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Abstract

Using detailed options holdings, we examine how mutual funds' use of options affects performance and risk. Using options generates, on average, no performance advantages. In fact, funds that follow certain distinct strategies underperformed. The only salutary impact is lower portfolio risk for a subset of funds that buy puts for insurance. Perhaps wanting to limit additional losses, these funds also respond to poor performance in the first part of the year by reducing portfolio risk. Our findings suggest no permanent or temporary aggressive risk taking by options users, suggesting instead that some funds use options primarily for risk management.

I. Introduction

Can large institutional investors expertly utilize complex securities? This question has attracted renewed interest after large financial institutions incurred heavy losses from their trades in credit default swaps and collateralized debt obligations at the onset of the recent financial crisis.[1] However, addressing this question in a comprehensive manner has been difficult due to the many complex securities that exist and the unavailability of data on how these securities are used by financial institutions. In this study we provide an extensive analysis on the use of one such complex security by a popular class of large institutional investors. Specifically, we examine the use of exchange-traded equity and index options by mutual funds. Our detailed options holdings data of all US-based equity mutual funds allows us to address controversial issues related to the use of options by mutual funds and the corresponding effect on the underlying fund investors.

Advantages from using options have been discussed in the business press, where mutual funds that invest in options are sometimes touted as superior investment choices.[2] Academics have also pointed to hypothesized benefits from the use of options either through enhanced performance or better risk management (Scholes (1981), Stoll and Whaley (1985), Merton (1995), and Koski and Pontiff (1999)). The view that options users can generate better performance than nonusers is supported by two arguments: First, several studies suggest that options markets attract informed investors who "…may choose to deal in options when [they]

[1] The incompetent use of these complex securities led to the collapse of Bear Stearns, Lehman Brothers, and Merrill Lynch, while it caused heavy losses for other large institutions, with AIG suffering some of the heaviest losses.

[2] Although most articles in the business press present a balanced view of the risk-reward trade-offs faced by funds that invest in options (see, e.g., Liase (2007)), some articles point to funds that use options as superior investment vehicles. For example Richards (2007) announces at the beginning of his article that "If you want a fund that offers a high level of income and limited exposure to the rises and falls of the stock market, then a covered call fund could be the one for you". Another article covering funds that specialize in a particular option trading strategy refers to the underlying strategy as "one of the investment community's best kept money-making techniques" (Investors Chronicle (2007)).

feel [they have] an especially important piece of information" [Black 1975, p. 61].[3] Thus, mutual funds that trade options could represent informed investors that better use their information by achieving stock-specific exposure for a fraction of the cost of buying stock shares directly (Koski and Pontiff (1999), Deli and Varma (2002), Almazan, Brown, Carlson, and Chapman (2004)). Another argument in support of superior performance among options users is based on the fact that using options requires specialized knowledge of options markets and options pricing. Such capabilities, which go beyond mutual fund managers' conventional skills, could suggest a higher degree of sophistication and therefore superior performance among options users.[4]

Skeptics, however, point to what happened in the case of Orange County, Baring's Bank, and Long Term Capital Management to question the value created through the use of options by large financial institutions. One concern is that mutual fund managers could use these securities to take excessive risks that adversely affect fund investors. Echoing such concerns, regulators are considering changes in the laws that regulate the mutual funds' use of derivatives and the disclosure of the associated risks (Donohue (2009)). Another concern is that trading options places mutual funds at an informational disadvantage relative to their trading counterparties, resulting in inferior performance. The informational disadvantage is potentially caused by mutual funds facing a larger fraction of institutional investors among their trading counterparties in the option markets[5], some of which, for example hedge funds, have proved to be skilled traders (see, e.g., Aragon and Martin (2012)).

[3] See also Sarin, and Shastri (1992); Easley, O'Hara, and Srinivas (1998); Chakravarty, Gulen, and Mayhew (2004); Cao, Chen, and Griffin (2005); and Pan and Poteshman (2006) who show that information is transmitted into option prices and volumes before making its way into stock prices, suggesting the presence of informed trading activity in the options markets.
[4] In fact, recognizing that a different set of skills is required when using options, some fund companies use different portfolio managers to separately manage the stock and the option parts of the fund portfolios, suggesting that options are not for every mutual fund manager (see, e.g., Pressman (2005)).
[5] The reason for this is that the option market contains a smaller fraction of retail investors relative to the stock market.

Given these opposing views we investigate two basic questions: (1) what types of mutual funds or portfolio managers are more likely to use options? and (2) how does option usage affect mutual fund performance and risk characteristics?

Using detailed holdings of mutual funds at the option position level, we identify 25,789 equity and index option positions held by 250 U.S. equity mutual funds during July 2003-December 2010. Mutual funds use two main strategies, *income* strategies and *directional* strategies. Income strategies, intended to generate income, involve covered call or put writing, with covered call writing alone comprising about 60 percent of all option positions.[6] Directional strategies involve purchasing calls or puts to obtain higher positive or negative exposure in a particular stock.

Relating the use of options to mutual fund and manager characteristics, we show that certain mutual funds and portfolio managers are more likely to use options than others. The fund characteristics we explore are assets, expense ratios, past returns, and past return volatility, while the portfolio manager characteristics are age, tenure, educational degrees, GMAT scores, and gender. Funds with larger assets under management and higher expense ratios show a stronger propensity to use options. Manager characteristics reflecting different aspects of human capital appear to be related with the likelihood of using options. For example, more experience due to a longer tenure makes portfolio managers less likely to employ options in their portfolios. Among portfolio managers that hold an MBA degree, those with higher GMAT score are less likely to use options, suggesting that a higher level of academic aptitude leads managers to stay away from riskier types of securities. Another interesting finding is that female portfolio managers are

[6] The documented prevalence of call writing is consistent with the increased popularity of covered call strategies among mutual funds discussed in the business press (see, e.g., Tan (2001), Liase (2007), Richards (2007), and Investors Chronicle (2007)).

less likely to use options than their male peers, a result which is similar with Barber and Odean's (2001) finding that men are more overconfident and trade a lot more than women.

Our results from performance and risk comparisons between options users and nonusers prove inconsistent with the view that options users as a group are able to generate superior performance relative to nonusers by leveraging their information in the options markets. In fact the risk-adjusted performance of options users, on average, is no better or worse than that of nonusers. Nor do our results reveal overall differences in risk characteristics between options users and nonusers.

Insights from overall comparisons between user and nonusers are potentially limited by cross-sectional differences among options users related to how they use options in their portfolios, in terms of both extent and purpose. Thus, we extend our comparisons to account for such differences. First, recognizing that some mutual funds use options to a greater extent than others, we categorize options users into heavy and light users. Second, recognizing that mutual funds employ options to pursue different strategies, we categorize users into call writers, put writers, call buyers, and put buyers.

Our results support the view that the impact of options on portfolio performance and risk depend on how options are employed in portfolios. For example, we find that put writers underperformed nonusers during our sample period by an economically and significant amount. A similar performance differential is documented for heavy call buyers. We also document that heavy put buyers exhibited significantly lower systematic, downside, and total portfolio risk than nonusers. This result is not that surprising since buying puts for insurance can potentially limit downside of portfolio returns. Taken together, our findings suggest that reliance on options generates no performance advantages relative to other mutual funds that do not use options and

that the only salutary impact of options is restricted to a subset of funds that lower portfolio risk by buying puts for insurance.

In further analysis, we explore whether options are used to increase portfolio risk towards the end of the year in response to poor performance in the earlier part of the year (see, e.g., Brown, Harlow, and Starks (1996)). Our results prove inconsistent with differential risk-taking behavior over shorter periods within the calendar year: Relative to nonusers, options users, on average, do not show a differential tendency to increase portfolio risk towards the end of the year in response to poor performance in the first part of the year. On the contrary, perhaps wanting to limit additional losses, options users that predominantly purchase puts show a stronger tendency than nonusers to reduce systematic portfolio risk in response to poor performance in the first part of the year. Thus, our findings disprove both long-term and short-term aggressive risk taking by options users and instead suggest that some mutual funds use options primarily for risk management.

