sell portfolios. For instance, across all option strategies and time-to-maturity categories, the differences in returns between buys and sells are not significantly different from 0. We do not detect any material performance differentiation between the two portfolios.

3.3 Robustness Test 2: Subsample Analyses

We conduct a battery of additional checks in the subsequent sections. First, we make sure our results are not affected by hedge fund investment preferences. For example, unlike other institutional types such as mutual funds, Griffin and Xu (2009) document hedge funds generally prefer smaller and opaque value securities. We build on the methodology outlined in the previous section but divide

our sample of firms according to four dimensions: (1) firm size; (2) age; (3) book-to-market; and (4) share turnover. Stocks are divided based on the sample median of each characteristic.

[Insert Table 6 here]

Literature suggests that information asymmetry is the greatest among small and young stocks. If hedge fund option positions are speculative in nature, we would expect greater outperformance among these stocks. Against this prediction, however, is that we find option strategies on small stocks generally fare worst across all option trading strategies, ranging between -0.538% and -0.224% per month (see Table 6). These hedge fund option strategies are also equally likely to underperform between young vs. old stocks and value vs. growth stocks. Lastly, using share turnover as the proxy for stock uncertainty as suggested by Barinov (2014), we still find no evidence on substantial performance differentiation between stocks with high and low uncertainties.

3.4 Robustness Test 3: Evidence From Future Earnings Announcements

Our next robustness test involves testing whether hedge fund option positions possess private information by examining their relations with firm's future earnings news. Since earnings announcements are often regarded as one of the most important corporate event for market participants, there is a voluminous of research that attempt to identify the group of investors who can exploit the event. Existing literature suggests that professional manager trading is positively associated with subsequent earnings announcements. Ali et al. (2004) document certain institutional managers do trade on information about future firm performance as evidenced from the positive association between changes in holdings and subsequent earnings announcement returns. Ke and Petroni (2004) investigate the transient investors trading behavior before a break in a string of consecutive earnings increases. They find transient investors can predict the break at least one quarter in advance of the break quarter, consistent with transient institutions obtaining information regarding the impending break from private communications with management. Yan and Zhang (2009) and Baik et al.

(2010) also come to similar conclusions on the return predictability by transient investors and local investors, respectively.

We obtain quarterly earnings announcement dates from Compustat. We consider three different window periods to compute earnings announcement abnormal return: $[-5, 1]$, $[-3, 1]$, and $[-1, 1]$, with 0 being the event date. Our inclusion of one trading day later is motivated by Berkman and Truong (2009) who show a significant portion of firms report their earnings after the close of trading day. Thus, our choice of earnings announcement windows would ensure that price changes from the news dissemination is well-captured and reflected in our analyses. Similar to previous sections, we form a short-term ATM option portfolio at beginning of each announcement windows based on the last quarter-end hedge fund option strategies disclosure. We then compute the buy-and-hold returns achieved by the four option strategies over these windows.

[Insert Table 7 here]

Table 7 reports the estimation results for our event study approach. Although the sign for some of the returns of tracking option portfolio are positive, they are not precisely estimated. Furthermore, take the bull strategy as example, a return of 0.02% over a 5-day interval translates into an annualized return of 1.01% $(0.02 * (252/5))$, which is deemed to be marginal by economic magnitude. A protective put tracking option portfolio is the worst, earning median returns from -0.07% for a 7-day interval to -0.043% for a 3-day interval.

3.5 Robustness Test 4: Comparison with Other Institutional Investors

To complete our analyses, we compare the option strategies performance between hedge funds and other institutional investors. Griffin and Xu (2009) find that, over the whole 1986-2004 period, the difference in stock selection skills between hedge funds and mutual funds is 1.32% per year and is only marginally significant, leading the authors to raise serious questions about the perceived hedge fund superior managerial ability. From Section 2, ur 13F/Thomson Reuters data consists of $2,172$ non-hedge fund institutional managers. Of these, about 6% of these managers trade in the options

market, a figure that is significantly lower than hedge funds (30%). Table 8 reports the differences in option strategies performance of these two groups of investors. Contrary to prediction, hedge funds generally underperform non-hedge funds across all strategy types but the differences are not statistically significant. Our results seem to resonate well with the conclusion made by Griffin and Xu (2009).

[Insert Table 8 here]

3.6 Conclusion

This paper visits the literature on hedge fund performance targeting the usage of options by fund managers. Based on detailed investigations on their long option positions, we conclude there is little evidence that suggests hedge fund managers are skilled in executing informed trades in the options market. Hypothetical portfolios that copycat these hedge fund option strategies give significant negative monthly returns across all strategies. Nonetheless, we point out one drawback of our study is we may not be able to generalize our conclusions to other hedge fund derivative positions such as futures, swaps, or even short option positions, which are not observable in our data. Thus, future research that has access to such information may prove to be fruitful.

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Table 1: Hedge fund managers and their option positions.

This table reports, for each year, the number of hedge fund managers, percentage of managers who disclosed at least one option position, and average percentage of option positions in the manager's overall portfolio holdings. We also categorize the manager's option positions into different option strategies and report the corresponding percentage. Following Aragon and Martin (2012) strategy classifications, for each quarter and each manager's option position, we classify the observed option position as bull strategy if the manager reports a call option with or without an existing equity position; bear strategy if the manager reports a put option only; protective put strategy if the manager reports a put option with an existing equity position; and, straddle if the manager reports both call and put options simultaneously, with or without an existing equity position. We use option's rational bounds to provide a maximum estimate on manager's exposure to the options market, defined as the ratio of option position value over the total portfolio value. If a manager discloses a call position, we use the call option's underlying stock price as the maximum value the call option can attain. Similarly, if a manager discloses a put position, we use the maximum strike price of the option class (i.e. the set of all the put options for the stock) as the maximum value the put option can attain. We report the time series median of the estimated maximum option exposure across all managers. The sample period is from 1999:Q1 to 2012:Q3.

Year	**Number**	**Option user (%)**	**Option holdings (%)**	**Bull (%)**	**Bear (%)**	**Protective put (%)**	**Straddle (%)**	**Estimated maximum option exposure (%)**
1999	204	2.45	6.84	2.40	0.07	1.88	2.49	3.46
2000	252	6.35	7.18	2.22	0.11	2.08	2.76	3.52
2001	265	6.42	7.69	2.33	0.34	2.06	2.96	2.89
2002	315	7.30	12.62	4.11	0.65	3.29	4.58	3.79
2003	372	6.99	13.75	4.00	0.92	1.89	6.94	5.26
2004	429	11.89	12.98	3.38	1.77	3.93	3.91	6.96
2005	515	17.86	12.98	4.21	2.41	3.32	3.04	7.76
2006	609	17.73	14.72	4.17	1.82	4.34	4.40	10.28
2007	708	21.89	14.92	4.55	1.98	4.23	4.15	9.52
2008	774	25.97	19.49	5.94	2.18	5.70	5.66	10.51
2009	793	22.82	17.27	5.16	1.85	4.92	5.34	11.63
2010	827	26.48	17.46	4.80	2.03	4.89	5.75	11.83
2011	883	26.95	16.40	4.51	2.15	4.78	4.96	13.21
2012	871	28.36	15.81	4.51	2.26	4.20	4.84	12.87

Table 2: Performance of quarterly tracking portfolio of options on hedge fund's directional option strategies.

This table reports the median returns of quarterly tracking portfolio of options on individual hedge funds quarter-end directional option strategies. The sample period is between 1999:Q1 and 2012:Q3. Panel A and B report results for portfolios that track the hedge fund's bull and bear strategies, respectively. Following Aragon and Martin (2012) strategy classifications, for each quarter and each manager's option holding position, we classify the observed option position as bull strategy if the manager reports a call option with or without an existing equity position; and bear strategy if the manager reports a put option only. At the beginning of each month, we form a short-term at-the-money (ATM) tracking portfolio of options based on manager's last quarter-end bull strategies. This portfolio includes all call options whose maturity is between 45 and 90 days and absolute delta is between 0.4 and 0.6 at the beginning of that month. The reported market value of option holdings (i.e. the product of option prices and the number of option contracts) are used to construct the individual manager's portfolio weights. We track the monthly raw returns of these weighted portfolios over the subsequent months. We report the time series of the median raw return across all hedge fund managers. We also report the median raw return for a medium-term ATM and long-term ATM tracking portfolio of options. Medium-term ATM (long-term ATM) tracking portfolio is formed using call options whose maturity is between 91 and 135 (136 and 180) days and absolute delta is between 0.4 and 0.6. In the last two columns, we report the results for portfolios that are long stocks underlying reported bull options holdings as in Aragon and Martin (2012). Here, quarterly reported underlying notional values of option holdings for bull is used to construct manager portfolios of the underlying common stock. Monthly raw returns and performance of these portfolios are generated over the subsequent months. We also compute the Daniel et al. (1997) characteristic-based benchmark-adjusted return for these portfolios. Similar procedures apply in constructing the tracking portfolios of options based on hedge fund's bear strategies, as reported in Panel B. A one-sample nonparametric sign test is used to test whether the reported median returns are significantly differed from 0. Standard deviations of portfolio returns are reported in parentheses. The superscripts $*$, $**$, and $***$ indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Bull