A related study by Aragon and Martin (2012) examines option trading in a different setting. Specifically, they analyze option holdings for a subset of 250 hedge funds, showing that hedge funds are skilled at using options for speculative purposes. However, since their data exclude positions on written options, only a partial view of the entire portfolio of options is provided. Because our study makes use of the entire portfolio of options of each mutual fund, including long as well as written options, we are able to analyze the use of options by mutual funds in a comprehensive manner. Furthermore, our finding that some mutual funds that use options suffer from weaker performance, combined with the finding of Aragon and Martin (2012) that hedge funds trade options in a profitable manner, suggests diverse abilities in the use of options among different types of institutional investors.

To the best of our knowledge, this is the first study to examine issues related to the use of options by mutual funds by analyzing mutual fund option holdings. Koski and Pontiff (1999), Deli and Varma (2002), Almazan, Brown, Carlson, and Chapman (2004) examined related issues by analyzing and comparing funds that were allowed to use derivatives with funds that were not. Chen (2011) compared hedge funds that self-reported use of derivatives to TASS, a commercial database, with hedge funds that did not. Our study makes several contributions to this literature: First, rather than looking at funds that are allowed to use derivatives, our study analyzes funds that are actual users of derivatives. This is an important dimension for analyzing the interaction between mutual funds and derivative markets since Almazan, Brown, Carlson, and Chapman (2004) show that only a small fraction of the funds that are allowed to use derivatives actually do so. Second, rather than relying on self-reported data such as the data captured by TASS for hedge funds, or partial data such as options positions in 13F reports, or our study uses complete option holdings data that mutual funds are mandated to report to the SEC by law. Third, our study provides a more granular analysis. One way we do this is by providing direct insight as to how mutual funds use options. Another way is by differentiating funds based on the amount of options usage and the type of strategies that they follow and relating these differentiating characteristics to fund performance and risk characteristics.

The remainder of the paper is organized as follows: Section II discusses regulatory issues related to the use of options by mutual funds. Data description and some initial analysis are provided in Section III. Section IV compares performance and risk characteristics between options users and nonusers. Risk shifting behavior of options users within the calendar year is examined in Section V. Section VI concludes.

II. Brief Discussion of the Legal Environment

A. Disclosure

As stipulated by the Securities Act of 1933 and Investment Company Act of 1940, a mutual fund must disclose its current use of options or its intention to use options to current and potential investors in its prospectus. The amount of disclosure related to options risk is determined by the extent to which a mutual fund is involved in options activities. For example, if less than five percent of a fund's assets are at risk in options positions, the prospectus is at most required to disclose the nature of the options-related activities without additional detail. However, since prospectus disclosure concerning derivatives has received special attention from the SEC in more recent years, and because funds might involuntarily exceed the five percent cut-off point due to changes in market values, mutual funds have been strongly advised to include appropriate risk disclosure in their prospectuses, regardless of the proximity to the 5% threshold.[7] Further, the current use or proposed use of options by mutual funds should be compatible with the fund's investment objective as detailed by the fund policies and investment restriction laid out in the prospectus.

B. Restrictions on Leverage

Section 18(f) of the Investment Company Act of 1940 limits the use of leverage by mutual funds. Writing of uncovered options is viewed as creating "leverage" and is therefore viewed as a violation of Section 18(f). Mutual funds are allowed to write options, however, as long as they comply with the *asset coverage requirement* established by the SEC. This requirement can be satisfied by one of the following two methods: The first method allows writing of options as long the fund holds the underlying security or on offsetting option position. The second method

[7] See Chicago Board Options Exchange (2001)

requires a fund to set aside a segregated, custodial account consisting of cash, U.S. government securities, or high-grade debt securities in an amount at least equal in value to the optioned securities. The example below illustrates how Value Line Asset Allocation Fund complies with the asset coverage requirement when writing options (Prospectus (August 1, 2008))[8]:

> "The Fund will write call options only if they are secured. A call option is "secured" if the Fund owns the securities underlying the call, if the Fund holds a call at the same exercise price for the same exercise period and on the same securities as the call written, or if the Fund establishes with its custodian at the time it writes the call, and maintains for the term of the option, a segregated account consisting of cash, U.S. Government Securities or other high-grade debt securities equal to the fluctuating market value of the optioned securities. The segregated account will be adjusted at least daily to reflect changes in the market value of the optioned securities."

III. Data and Sample Statistics

We describe the various data sources used to build our database. Next, we next explain how we identify option positions and funds that use options. Following that, we provide sample descriptive statistics and an initial set of tests.

A. Databases

We used two main data sources to build our database of options positions of U.S. equity mutual funds: (1) the CRSP Survivor-Bias-Free US Mutual Fund database (CRSP MF) and (2) Morningstar Direct. Starting with the CRSP MF database, we obtained detailed fund holdings covering July 2003-June 2007. We used the data vintage covering holdings that ended in June 2007 (hereafter, 2007 database), which was assembled by CRSP with data from Morningstar. Its holdings reflect not only long equity positions but also options and other types of securities. CRSP stopped using Morningstar at the end of 2007, however, and switched to using Lipper as provider of historical holdings data. As a result, subsequent vintages of CRSP MF contained no

[8] Available at http://www.sec.gov/Archives/edgar/data/904170/000118811208002245/d23469.htm.

historical option holdings. To extend coverage to the end of 2010, we supplemented our 2007 database with holdings that we manually downloaded from Morningstar Direct for the 2007-2010 period.[9] This extension enabled us to identify additional funds that used options during 2007-2010 that were not in the 2007 database.

For each position our combined holdings database reports the CUSIP identifier (only for equity securities), the name, number of shares held, and market value.[10] To transform the option holdings data into a usable format, we followed several procedures. Since no data fields were available to categorize holdings by type of security, we first created a screening algorithm to identify all possible mutual fund option holdings. Using the names of fund holdings as the main input, the algorithm identified positions that contained the "CALL" or "PUT" text strings in the names, and flagged these instances as option holdings. We next removed positions that contained these strings but were not option holdings. This was done with visual inspections to remove holdings that contained words such as "CALLABLE", "CALLAHAN", "PUTTABLE", "OUTPUT", "COMPUTER". Following this step, we removed options on currencies or interest rates keeping only options on stocks and stock indices. Also, we classified options holdings into calls and puts using the names of the holdings and into long or written positions using the sign of the position valuation.

Index options were distinguished from equity options by screening the holdings names for different variations of the names of major stock indices (e.g., "S&P 500" or "S + P 500", "S and P 500") and ticker symbols of ETFs and Indices (e.g., QQQ, SPX, SPY, SPDR). The final option holdings dataset was again visually inspected for errors or inconsistencies.

[9] To make sure that data came from the same source for 2007, we replaced option holdings for that year from the 2007 database with data we obtained from Morningstar Direct.

[10] A number of funds reported holdings to Morningstar as often as monthly on a voluntary basis although they were required to report holdings to the SEC semiannually until 2004 but quarterly thereafter.

Besides holdings, we also collected data on other fund and stock holdings characteristics. Monthly fund returns and other fund characteristics came from the CRSP MF database. Portfolio manager characteristics came from Morningstar Principia CDs. From the CRSP US stock database, we obtained stock prices and returns for all the stocks traded in US exchanges and historical security CUSIPs that were used to merge holdings with stock characteristics.

For each option holding we tried to identify the underlying stock or index. This step was completed by name-matching algorithms based on spelling distance and visual inspections. The positions that could not be matched with any underlying security or index corresponded to cases for which the names of the option holdings did not have sufficient identifying information simply because their names were abbreviated beyond recognition.

We excluded index funds and relied on the Lipper Investment Objective classification to restrict our sample to include only equity funds. Our final sample includes a total of 2,509 U.S. equity mutual funds broken down into 250 funds that used options at least once during our July 2003-December 2010 sample period and 2,259 mutual funds that did not.

B. Option Positions Characteristics

Table 1 reports statistics on the option positions held by U.S. equity mutual funds. Panel A shows that out of the total 25,789 identified option positions, 23,463 positions correspond to equity options and the remaining positions correspond to index options. Written calls represent the majority of options positions, making up roughly 60 percent of all option positions. The second largest category includes purchased put options, which make up roughly 18 percent of all positions.

Panel B categorizes option positions within each type into three categories, depending on whether the option is accompanied by a long, short, or no position in the underlying security.

Consistent with mutual funds complying with the asset coverage requirement by holding the underlying security, the majority (roughly 92%) of written calls are covered by long positions in the underlying securities. On the other hand, it appears that mutual funds might be satisfying the asset coverage requirement for written puts by putting aside segregated accounts holding very liquid assets.[11]

Out of all purchased calls, about 33 percent correspond to no underlying security positions, 26 percent correspond to long positions in the underlying securities, and about 41 percent correspond to short positions in the underlying securities. Also, out of all purchased puts, about 50 percent correspond to no underlying security positions, about 32 percent correspond to short underlying security positions, and 18 percent correspond to long positions in the underlying securities.