Year	Short-term	Medium-term	Long-term	Stock	DGTW
1999	-2.829*	-0.221	-1.607	0.503	0.27
2000	-7.162***	-0.175	-2.469***	-1.721	-0.717
2001	-2.535**	-0.431	-0.736	1.086	0.435
2002	-3.718***	-1.433***	-1.711***	-1.713***	0.527
2003	0.294	0.661*	1.954***	1.569***	0.385*
2004	-0.715**	-0.002	0.719**	0.838***	-0.142
2005	-1.396***	-0.141*	-0.175	0.516**	-0.218
2006	-1.153***	-0.154**	0.39**	0.943***	0.111
2007	-2.533***	-0.186***	-0.491***	-0.991***	-0.342***
2008	-4.256***	-0.98***	-2.08***	-3.328***	-0.146
2009	0.711***	0.574***	3.462***	4.203***	1.295***
2010	-0.299	0.404***	0.88***	1.686***	-0.469***
2011	-1.81***	-0.104*	-0.777***	-0.03	-1.42***
2012	-1.561***	-0.222**	0.205	0.29	2.49***
1999-2006	-1.522***	-0.158***	0.103	0.641***	-0.015
	(14.418)	(12.107)	(15.459)	(8.399)	(6.946)
2007-2012	-1.785***	-0.11***	0	0.536***	0.002
	(13.588)	(12.836)	(17.202)	(12.427)	(10.509)
1999-2012	-1.722***	-0.121***	0.014	0.575***	-0.003
	(13.763)	(12.69)	(16.847)	(11.631)	(9.804)

Panel B: Bear

Year	Short-term	Medium-term	Long-term	Stock	DGTW
1999	-1.963	-0.588	-1.09	-0.092	3.745
2000	1.87	3.975	5.096	-8.558*	-1.24
2001	-2.157*	-0.709**	0.53	-1.844	-3.164
2002	-0.518	0.249	0.829**	-3.212***	-0.675
2003	-3.185***	-0.64***	-1.2***	2.847***	1.392**
2004	-1.773***	-0.08	-0.706***	0.227	-0.443
2005	-1.966***	-0.45***	-0.522**	0.599*	-0.125
2006	-1.797***	-0.358***	-0.32	0.37	-0.138
2007	0.074	0.11**	1.636***	-2.478***	-1.805***
2008	0.268	0.346**	2.633***	-5.887***	-1.37***
2009	-4.402***	-1.335***	-3.035***	4.479***	1.4***
2010	-3.327***	-0.949***	-1.461***	1.816***	-0.361
2011	-1.971***	-0.391***	-0.004	-0.59*	-1.899***
2012	-1.385***	-0.441***	-0.756***	-0.435	2.879***
1999-2006	-1.992***	-0.303***	-0.444***	0.395**	-0.149
	(10.283)	(10.585)	(12.94)	(10.17)	(8.993)
2007-2012	-1.856***	-0.386***	-0.34***	-0.225	-0.487***
	(10.698)	(9.347)	(14.229)	(13.427)	(11.647)
1999-2012	-1.894***	-0.366***	-0.365***	-0.001	-0.382***
	(10.617)	(9.62)	(13.972)	(12.743)	(11.067)

Table 3: Performance of quarterly tracking portfolio of options on hedge fund's directional option strategies - moneyness assumptions.