In summary, our sample mutual funds use two main option strategies, income generating strategies and directional strategies. Income generating strategies involve call and put writing, intended to generate income from premiums. The directional strategies involve purchasing calls and puts to obtain higher positive or negative exposure in a particular stock.

Panel D reports statistics on option usage computed across 2,618 portfolio-date observations with at least one option position. For each fund on a given holdings report date, we calculate the number of options in the portfolio and the fraction of all portfolio positions that correspond to option securities. While the average number of options per portfolio on a given report date is 11 and the average fraction of positions in options is 10.37 percent, the ranges of these measures are quite large, suggesting a high level of heterogeneity across portfolios in terms of option usage, a subject that will be addressed later in the paper.

[11] Data on segregated accounts is not available in the CRSP mutual fund holdings database or any other similar commercial databases which precludes us from identifying the type of liquid assets used in these segregates accounts.

C. A First Look at Profitability of Option Positions

In this section we take a first look at the profitability of option positions. For each period and mutual fund that uses options, we construct a portfolio of stocks reflecting the underlying options positions for each of the four categories: purchased calls, purchased puts, written calls, and written puts. These option-tracking portfolios are held for periods ranging from one to 12 months, rebalanced at the end of each holding period, and have their returns benchmarked against Daniel, Grinblatt, Titman and Wermers (1997) (DGTW) benchmark portfolios.[12] Benchmarked returns of option-tracking portfolios are averaged (with equal weights) across all options users for each portfolio formation date. The returns of stocks within each option-tracking portfolio of each fund are both equal and value-weighted, with results reported for both weighting schemes. Standard errors are adjusted for serial correlation using the Newey and West (1987) correction and t-statistics are reported in parentheses.

Panel A of Table 2 reports average DGTW-adjusted returns and Panel B reports the fractions of positions with positive DGTW-adjusted returns. Panel A provides no conclusive evidence of skill in the use of options by mutual funds. The DGTW-adjusted returns for the portfolios tracking the four different types of option positions and the different holding periods are generally statistically insignificant. These results are confirmed by Panel B results where we see that the fraction of positive and negative adjusted returns is split in ways that do not reveal evidence of ability.

Only in the case of written puts and only for a three-month holding period, we observe that the underlying stocks generated significant negative DGTW-adjusted returns in the magnitude of

[12] Following DGTW, we form 125 benchmark portfolios based on market capitalization, book-to-market ratio, and prior 12-month return each July. The returns of each benchmark portfolio are value-weighted buy-and-hold returns over the next one to 12 month holding periods. The benchmark-adjusted return of each stock in each option-tracking portfolio is constructed as its buy-and-hold return minus the buy-and-hold return of its benchmark.

-1.29 to -2.05 percent. This is consistent with mutual funds being unable to profit from writing puts, a result which will be confirmed later in the paper in more detail. However, results from Table 2 should be interpreted with a caveat: not knowing exactly the day when mutual funds bought, wrote, exercised, or sold these options limits the power of our tests, suggesting caution in the interpretation of these results.

D. Fund Characteristics

Table 3 provides statistics for our sample of options users. We use the detailed Lipper Objective Code from the CRSP MF database to more broadly reclassify funds into Gowth, Growth and Income, Income, Midcap, Small Cap, Micro Cap, and Non-Conventional[13] investment style categories. Panel A reports the frequency of options users and nonusers by fund categories. Funds in the Growth category represent the largest group of options users, with roughly 42 percent of the sample. The distribution of funds in the different categories is slightly different for the options users and nonusers. For example, the Non-Conventional category is overrepresented among options users while the Mid Cap and Small Cap categories are underrepresented.

Panel B performs univariate comparisons of the main characteristics between users and nonusers. At first glance, options users are smaller and come from smaller families. More specifically, the average nonuser is twice as large as the average user and belongs to a family that is four times larger than that of the average user. In addition, users charge higher expense ratios and have higher portfolio turnover. Given that all these characteristics have been documented to

[13] This category includes funds that follow non-traditional investment approaches such as short-selling or absolute return type of strategies and have the following Lipper Objective Codes: ABR; DL; DSB; EMN and LSE.

affect fund performance[14], our later performance comparisons will control for differences related to these characteristics.

Interestingly, option users appear to generate lower fund returns than nonusers. This could be due to lower portfolio risk or poor information generating abilities among options users, but it could also be due to a combination of fund characteristics specific to options users that put them at a disadvantage. To examine whether option usage does indeed affect raw fund returns, restricting the analysis to all portfolio snapshots of only option users, we estimate regressions of raw returns on the fraction of portfolio positions in options using the Fama-Macbeth approach.[15] In the interest of brevity results are reported in Table 1 of Appendix A. Results show that funds with a higher level of option usage generate lower fund returns, everything else equal. For example, moving from the median fund (with 5.06% of portfolio positions in options) to the 75th percentile fund (with 13.85% of the portfolio positions in options) is associated with a monthly decline in performance of roughly 20 basis points per month. Our later analysis will investigate whether differences in the information generating abilities or risk profiles of option users are responsible for this effect.

E. Determinants of Option Usage

In this section, we relate options usage with fund and manager characteristics by estimating a pooled logit regression. The key dependent variable equals one if the fund used options in a given period, and zero otherwise. Two sets of independent variables capture both fund and portfolio manager characteristics. The fund-level variables include: the log of total net assets

[14] See, for example, Carhart (1997) and Chen, Hong, Huag, and Kubik (2004).

[15]Every period a cross-sectional regression of fund returns on the fraction of portfolio positions in options is estimated. The resulting time-series of coefficients is used to compute a mean and standard error which is corrected for autocorrelation using the Newey-West correction. Control variables include: portfolio fraction invested in common stocks, portfolio fraction invested in bonds, the log of total net assets measured in millions of dollars; expense ratio; fund's age in years; a load dummy, and portfolio turnover.

measured in millions of dollars (Log(TNA)); expense ratio (Expense Ratio); fund's age in years (Fund Age); portfolio turnover (Turnover); average fund returns over the last 12 months (Past Return); and the standard deviation of returns over the last twelve months (STDEV Return). The manager-level variables obtained from Morningstar Principia CDs include: a dummy variable indicating whether the portfolio manager managing the fund holds an MBA degree (MBA); GMAT score of the portfolio manager (GMAT); a dummy variable indicating whether the portfolio manager holds a PHD degree (PHD); an indicator variable indicating whether the portfolio manager holds the CFA designation (CFA); portfolio manager age (Manager AGE); portfolio manager tenure (Tenure); and a dummy variable indicating whether the portfolio manager is female (Female).[16]

Table 4 reports marginal probabilities for the independent variables. Marginal probabilities are evaluated at the means for the continuous variables and as the probability change resulting from a change in value from 0 to 1 for the dummy variables. Since use of options among mutual funds is not prevalent, we try to correct for the rare event estimation bias discussed in King and Zeng (2001). Thus, along with the standard z-scores we also report z-scores based on the King and Zeng (2001) correction.[17] To account for correlations among observations belonging to the same fund, both sets of z-scores are computed from standard errors that are clustered by fund.

In the first two models we include the whole universe of managers for whom we were able to collect data. Since we also want to assess the relation between GMAT scores and probability of using options, the last two models are estimated on the subset of managers who had an MBA

[16] To better isolate the effect of individual manager characteristics on options usage, our analysis here focuses only on mutual funds that are managed by single portfolio managers. Despite this restriction, we still end up with 190 mutual funds that used options at least once during the sample period. The steps that were followed to construct the manager characteristic variables are described in Andreu and Puetz (2012) and are omitted here in the interest of brevity.

[17] Traditional logit estimates for rare events (i.e., in our case use of options by mutual funds) cause the probability of the rare event to be underestimated and standard errors to be overestimated. To deal with this problem, King and Zeng (2001) propose a bias correction method for the coefficient estimates and the use of White's standard errors.

degree. Results from the first two models suggest that option usage is positively related with fund size and expense ratios. When looking at manager characteristics, the first two models show that human capital variables related to education, such as the presence of an MBA degree, PHD degree, or a CFA designation are negatively related to the probability of using options but in a statistically insignificant way.

Human capital variables related to experience such as Manager Age and Tenure provide mixed results. The coefficient on Manager Age is positive but not statistically significant, while the coefficient on Tenure is negative and statistically significant. The negative coefficient on Tenure is consistent with experience reducing the propensity for portfolio managers to employ riskier securities such as options. Finally, results suggest that female portfolio managers are less likely to use options. This result is statistically significant in all specifications and is consistent with Barber and Odean's (2001) finding that men are more overconfident and trade a lot more than women. Results from models 3 and 4 run on the subset of managers that have MBA degrees, show a negative relation between managers' GMAT scores and the likelihood of using options, suggesting that managers with a higher academic aptitude are less likely to use options.

IV. Performance and Risk Comparisons

A. Performance Measures

We use seven measures of performance for our comparisons. The first four are intercepts from the CAPM, Fama and French (1993), Carhart (1997), and Ferson and Schadt (1996) models specified, respectively, as follows:

$$R_{p,t} = a_{CAPM} + \beta_{MKT} R_{mkt,t} + \varepsilon_t , \quad (1)$$

$$R_{p,t} = a_{FF} + \beta_{MKT} R_{mkt,t} + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \varepsilon_t , \quad (2)$$

$$R_{p,t} = a_{Carhart} + \beta_{MKT} R_{mkt,t} + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \beta_{UMD} UMD_t + \varepsilon_t, \quad (3)$$

$$R_{p,t} = a_{FS} + \beta_{MKT} R_{mkt,t} + \delta_{RMRF} \left(z_{t-1} \times R_{mkt,t} \right) + \varepsilon_t \quad (4)$$

where $R_{p,t}$ is the fund's reported return in month *t* in excess of the risk free rate and $R_{mkt,t}$ is the market portfolio return in month *t* in excess of the risk-free rate. The common factor variables SMB_t, HML_t, and UMD_t are the month-*t* return differentials between small cap and large cap stocks, high and low book-to-market stocks, and positive and negative return-momentum stocks, respectively. δ represents a vector of factor loadings of the conditional regression factors and z_{t-1} is a vector of lagged public information variables. The public information variables include: 1) level of the one-month Treasury bill yield, 2) divided yield of the CRSP valued-weighted NYSE and AMEX stock index, 3) quality spread in the corporate bond market, and 4) a measure of the slope of the term structure. Since the Ferson and Schadt (1996) model estimates time-varying conditional betas and controls for common variation due to public information, the model accounts for fluctuations in portfolio risk factors caused by option strategies that respond to public information.

The next three models we employ are intended to take into account asset pricing implications that arise from investors' preferences for positive skewness (or dislike for downside risk) in asset returns. Here the fifth model, which is in the spirit of Bawa and Lindenberg (1977) is used to explicitly adjust for downside risk and is specified as follows:

$$B\&L\ \alpha_p = E(R_p) - B_{BL}[E(R_{mkt})], \quad (5)$$

where $B_{BL} = \dfrac{cov(R_p, R_{mkt} \mid R_{mkt} < 0)}{var(R_{mkt} \mid R_{mkt} < 0)}$

Downside risk was analyzed in Bawa and Lindenberg (1977) and Ang, Chen, and Xing (2006), among others, where the basic argument is that investors that are sensitive to downside losses will require a premium for investing in assets that covary strongly with the market when the market is declining. Thus, in an economy where investor care more about downside risk, securities that are more sensitive to downside risk ought to have higher expected returns. Applied to our setting, depending on whether mutual funds use options to increase or decrease downside risk exposure, traditional performance measures that do not account for downside risk explicitly might generate performance measures that are biased, respectively, upward or downward.

The fifth model, which is in the spirit of Whaley (2002), is also indented to adjust for downside risk, but is specified in a slightly different way from the previous model.

$$Whaley\,\alpha_p = E(R_p) - B_{Whaley}[E(R_{mkt})] \qquad (6)$$

where $B_{Whaley} = \dfrac{cov(R_p, R_{mkt} \mid R_p < 0, R_{mkt} < 0)}{var(R_{mkt} \mid R_{mkt} < 0)}$

The difference between model 5 and 6 is that in model 5 the downside covariance with the market is estimated only when both the portfolio and market returns in excess of the risk free rate underperform the zero threshold.

Our final model is based on Leland's (1999) extension of the mean-variance framework to account for "…all elements of risk, including skewness, kurtosis, and other characteristics that further describe the shape of the return distribution".[18] Performance under the Leland model is estimated as follows:

[18] Leland (1999) also argues that investors prefer positively skewed returns and therefore security prices should reflect more than mean and variance of returns. Furthermore, he argues that because CAPM ignores investors' preferences for skewness, the beta risk measure under CAPM will incorrectly measure risk, causing alpha estimates to incorrectly measure performance. He shows that portfolios relying on option strategies that reduce skewness, such as covered call writing on the market portfolio, will generate alphas that are positively biased under traditional performance measures. Alternatively, strategies that increase skweness, for example holding the market portfolio and buying puts on the market portfolio, will generate alphas that are negatively biased under traditional performance measures.

$$Leland\ alpha_p = E(R_p) - B_p[E(R_{mkt})] \qquad (7)$$

where $B_{Leland} = \dfrac{cov[R_p, -(1+R_{mkt})^{-b}]}{cov[R_{mkt}, -(1+R_{mkt})^{-b}]}$ and $b = \dfrac{ln[E(1+R_{mkt})] - ln(1+r_f)}{var[ln(1+R_{mkt})]}$

For the last three models, we also estimated alphas based on portfolio and market returns that were orthogonalized with respect to the three common risk factors, SMB, HML, and UMD. Results, not reported here in the interest of brevity, are not qualitatively different.

B. Risk and Other Return Distribution Characteristics

We employ eight measures to characterize the risks and other distribution characteristics of fund returns. The first measure, intended to capture systematic risk, is the beta coefficient (CAPM β). For each equity fund, CAPM β is estimated from a regression of fund returns in excess of the risk-free rate on the CRSP Value-Weighted Index returns in excess of the risk-free rate as specified in the first performance model. The second measure, intended to measure systematic downside risk, is the downside beta (B&L β), and is computed as specified in Model (5). The third measure, which is also intended to measure systematic downside risk, it the Whaley Beta (WHALEY β) and is computed as specified in Model (6). The fourth measures, intended to capture total portfolio risk, is the standard deviation (STD) of monthly fund returns. The fifth measure, intended to measure total downside risk, is the semi-standard deviation (S-STD) of monthly fund returns. Our sixth measure is the idiosyncratic risk (IDIO), measured as the standard deviation of the residuals from the corresponding one-factor model used to estimate CAPM β. Since options can introduce departures from normality in the distribution of fund returns, we also include skewness (SKEW) and kurtosis (KURT) of monthly fund returns.

C. A First Look at Performance and Risk Comparisons

To conduct performance and risk comparisons between options users and nonusers, we start with pooled regressions of fund-specific performance and risk measures, computed for each fund over the entire sample period. Our key independent variable, *Option User*, equals one if a fund used options at least once during the entire sample period, and zero otherwise. The control variables, which are derived by averaging each fund's characteristics over the entire sample period, control for fund characteristics that previous research has documented to be significant in explaining fund performance. They include: log of fund assets[19], expense ratio; portfolio turnover; a load fund dummy, and fund age in years. The regressions include fund style, based on the most recent reported style, and family fixed effects. Funds with fewer than 12 valid observations are treated as missing observations.

Coefficients and associated t-statistics on the *Option User* dummy reported in Panel A of Table 5 show no statistically significant differences in risk-adjusted performance between options users and nonusers. This goes against the view that options users generate superior information that they try to exploit in the options markets. Results from Panel B, which compares risk characteristics, suggest that options users have significantly lower CAPM betas but higher standard deviation, semi standard deviation, and idiosyncratic risk. Options users also appear to have significantly higher kurtosis than nonusers, which is consistent with a higher probability of extreme return realizations among them.

D. Option Usage and Subsequent Performance and Risk

Although Table 5 results do no reveal performance differences between users and nonusers, comparisons based on fund measures constructed over the entire sample period could mask

[19] See, for example, Berk and Green (2004) for a theoretical discussion of how size affects fund performance. For direct empirical evidence on the relation between fund size and performance, see Chen, Hong, Huang, and Kubik (2004).

casual effects. For example using options could affect portfolio returns and risk, but mutual funds could also choose to use options in response to past performance or risk characteristics.