This table reports the median returns of quarterly tracking portfolio of options on individual hedge funds quarter-end directional option strategies. The sample period is between 1999:Q1 and 2012:Q3. Panel A and B report results for portfolios that track the hedge fund's bull and bear strategies, respectively. Following Aragon and Martin (2012) strategy classifications, for each quarter and each manager's option holding position, we classify the observed option position as bull strategy if the manager reports a call option with or without an existing equity position; and bear strategy if the manager reports a put option only. Let $|\Delta|$ be the option's hedge ratio. We divide the option's moneyness into 5 groups: deep-out-of-the-money (DOTM) where $|\Delta| \in [0, 0.2)$; out-of-the-money (OTM) where $|\Delta| \in [0.2, 0.4)$; at-the-money (ATM) where $|\Delta| \in [0.4, 0.6]$; in-the-money (ITM) where $|\Delta| \in (0.6, 0.8]$; and deep-in-the-money (DITM) where $|\Delta| \in (0.8, 1]$. For each of this moneyness group, at the beginning of each month, we form a short-term tracking portfolio of options based on manager's last quarter-end bull strategies. For instance, a short-term DOTM tracking portfolio of options includes all call options whose maturity is between 45 and 90 days and $|\Delta| \in [0, 0.2)$ at the beginning of that month. The reported market value of option holdings (i.e. the product of option prices and the number of option contracts) are used to construct the individual manager's portfolio weights. We track the monthly raw returns of these weighted portfolios over the subsequent months. We report the median raw return across all hedge fund managers. We also report the median raw return for a medium-term ATM and long-term ATM tracking portfolio of options. Medium-term ATM (long-term ATM) tracking portfolio is formed using call options whose maturity is between 91 and 135 (136 and 180) days and absolute delta is between 0.4 and 0.6. Similar procedures apply in constructing the tracking portfolios of options based on hedge fund's bear strategies, as reported in Panel B. Standard deviations of portfolio returns are reported in parentheses. A one-sample nonparametric sign test is used to test whether the reported median returns are significantly differed from 0. Standard deviations of portfolio returns are reported in parentheses. The superscripts $*$, $**$, and $***$ indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Bull			
Moneyness	**Short-term**	**Medium-term**	**Long-term**
DOTM	-1.824***	-0.386***	-0.384***
	(44.502)	(54.632)	(44.433)
OTM	-2.383***	-0.284***	-0.199***
	(20.713)	(18.023)	(24.632)
ATM	-1.722***	-0.121***	0.014
	(13.763)	(12.69)	(16.847)
ITM	-0.869***	0	0.132***
	(8.282)	(7.652)	(11.799)
DITM	-0.55***	0	0.03*
	(5.96)	(5.326)	(6.921)
Panel B: Bear			
Moneyness	**Short-term**	**Medium-term**	**Long-term**
DOTM	-3.19***	-1.176***	-1.626***
	(23.566)	(27.278)	(23.835)
OTM	-2.735***	-0.645***	-0.837***
	(17.321)	(18.617)	(18.223)
ATM	-1.894***	-0.366***	-0.365***
	(10.617)	(9.62)	(13.972)
ITM	-1.219***	-0.193***	-0.172***
	(49.251)	(8.421)	(10.42)
DITM	-0.762***	-0.211***	-0.201***
	(7.334)	(5.684)	(6.603)

Table 4: Performance of quarterly tracking portfolio of options on hedge fund's straddle option strategies.

This table reports the median returns of quarterly tracking portfolio of options on individual hedge funds quarter-end straddle option strategies. The sample period is between 1999:Q1 and 2012:Q3. Following Aragon and Martin (2012) strategy classifications, for each quarter and each manager's option holding position, we classify the observed option position as straddle if the manager reports both call and put options simultaneously, with or without an existing equity position. At the beginning of each month, we form a short-term at-the-money (ATM) tracking portfolio of options based on manager's last quarter-end straddle strategies. We retain all paired call and put option that share the same time-to-maturity and strike price. This portfolio includes all paired call and put options whose maturity is between 45 and 90 days, and absolute delta is between 0.4 and 0.6 at the beginning of that month. The reported market value of option holdings (i.e. the product of option prices and the number of option contracts) are used to construct the individual manager's portfolio weights. We track the monthly raw returns of these weighted portfolios over the subsequent months. We report the time series of the median raw return across all hedge fund managers. We also report the median raw return for a medium-term ATM and long-term ATM tracking portfolio of options. Medium-term ATM (long-term ATM) tracking portfolio is formed using call options whose maturity is between 91 and 135 (136 and 180) days and absolute delta is between 0.4 and 0.6. A one-sample nonparametric sign test is used to test whether the reported median returns are significantly differed from 0. Standard deviations of portfolio returns are reported in parentheses. The superscripts $*$, $**$, and $***$ indicate significance at the 10%, 5%, and 1% levels, respectively.