To address this limitation, Table 6 introduces a different testing approach, which relates use of options in a given year with subsequent fund performance and risk characteristics. Another interesting feature of this approach is that it accounts for the fact that options users used options only for a third of the reporting periods. Recall that the approach in the previous section classifies a fund as an option user for the entire sample period even if it used options only once

We rely on pooled regressions where annual measures of performance and risk are regressed on a variable (*Previous Option User*) indicating whether a mutual fund used options in the previous year and the same set of control variables as in the previous section. The regressions include year, fund style, and family fixed effects. Measures of performance and risk for each calendar year are computed for each mutual fund that has 12 non-missing monthly returns in a given year. Observations that do not meet this condition are treated as missing values. The associated t-statistics are reported in parentheses and standard errors are clustered by fund to account for correlations among observations belonging to the same fund.

Results from Panel A of Table 6 are similar to those in Table 5 in that they reveal no statistically significant differences in the subsequent risk-adjusted performance of funds that used options and those that did not. Again, this is inconsistent with the view that options users generate superior information that they try to exploit in the options markets. Results from Panel B, which compare risk characteristics, suggest that funds that used options in a given year had lower subsequent systematic risk, total risk measures but higher idiosyncratic risk. However, these differences are statistically insignificant at conventional levels.

E. Options User Stratified by Level of Options Usage

Although Table 6 shows no discernible differences in terms of performance and risk between options users as a group and other funds, it is likely that important differences exist among funds in terms of how they employ options in their portfolios. Such heterogeneity among options users, if present, could limit the power of tests intended to detect performance or risk differences. We first distinguish among options users by how much they utilize options in their portfolios. If options users have superior-talent, which helps them generate useful information that they exploit in the options markets, performance should increase with the level of option usage. A similar argument is made regarding the trading of equities by individual mutual funds in Chen, Jegadeesh, and Wermers (2000) who raise the possibility "…that some fund managers are able to routinely identify attractive investment opportunities and, hence, trade frequently, while managers with more limited skills may be much more cautious in their trades."

We categorize funds based on the extent of options involvement in their portfolios by ranking and sorting all users each year into two groups based on their average portfolio fraction invested in options. Options users with an average portfolio fraction above the cross-sectional median are classified as *heavy* users and the rest, as *light* users. We next modify the pooled regressions employed in Table 6 by replacing the *Previous Option User* dummy with two dummy variables, *Heavy User* and *Light User*, which indicate whether a fund belonged to the heavy or light user groups in the previous year. Again, the base group includes all nonusers and the same control variables as in Table 6 are employed.

Results from Panel A.1 of Table 7 suggest that, regardless of the performance measure, the subsequent performance of nonusers was higher than the performance of heavy users and lower than that of light users. However, these differences are not statistically significant consistently

across the different performance measures. These findings are inconsistent with greater option usage being associated with better performance and thus go against the view that greater reliance on options affords certain portfolio managers ways to better utilize their superior information in the options markets.

With regards to portfolio risk, we would expect a higher level of options use to intensify any differences between users and nonusers. However, as reported in Panel A.2, risk differences between users in each of the two categories and nonusers are statistically insignificant, with the exception of heavy users having higher idiosyncratic risk and kurtosis than nonusers at a significance level of ten percent.

F. Options Users Stratified by Type of Options Strategy

The second dimension we use to differentiate among options users is based on the main type of option strategy that funds employ. Some options users specialize in option writing, which is intended to generate income by collecting option premiums while some others purchase calls or puts intended to profit from directional stock price moves. These strategies could affect performance in different ways. For example, while income strategies face more limited potential profitability, directional strategies could potentially be highly profitable. Different strategies could also affect portfolio risk in predictable ways. For example, while income strategies could truncate returns, affecting both betas as well as higher moments of portfolio returns,[20] directional strategies could affect portfolio risk in opposite ways.[21]

We classify options users each year into four groups: (1) Call Writer, (2) Put Writer, (3) Call Buyer, and (4) Put Buyer. Funds in the Call Writer group are funds for which written calls

[20] For example, a portfolio consisting of only a share of a common stock on which a call option has been written will have limited return upside, causing its returns to be negatively skewed.
[21] A portfolio consisting of only one long call option will have an amplified beta and positively skewed returns.

constitute at least half of their options portfolios. A similar approach is used to define the other three groups. We modify the pooled regressions from Table 6 by replacing the *Previous Option User* dummy with four dummy variables indicating whether in the previous year an option user belonged to one of the four groups defined above. The base group includes all nonusers and the same control variables as in Table 6 are employed.

Results from Panel B.1 of Table 7 suggest that the effect of options on fund performance depends on the type of option strategy employed. Specifically, users that engaged predominantly in put writing in a given year underperformed nonusers by an amount that was economically significant (9 to 28 basis points per month) and statistically significant for five out of the seven performance measures. That Put Writers were at the greatest disadvantage relative to nonusers during our sample period is not that surprising. Our sample period covers one of the sharpest declines in the history of the U.S. stock market, which would work against any trader that had written a substantial amount of put options.[22] Interestingly, Panel B.2 shows that Put Writers were also exposed to higher downside risk, measured by the B&L Beta, than nonusers during our sample period.

Panel B.2 also suggests that Put Buyers exhibit significantly lower average market and downside betas. These results are consistent with this group of options users buying insurance to limit the downside of portfolio returns as part of a hedging strategy.

Overall, our results suggest that the way in which options are used is not uniform across funds and affects their portfolios in different ways. Another conclusion is that mutual funds that follow certain specialized strategies appear more vulnerable to sharp and extreme changes in stock market valuations than nonusers.

[22] The S&P 500 declined by about 50% from its high levels in July 2007 to its low levels of 2009. Year fixed effects in our regressions can not fully account for this effect given that different strategies will respond differently to extreme market movements.

G. Heavy Options Users Stratified by Type of Options Strategy

The last two sections suggest that the extent of option usage and option strategy type matter for portfolios of options users. The interaction of these two effects should provide even more powerful tests to detect differences among users and nonusers. Simply put, particular option strategies are likely to have a noticeable effect on portfolio risk and returns if they constitute a big portion of the portfolio.

We examine how heavy users of options that follow each of the four strategies discussed above differ from nonusers. Following Section E, we first split options users into heavy and light users. Using the same approach as in the previous section, we categorize users into the four-strategy based groups. Using the intersection of these two categorization schemes we then create the following four groups: (1) Heavy Call Writer, (2) Heavy Put Writer, (3) Heavy Call Buyer, and (4) Heavy Put Buyer. We modify the pooled regressions employed in Table 6 by first restricting the set of options users to include only heavy users and then replacing the *Previous Option User* dummy with four dummy variables indicating whether in the previous year an option user belonged to one of the four groups defined above. The base group again includes all nonusers and the same control variables as in Table 6 are employed.

Panel C of Table 7 shows that results from comparisons between heavy users in each of the strategy categories and nonusers are similar to those in Panel B and get stronger in some cases. For example, similar to the results for Put Writers in Panel B1, Heavy Put Writers underperform nonusers by economically significant amounts. This result is statistically significant for five out of the seven performance measures. Comparing Panels B.2 and C.2 suggests that the difference in downside risk measures between put writers and nonusers gets even larger when we focus on heavy put writers. Also, Heavy Call Buyers underperform nonusers in a statistically significant

way for six out of the seven performance measures. These results are overall consistent with heavier options usage having a more noticeable effect on portfolio return characteristics, but still confirm earlier findings that options do not afford portfolio managers any performance advantages.

Panel C.2 also suggests that Heavy Put Buyers exhibit significantly lower market beta, downside beta, standard deviation, and semi-standard deviation than nonusers. Given that these risk differentials for Heavy Put Buyers are stronger than the risk differentials of Put Buyers from Panel B.2, this is consistent with heavier employment of options having a more noticeable effect on portfolio risk. In addition, the nature of these results is sensible since put options added to a portfolio can potentially limit the downside of portfolio returns as part of a portfolio hedging strategy.