Year	**Short-term**	**Medium-term**	**Long-term**
1999	-0.884	0.914	0.262
2000	-0.558	0.038	0.505
2001	-1.192***	-0.134	-0.182
2002	-1.366***	-0.156*	-0.409*
2003	-1.275***	-0.062	-0.441***
2004	-1.188***	-0.194*	-0.42**
2005	-1.079***	-0.175**	-0.403***
2006	-0.95***	-0.099	-0.081
2007	-0.723***	-0.076*	0.225
2008	-1.104***	-0.103**	-0.032
2009	-1.716***	-0.271***	-0.983***
2010	-1.31***	-0.237***	-0.56***
2011	-1.645***	-0.208***	-0.109
2012	-1.724***	-0.245***	-0.811***
1999-2006	-1.099***	-0.094***	-0.269***
	(5.22)	(3.731)	(4.554)
2007-2012	-1.366***	-0.187***	-0.359***
	(7.163)	(6.284)	(8.209)
1999-2012	-1.265***	-0.168***	-0.336***
	(6.776)	(5.776)	(7.523)

Table 5: Performance of hedge fund option strategies - an aggregate approach.

This table reports the median returns of quarterly tracking portfolio of options based on aggregate hedge funds quarter-end option strategies using Chen et al. (2000) approach. The sample period is between 1999:Q1 and 2012:Q3. Following Aragon and Martin (2012) strategy classifications, for each quarter and manager's option holding position, we classify the observed option position as bull strategy if the manager reports a call option with or without an existing equity position; bear strategy if the manager reports a put option only; protective put strategy if the manager reports a put option with an existing equity position; and, straddle if the manager reports both call and put options simultaneously, with or without an existing equity position. At the end of each quarter, we compute the aggregate hedge funds' option positions for each stock according to the strategy classifications. To illustrate, in Panel A, at the beginning of each month, we form a short-term at-the-money (ATM) tracking portfolio of options based on last quarter-end bull strategies of all managers. This portfolio includes all call options whose maturity is between 45 and 90 days and absolute delta is between 0.4 and 0.6 at the beginning of that month. The reported market value of option holdings (i.e. the product of option prices and the number of option contracts) are used to construct the portfolio weights. We track the monthly raw returns of these weighted portfolios over the subsequent months. We report the median raw return across all months. We also report the median raw return for a medium-term ATM and long-term ATM tracking portfolio of options. Medium-term ATM (long-term ATM) tracking portfolio is formed using call options whose maturity is between 91 and 135 (136 and 180) days and absolute delta is between 0.4 and 0.6. This procedure applies similarly to bear, protective put, and straddle strategies. In Panel B, we assess whether the bull and bear results in Panel A are robust against moneyness assumptions. Let $|\Delta|$ be the option's hedge ratio. We divide the option's moneyness into 5 groups: deep-out-of-the-money (DOTM) where $|\Delta| \in [0, 0.2)$; out-of-the-money (OTM) where $|\Delta| \in [0.2, 0.4)$; at-the-money (ATM) where $|\Delta| \in [0.4, 0.6]$; in-the-money (ITM) where $|\Delta| \in (0.6, 0.8]$; and deep-in-the-money (DITM) where $|\Delta| \in (0.8, 1]$. For each of this moneyness group, at the beginning of each month, we form a short-term tracking portfolio of options based on manager's last quarter-end bull or bear strategies. We track the monthly raw returns over the subsequent months and report the median return. In Panel C, we form a short-term quarterly tracking portfolio of options based on hedge funds net trading positions. For each quarter-end and each disclosed option position, we compute the net change in the number of contracts held by hedge funds from the previous quarter. If the net change is positive we assign this position to the buy portfolio, otherwise we assign it to the sell portfolio. We then compute the buy-and-hold returns on these two trade portfolios by mimicking the changes in number of contracts during each quarter using long positions only. A one-sample nonparametric sign test is used to test whether the reported median returns are significantly differed from 0. A Wilcoxon two-sample test is used to test whether the returns between the buy portfolio and sell portfolio are significantly different from each other. Standard deviations of portfolio returns are reported in parentheses. The superscripts $*$, $**$, and $***$ indicate significance at the 10%, 5%, and 1% levels, respectively.