V. Risk Shifting within the Calendar Year

Our results so far cast doubt on the view that options users across the different categories explored above engage in risk taking behavior by using options to amplify portfolio risks. On the contrary, some options users appear to effectively lower portfolio risk. Nonetheless, our findings so far cannot rule out the possibility that funds use options opportunistically to alter portfolio risk over shorter intervals within the calendar year in a way that is consistent with the tournament-driven pattern documented for mainstream equity funds by Brown, Harlow, and Starks (1996). Unlike other mutual funds that do not use options, options can afford mutual funds that use them a greater flexibility to change portfolio risk relatively quickly over shorter periods of times. We next explore whether options users exhibit a stronger tendency than nonuser funds to increase portfolio risk at the end of the year in response to poor performance in the earlier part of the year.

To examine the intertemporal relation between portfolio risk and interim performance, we estimate pooled regressions of changes in risk between the second and the first half of the calendar year on the peer-adjusted return of the fund during the first half of the year (*Performance*); an indicator variable that equals one if a fund used options in that year, and zero otherwise (*Option User)*; the interaction term *Option User*×*Performance*; lagged value of the risk variable in the first half of the year and the same set of control variables used in the previous section. We use three different measures of risk, systematic risk (CAPM β), total risk (STD), and idiosyncratic risk (IDIO) in separate models to construct our dependent variable. Similar to Koski and Pontiff (1999), *Performance* is measured as the difference between the return of a given fund and the average return of funds that share the same investment style. The regressions also include time, style, and family fixed effects and correlations among observations belonging to the same fund are accounted for by clustering standard errors at the fund level.

If options afford mutual funds an easier way to game performance in a way that is consistent with patterns documented by Brown, Harlow, and Starks (1996), we should expect the following pattern for options users: They should show a stronger negative relation between performance in the first half and changes in portfolio risk during the second calendar semiannual period— at the end of which mutual funds are evaluated against their peers—than nonusers.

Panel A of Table 8 reports regression results. The negative and statistically significant coefficients on *Performance* when Beta and STD are used as risk measures suggest that nonuser funds are more likely to increase the systematic risk of their portfolio following poor performance in the first calendar semiannual period. This finding is consistent with the tournament hypothesis of Brown, Harlow, and Starks (1996). The insignificant interaction term

*Option User*Performance* suggests that option users as a group respond to performance in the first part of the year in a away that is not different from nonusers.

Although, on average, we observe no differential risk taking by options users in response to poor interim performance, it is possible that large differences in intra-year risk changing behavior across users exist that are difficult to detect when they are grouped together. Using the different categorizations of options users employed in the previous section, we next explore whether differential risk-taking behavior exists among those different categories of options users.

Starting with the first categorization of heavy and light users in Panel B, we show that none of these groups exhibit differential interim risk-taking behavior relative to nonusers. In Panel B we test whether each of the four strategy-based groups exhibit different interim risk taking behavior relative to nonusers. Interestingly, rather than increasing systematic risk following poor relative performance in the first half of the year, Put Buyers reduce their systematic risk. This finding is inconsistent with differential risk taking by put buyers. Instead it reveals a conservative tendency for put buyers to stem further losses in response to poor performance in the first half of the year. This is further confirmed by results from Panel D, which modifies the pooled regressions of Panel C by excluding all light options users. Panel D shows that heavy put buyers show an even stronger tendency compared to all put buyers of lowering systematic risk in the second half in response to poor performance in the first half of the year.

VI. Conclusion

This study analyzed the use of exchange-traded options by all U.S. equity mutual funds. By using detailed options holdings data, we are the first to shed light on the extent to which mutual funds employ options, the characteristics of mutual funds and portfolio managers that employ

options, and identify the main options strategies that mutual funds follow in their portfolios. We document a wide variation in the extent to which options are used across mutual funds. Most important, use of options is related to experience, education and gender characteristics of portfolio managers. Mutual funds managed by portfolio managers with a longer tenure and female portfolio managers are less likely to use options. Portfolio managers with higher GMAT scores—most likely characterized by a higher level of academic aptitude—are also less likely to use options in their portfolios. Dissecting the portions of portfolios invested in options, we learn that mutual funds primarily follow strategies intended to either generate income through option writing or place directional bets on the underlying stock price moves through long call or put options.

Mutual funds that are allowed to use derivatives such as options have the means to engage in extreme risk taking, a concern that has received renewed attention from regulators and the business press. However, these mutual funds also have the means to better use their information in the options market to potentially improve portfolio performance, as they are able to create exposure in a particular stock or index for a fraction of the cost associated with direct stock or index ownership

Our results disprove the view that managers of mutual funds that use options have abilities to generate proprietary information that can lead to superior fund performance relative to funds that do not use options. Far from it, our results reveal that certain categories of options users that engaged in distinct strategies suffered from worse performance than other funds that did not use options during our sample.

Our findings suggest that mutual funds that use options do not pursue strategies that lead to extreme portfolio risk levels; in fact some funds that buy puts for portfolio insurance show much

lower systematic risk levels than nonusers. Perhaps wanting to limit additional losses, these funds also respond to poor performance in the first part of the year by reducing portfolio risk. Thus, our findings disprove both permanent and temporary aggressive risk taking by options users and instead suggest that some mutual funds use options primarily for risk management and risk hedging purposes.

Overall, our performance and risk analysis of mutual funds that use options does not reveal evidence of a clear advantage afforded to investors that invest in mutual funds that use options.

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Table 1
Statistics on Options Positions

This table reports statistics on the option positions held by all US equity mutual funds that reported at least one option position over the July 2003-December 2010 sample period. Panel A reports the number of positions by type of option security. Panel B categorizes option positions within each option type into three additional categories, depending on whether the option is accompanied by a long, short, or no underlying security position in the portfolio at the same holdings report date. Panel C reports statistics at the portfolio level, where each mutual fund portfolio on each report date represents one observation. For each mutual fund and holdings report date where the mutual fund reported at least one option position, we calculate the number of options in the portfolio (*Number*) and the fraction of all portfolio positions that correspond to option securities (*Fraction*).

Panel A. Number of Positions by Option Type

	Equity Options		Index Options		Equity & Index Options	
Option Type	Number	Fraction	Number	Fraction	Total	Fraction
Call	2,887	12.30%	217	9.33%	3,104	12.04%
Written Call	14,743	62.84%	728	31.30%	15,471	59.99%
Put	3,454	14.72%	1,257	54.04%	4,711	18.27%
Written Put	2,379	10.14%	124	5.33%	2,503	9.71%
Total	23,463	100%	2,326	100%	25,789	100%

Panel B. Breakdown of Equity Option Positions by Accompanying Underlying Security Positions

	Accompanying Stock Positions							
	Long		Short		None		Total	
Option Type	N	(%)	N	(%)	N	(%)	N	(%)
Call	662	26.02	1,034	40.52	854	33.46	2,552	11.79
Written Call	12,693	91.64	312	2.25	846	6.11	13,851	63.97
Put	547	17.90	970	31.74	1,539	50.36	3,056	14.11
Written Put	1,596	72.78	31	1.41	566	25.81	2,193	10.13
Total	15,498	71.58	2,347	10.84	3,805	17.57	21,652	100.00

Panel C. Number of Options per Portfolio and Report Date (N=2,618)

Variable	Mean	Min	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile	Max
Number	11	1	1	1	4	10	25	304
Fraction (%)	10.37	0.04	1.02	2.20	5.06	13.85	25.72	75.00

Table 2
Performance of Stock Portfolios Mimicking Option Positions

This table reports DGTW-adjusted returns for portfolios of stocks that reflect the underlying reported option positions in mutual fund portfolios. For each period and each fund that uses options, we construct a portfolio of stocks reflecting the underlying options positions for each of the four categories: purchased calls, purchased puts, written calls, and written puts. The buy-and-hold benchmark-adjusted returns of the portfolio are calculated for holding periods ranging from one to 12 months. The benchmark portfolios were constructed as in Daniel, Grinblatt, Titman and Wermers (1997). We form 125 portfolios based on market capitalization, book-to-market ratio, and prior 12-month return each July. The returns of each of 125 benchmark portfolios are value-weighted buy-and-hold returns over the next one to 12 month holding periods. The benchmark-adjusted return of each stock in each option-tracking portfolio is constructed as its buy-and-hold return minus the buy-and-hold return of its benchmark. Benchmarked returns of option-tracking portfolios are equally averaged across all options users for each portfolio formation date. The returns of stocks in the option-tracking portfolio of each fund are equal and value-weighted and results are reported for both weighting schemes. Panel A reports DGTW-adjusted returns for the option tracking portfolios and Panel B reports the fraction of option positions with positive DGTW-adjusted returns. Standard errors are adjusted for serial correlation using the Newey and West (1987) correction and *t*-statistics are reported in parentheses.