- Continued on next page -

Panel A: Holding-based approach			
Strategy	**Short-term**	**Medium-term**	**Long-term**
Bull	-1.411**	0.191	2.362***
	(5.993)	(5.144)	(6.563)
Bear	-1.241**	-0.021	0.591
	(4.312)	(8.139)	(6.605)
Protective Put	-1.588***	-0.136	0.01
	(4.334)	(3.182)	(5.184)
Straddle	-0.887***	-0.02	0.058
	(1.693)	(1.772)	(2)
Panel B: Moneyness assumptions			
Strategy	**Moneyness**	**Return**	**Standard Deviation**
Bull	DOTM	-0.937*	(16.287)
	OTM	-1.575**	(7.777)
	ATM	-1.411**	(5.99)
	ITM	-0.637*	(3.761)
	DITM	-0.508***	(2.958)
Bear	DOTM	-2.729***	(8.999)
	OTM	-1.998***	(6.303)
	ATM	-1.241**	(4.312)
	ITM	-0.924**	(4.452)
	DITM	-0.785***	(3.526)
Panel C: Trading-based approach			
Strategy	**Buy**	**Sell**	**Buy-minus-sell**
Bull	-1.247	-0.685**	-0.562
	(9.507)	(6.407)	
Bear	-1.019**	-1.185***	0.166
	(4.192)	(5.272)	
Protective Put	-1.649***	-1.676***	0.027
	(4.604)	(4.595)	
Straddle	-0.946***	-0.891***	-0.055
	(2.003)	(2.28)	

Table 6: Performance of hedge fund option strategies - subsample analyses.

This table reports the median returns of quarterly tracking portfolio of options based on aggregate hedge funds quarter-end option strategies using Chen et al. (2000) approach. The sample period is between 1999:Q1 and 2012:Q3. We classify stocks into four dimensions (size, age, book-to-market ratio, and share turnover) based on the median cutoff point in our sample. Following Aragon and Martin (2012) strategy classifications, for each quarter and manager's option holding position, we classify the observed option position as bull strategy if the manager reports a call option with or without an existing equity position; bear strategy if the manager reports a put option only; protective put strategy if the manager reports a put option with an existing equity position; and, straddle if the manager reports both call and put options simultaneously, with or without an existing equity position. At the end of each quarter, we compute the aggregate hedge funds' option positions for each stock according to the strategy classifications. To illustrate, In Panel A, at the beginning of each month, we form a short-term at-the-money (ATM) tracking portfolio of options based on last quarter-end bull strategies of all managers. This portfolio includes all call options whose maturity is between 45 and 90 days and absolute delta is between 0.4 and 0.6 at the beginning of that month. The reported market value of option holdings (i.e. the product of option prices and the number of option contracts) are used to construct the portfolio weights. We track the monthly raw returns of these weighted portfolios over the subsequent months. We report the median raw return. This procedure applies similarly to bear, protective put, and straddle strategies. A one-sample nonparametric sign test is used to test whether the reported median returns are significantly differed from 0. A Wilcoxon two-sample test is used to test whether the returns between the two portfolios are significantly different from each other. Standard deviations of portfolio returns are reported in parentheses. The superscripts $*$, $**$, and $***$ indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Size

Strategy	**Small**	**Large**	**Difference**
Bull	-1.452***	-1.228*	-0.224
	(12.413)	(6.06)	
Bear	-1.65***	-1.319***	-0.331***
	(6.635)	(4.595)	
Protective Put	-2.301***	-1.763***	-0.538**
	(14.818)	(4.411)	
Straddle	-1.29***	-0.885***	-0.405***
	(4.668)	(1.771)	

Panel B: Age

Strategy	**Young**	**Old**	**Difference**
Bull	-0.933*	-1.355***	0.422
	(8.074)	(5.288)	
Bear	-1.577***	-1.473***	-0.104
	(6.476)	(5.143)	
Protective Put	-1.908***	-1.784***	-0.124
	(5.345)	(4.742)	
Straddle	-0.681***	-0.884***	0.203
	(2.265)	(1.894)	

Panel C: Book-to-market

Strategy	**Growth**	**Value**	**Difference**
Bull	-1.061*	-0.921**	-0.14
	(6.761)	(6.024)	
Bear	-1.54***	-1.209***	-0.331
	(5.121)	(7.159)	
Protective Put	-1.974***	-1.007***	-0.967
	(4.703)	(4.649)	
Straddle	-0.972***	-0.986***	0.014
	(2.052)	(3.179)	

Panel D: Share Turnover

Strategy	**Low**	**High**	**Difference**
Bull	-1.209***	-1.101	-0.108
	(4.956)	(7.183)	
Bear	-1.761***	-0.967***	-0.794
	(5.274)	(4.89)	
Protective Put	-1.648***	-2.037***	0.389
	(4.581)	(5.253)	
Straddle	-0.776***	-0.947***	0.171
	(2.121)	(2.136)	

Table 7: Performance of hedge fund option strategies - returns on future earnings announcements.

This table reports the median returns of quarterly tracking portfolio of options over different earnings announcement intervals based on hedge funds quarter-end option strategies disclosures using Chen et al. (2000) aggregation approach. The sample period is between 1999:Q1 and 2012:Q3. Following Aragon and Martin (2012) strategy classifications, for each quarter and manager's option holding position, we classify the observed option position as bull strategy if the manager reports a call option with or without an existing equity position; bear strategy if the manager reports a put option only; protective put strategy if the manager reports a put option with an existing equity position; and, straddle if the manager reports both call and put options simultaneously, with or without an existing equity position. We report the median portfolio returns achieved in three different earnings announcement intervals: $[-1, 1]$, $[-3, 1]$, and $[-5, 1]$. For each earnings announcement interval, we form a short-term at-the-money (ATM) tracking portfolio of options based on last quarter-end bull strategies of all managers. This portfolio includes all call options whose maturity is between 45 and 90 days and absolute delta is between 0.4 and 0.6 at the beginning of the event window. The reported market value of option holdings (i.e. the product of option prices and the number of option contracts) are used to construct the portfolio weights. A one-sample nonparametric sign test is used to test whether the reported median returns are significantly differed from 0. Standard deviations of portfolio returns are reported in parentheses. The superscripts $*$, $**$, and $***$ indicate significance at the 10%, 5%, and 1% levels, respectively.

Strategy	**[-1,1]**	**[-3,1]**	**[-5,1]**
Bull	0.007	0.02	0.002
	(0.308)	(0.21)	(0.266)
Bear	0.002	-0.021	-0.015
	(0.439)	(0.664)	(0.603)
Protective Put	-0.043***	-0.063**	-0.066**
	(0.444)	(0.173)	(0.41)
Straddle	0.014	0.004	0.009
	(0.056)	(0.061)	(0.058)

Table 8: Performance comparisons between hedge funds and other institutional investors.

This table reports the median returns of quarterly tracking portfolio of options on both hedge funds and other institutional investors quarter-end option strategies disclosures using Chen et al. (2000) aggregation approach. The sample period is between 1999:Q1 and 2012:Q3. Following Aragon and Martin (2012) strategy classifications, for each quarter and manager's option holding position, we classify the observed option position as bull strategy if the manager reports a call option with or without an existing equity position; bear strategy if the manager reports a put option only; protective put strategy if the manager reports a put option with an existing equity position; and, straddle if the manager reports both call and put options simultaneously, with or without an existing equity position. At the end of each quarter, we compute the aggregate hedge funds' option positions for each stock according to the strategy classifications. To illustrate, In Panel A, at the beginning of each month, we form a short-term at-the-money (ATM) tracking portfolio of options based on last quarter-end bull strategies of all managers. This portfolio includes all call options whose maturity is between 45 and 90 days and absolute delta is between 0.4 and 0.6 at the beginning of that month. The reported market value of option holdings (i.e. the product of option prices and the number of option contracts) are used to construct the portfolio weights. We track the monthly raw returns of these weighted portfolios over the subsequent months. We report the median raw return. This example applies similarly to bear strategy, protective put strategy, and straddle strategy. We repeat this for other institutions as well. A one-sample nonparametric sign test is used to test whether the reported median returns are significantly differed from 0. A Wilcoxon two-sample test is used to test whether the returns between the two portfolios are significantly different from each other. Standard deviations of portfolio returns are reported in parentheses. The superscripts $*$, $**$, and $***$ indicate significance at the 10%, 5%, and 1% levels, respectively.

Strategy	**Hedge funds**	**Other institutional investors**	**Difference**
Bull	-1.411**	-0.935	-0.476
	(5.993)	(6.234)	
Bear	-1.241**	-1.642***	0.401
	(4.312)	(4.276)	
Protective put	-1.588***	-1.432***	-0.156
	(4.334)	(4.098)	
Straddles	-0.887***	-0.874***	-0.013
	(1.693)	(1.884)	