Panel A. DGTW-adjusted Returns for (1, 3, 6, 12 month) Holding Periods (in %)

Option Tracking Portfolios	**Equally-Weighted**				**Value-Weighted**			
	1	**3**	**6**	**12**	**1**	**3**	**6**	**12**
Purchased Calls	-0.380 *(-0.90)*	0.852 *(0.62)*	1.231 *(1.46)*	-0.282 *(-0.15)*	-0.201 *(-0.40)*	1.041 *(0.69)*	1.437 *(1.62)*	-0.377 *(-0.22)*
Purchased Puts	-0.947 *(-1.78)*	-0.928 *(-0.89)*	0.379 *(0.21)*	-1.182 *(-0.39)*	-1.058 *(-1.50)*	-0.876 *(-0.78)*	0.743 *(0.41)*	0.195 *(0.08)*
Difference	0.568 *(0.96)*	1.780 *(0.88)*	0.852 *(0.39)*	0.900 *(0.24)*	0.856 *(1.01)*	1.917 *(0.88)*	0.694 *(0.33)*	-0.572 *(-0.19)*
Written Calls	-0.002 *(-0.01)*	-0.300 *(-0.54)*	-0.983 *(-1.10)*	-1.470 *(-0.96)*	-0.016 *(-0.07)*	-0.384 *(-0.64)*	-1.103 *(-1.22)*	-1.696 *(-1.07)*
Written Puts	-0.221 *(-0.52)*	-1.292 *(-1.85)*	-1.622 *(-0.92)*	-1.426 *(-0.37)*	-0.411 *(-0.87)*	-2.049 *(-2.86)*	-3.027 *(-1.64)*	-3.147 *(-0.81)*
Difference	0.219 *(0.51)*	0.993 *(1.25)*	0.639 *(0.42)*	-0.044 *(-0.01)*	0.395 *(0.83)*	1.665 *(1.95)*	1.924 *(1.13)*	1.451 *(0.46)*

Table 2 continued

Panel B. Fraction of Positions with Positive DGTW-adjusted Returns for (1, 3, 6, 12 month) Holding Periods								
Option Tracking Portfolios	**Equally-Weighted**				**Value-Weighted**			
	1	**3**	**6**	**12**	**1**	**3**	**6**	**12**
Purchased Calls	48.71	46.26	48.95	42.48	49.87	46.13	48.64	39.85
Purchased Puts	48.17	46.37	45.64	42.34	47.71	45.82	45.44	42.46
Written Calls	44.47	47.03	48.57	42.63	44.19	48.20	49.76	43.68
Written Puts	49.54	46.31	44.64	37.42	49.17	45.39	42.72	35.51

Table 3
Fund Characteristics

This table provides mutual fund statistics for options users and nonusers. Panel A reports the frequency of option users and nonusers by investment objectives. Panel B reports average fund characteristics for users and nonusers.

Panel A. Investment Categories

Users	Growth	Growth & Income	Income	Mid Cap	Small Cap	Micro Cap	Non-Conventional
%	42.4	16.40	6.40	6.00	10.40	1.60	16.80
N	106	41	16	15	26	4	42
Nonusers							
%	41.7	17.84	6.29	12.17	19.26	1.59	1.15
N	942	403	142	275	435	36	26

Panel B. Fund Characteristics

	Mean		Median	
Fund Characteristics	Users	Nonusers	Users	Nonusers
Number of Funds	250	2,259		
TNA ($ millions)	558	1085	106	137
Family TNA ($ millions)	8166	31970	1710	4460
Expense Ratio (%)	1.67	1.35	1.51	1.27
Turnover (%)	143	98	82	74
Age (Years)	10	11	7	8
Monthly Return (%)	0.63	0.78	0.68	0.76

Table 4
Relation of Option Usage with Fund and Manager Characteristics

Table 4 presents results from a logit regression that relates use of options with fund and manager characteristics. The dependent variable equals one if a given fund uses options in a given period, and zero otherwise. The fund-level regressors include: the log of total net assets measured in millions of dollars (*Log(TNA)*); expense ratio (*Expense Ratio*); fund's age in years (*Fund Age*); portfolio turnover (*Turnover*); average fund returns over the last 12 months (*Past Return*); and the standard deviation of returns over the last twelve months (*STDEV Return*). The manager-level regressors include: a dummy variable indicating whether the portfolio manager managing the fund holds an MBA degree (*MBA*); GMAT score of the portfolio manager (*GMAT*); a dummy variable indicating whether the portfolio manager holds a PHD degree (*PHD*); an indicator variable indicating whether the portfolio manager holds the CFA designation (*CFA*); portfolio manager age (*Manager AGE*); portfolio manager tenure (*Tenure*); and a dummy variable indicating whether the portfolio manager is female (*Female*). The marginal probabilities for the independent variables are evaluated at their means for the continuous variables. For the dummy variables the marginal probabilities indicate the change in probability resulting from a change in value from 0 to 1. Associated standard z-scores are presented in parentheses. The second set of z-scores is based on the King and Zeng (2001) correction. Both sets of z-scores are computed from standard errors that are clustered by fund.

Table 4 continued

Independent Variables	Model 1			Model 2			Model 3			Model 4		
Fund Characteristics	Coefficient	*Z-score*	*Z-score**	Coefficient	*Z-score*	*Z-score**	Coefficient	*Z-score*	*Z-score**	Coefficient	*Z-score*	*Z-score**
Log (TNA)	0.00375	*(1.87)*	*(1.86)*	0.00297	*(1.96)*	*(1.94)*	0.00076	*(0.45)*	*(0.43)*	0.00037	*(0.31)*	*(0.30)*
Expense Ratio	2.53217	*(4.74)*	*(4.71)*	2.22397	*(4.89)*	*(4.85)*	1.28652	*(1.44)*	*(1.44)*	1.25302	*(1.74)*	*(1.73)*
Turnover	0.00056	*(1.11)*	*(1.30)*	0.00037	*(0.79)*	*(1.02)*	-0.00087	*(-0.26)*	*(-0.24)*	-0.00096	*(-0.40)*	*(-0.37)*
Fund Age	-0.00018	*(-0.63)*	*(-0.61)*	-0.00023	*(-0.96)*	*(-0.94)*	-0.00053	*(-1.22)*	*(-1.18)*	-0.00041	*(-1.34)*	*(-1.30)*
Past Return	-0.24135	*(-1.49)*	*(-1.48)*	0.20412	*(1.37)*	*(1.39)*	-0.11461	*(-0.74)*	*(-0.74)*	0.26235	*(1.60)*	*(1.59)*
STDEV Past Return	-0.34623	*(-1.87)*	*(-1.85)*	-0.14248	*(-0.60)*	*(-0.60)*	-0.33567	*(-2.31)*	*(-2.28)*	-0.26807	*(-1.96)*	*(-1.93)*
Manager Characteristics												
MBA	-0.01229	*(-1.40)*	*(-1.40)*	-0.00992	*(-1.32)*	*(-1.33)*						
GMAT							-0.00012	*(-2.88)*	*(-2.87)*	-0.00009	*(-2.83)*	*(-2.82)*
PHD	0.00276	*(0.30)*	*(0.32)*	0.00143	*(0.18)*	*(0.21)*	0.00021	*(0.02)*	*(0.07)*	-0.00227	*(-0.27)*	*(-0.22)*
CFA	-0.00302	*(-0.44)*	*(-0.45)*	-0.00242	*(-0.42)*	*(-0.43)*	-0.01286	*(-1.59)*	*(-1.59)*	-0.00928	*(-1.55)*	*(-1.54)*
Manager Age	0.00015	*(0.45)*	*(0.45)*	0.00014	*(0.47)*	*(0.48)*	0.00030	*(0.96)*	*(0.96)*	0.00037	*(1.58)*	*(1.58)*
Tenure	-0.00113	*(-1.88)*	*(-1.86)*	-0.00106	*(-2.04)*	*(-2.02)*	-0.00092	*(-1.43)*	*(-1.42)*	-0.00092	*(-1.93)*	*(-1.91)*
Female	-0.01403	*(-2.10)*	*(-2.08)*	-0.01123	*(-1.94)*	*(-1.92)*	-0.01277	*(-1.64)*	*(-1.62)*	-0.00943	*(-1.74)*	*(-1.72)*
Fixed Effects												
Style	No			Yes			No			Yes		
Year	No			Yes			No			Yes		
Pseudo R^2	7.00%			10.99%			10.27%			16.04%		
N	17,698			17,594			10,206			10,206		

Table 5
Individual Fund Performance and Risk and Option Usage

This table reports coefficient estimates from regressions of fund-specific performance and risk measures, which are computed for each fund over the entire sample period. Our key independent variable, *Option User*, equals one if a fund used options at least once during the entire sample period, and zero otherwise. In Panel A, the dependent variables are performance measures that include alphas computed, respectively, from the CAPM (CAPM α), Fama and French (1993) (F&F α), Carhart (1997) (Carhart α), Ferson and Schadt (1996) (F&S α), Bawa and Lindenberg (1977) (B&L α), Whaley (2002) (Whaley α), and Leland (1999) (Leland α) models. In Panel B, the portfolio risk measures used as dependent variables include: CAPM beta (CAPM β), Bawa and Lindenberg (1977) beta (B&L β); Whaley beta (Whaley β); standard deviation (STD); semi-standard deviation (S-STD); idiosyncratic risk (IDIO); skewness (SKEW); and kurtosis (KURT) of monthly fund returns. The control variables are derived by averaging each fund's characteristics over the entire sample period. They include: log of fund assets; expense ratio; portfolio turnover; a load fund dummy; and fund age in years. The regressions include fund style, based on the most recent reported style, and family fixed effects. *t*-statistics are reported in parentheses.

Panel A. Performance Regressions (estimates in % /month)

	Dependent Variable						
Independent Variables	CAPM α	F&F α	Carhart α	F&S α	B&L α	Whaley α	Leland α
Option User	0.018	0.005	0.000	0.042	0.011	-0.015	0.015
	(0.67)	*(0.18)*	*(0.02)*	*(1.60)*	*(0.31)*	*(-0.39)*	*(0.55)*
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Style Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	35.00%	37.74%	37.44%	35.72%	35.77%	40.77%	34.27%
Observations	2,287	2,287	2,287	2,287	2,287	2,287	2,287

Table 5-continued

Panel B. Risk Regressions								
	Dependent Variable							
Independent Variables	CAPM β	B&L β	Whaley β	STD	S-STD	IDIO	SKEW	KURT
Option User	-0.057	-0.050	-0.024	0.002	0.001	0.001	-0.065	0.329
	(-1.82)	*(-1.45)*	*(-0.98)*	*(1.77)*	*(1.97)*	*(1.99)*	*(-1.22)*	*(2.12)*
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Style Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	54.71%	46.98%	45.89%	46.03%	41.02%	55.86%	38.41%	37.66%
Observations	2,287	2,287	2,287	2,287	2,287	2,287	2,287	2,287

Table 6
Option Usage and Subsequent Fund Performance and Risk

This table reports coefficient estimates from regressions of annual fund-specific performance and risk measures. Performance and risk measures are computed for each fund and each year. Our key independent variable, *Previous Option User*, equals one if a fund used options at least once during the previous year, and zero otherwise. In Panel A, the dependent variables are performance measures that include alphas computed, respectively, from the CAPM (CAPM α), Fama and French (1993) (F&F α), Carhart (1997) (Carhart α), Ferson and Schadt (1996) (F&S α), Bawa and Lindenberg (1977) (B&L α), Whaley (2002) (Whaley α), and Leland (1999) (Leland α) models. In Panel B, the portfolio risk measures used as dependent variables include: CAPM beta (CAPM β), Bawa and Lindenberg (1977) beta (B&L β); Whaley beta (Whaley β); standard deviation (STD); semi-standard deviation (S-STD); idiosyncratic risk (IDIO); skewness (SKEW); and kurtosis (KURT) of monthly fund returns. The control variables represent one-year lagged fund characteristics. They include: log of fund assets; expense ratio; portfolio turnover; a load fund dummy; and fund age in years. The regressions include year fixed effects, fund style fixed effects, based on the most recent reported style, and family fixed effects. Standard errors are clustered by fund and *t*-statistics are reported in parentheses.

Panel A. Performance Regressions (estimates in % /month)

	Dependent Variable						
Independent Variables	CAPM α	F&F α	Carhart α	F&S α	B&L α	Whaley α	Leland α
Previous Option User	0.013	0.054	0.036	-0.027	0.019	0.009	0.008
	(0.37)	*(1.49)*	*(0.96)*	*(-0.64)*	*(0.43)*	*(0.21)*	*(0.22)*
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Style Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	17.25%	18.44%	14.78%	18.30%	16.11%	18.91%	17.54%
Observations	11,476	11,476	11,476	11,476	11,476	11,476	11,476

Table 6-continued

Panel B. Risk Regressions								
	Dependent Variable							
Independent Variables	CAPM β	B&L β	Whaley β	STD	S-STD	IDIO	SKEW	KURT
Previous Option User	-0.063	-0.055	-0.034	0.000	0.000	0.001	-0.009	0.050
	(-1.48)	*(-1.17)*	*(-0.98)*	*(-0.46)*	*(-0.08)*	*(1.48)*	*(-0.33)*	*(0.82)*
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Style Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	46.49%	39.54%	40.92%	80.90%	83.78%	53.44%	25.38%	34.30%
Observations	11,476	11,476	11,476	11,476	11,476	11,476	11,476	11,476

Table 7
Option Usage and Subsequent Performance and Risk for Different Types of Option Users

This table reports coefficient estimates from regressions of annual fund-specific performance and risk measures. Performance and risk measures are computed for each fund and each year. Our key independent variables are indicator variables indicating whether options users belonged to a particular category in the previous year or not. In Panel A, we categorize users by the amount of options involvement in their portfolios. This is done by ranking and sorting all options users each year into two groups based on their average portfolio fraction invested in options. Options users with an average portfolio fraction above the cross-sectional median are classified as *heavy* users and the rest, as *light* users. In Panel B, we categorize options users by their main type of strategy. This is done by classifying options users each year into four groups: (1) Call Writer, (2) Put Writer, (3) Call Buyer, and (4) Put Buyer. Funds in the Call Writer group are funds for which written calls constituted at least half of their option portfolios in the previous year. A similar approach is used to define the other three groups. In Panel C, we exclude light options users from the sample of options users and use the intersection of the previous two categorizations to classify options users into: (1) Heavy Call Writer, (2) Heavy Put Writer, (3) Heavy Call Buyer, and (4) Heavy Put Buyer. In the first part of each panel the dependent variables are performance measures that include alphas computed, respectively, from the CAPM (CAPM α), Fama and French (1993) (F&F α), Carhart (1997) (Carhart α), Ferson and Schadt (1996) (F&S α), Bawa and Lindenberg (1977) (B&L α), Whaley (2002) (Whaley α), and Leland (1999) (Leland α) models. In the second part of each panel, the portfolio risk measures used as dependent variables include: CAPM beta (CAPM β), Bawa and Lindenberg (1977) beta (B&L β); Whaley beta (Whaley β); standard deviation (STD); semi-standard deviation (S-STD); idiosyncratic risk (IDIO); skewness (SKEW); and kurtosis (KURT) of monthly fund returns. The control variables represent one-year lagged fund characteristics. They include: log of fund assets; expense ratio; portfolio turnover; a load fund dummy; and fund age in years. The regressions include year fixed effects, fund style fixed effects, based on the most recent reported style, and family fixed effects. Standard errors are clustered by fund and *t*-statistics are reported in parentheses.

Table 7 continued

Panel A. Heavy and Light Users (N=11,476)							
Panel A.1. Performance Regressions (estimates in % /month)							
Dependent Variables:	CAPM α	F&F α	Carhart α	F&S α	B&L α	Whaley α	Leland α
Heavy User	-0.053	-0.043	-0.066	-0.107	-0.062	-0.073	-0.058
	(-0.90)	*(-0.76)*	*(-1.07)*	*(-1.67)*	*(-0.89)*	*(-1.05)*	*(-1.00)*
Light User	0.058	0.120	0.105	0.028	0.074	0.065	0.053
	(1.29)	*(2.59)*	*(2.31)*	*(0.54)*	*(1.40)*	*(1.19)*	*(1.16)*
Adjusted R^2	17.26%	18.49%	14.86%	18.32%	16.13%	18.93%	17.55%

Panel A.2. Risk Regressions

Dependent Variables:	CAPM β	B&L β	Whaley β	STD	S-STD	IDIO	SKEW	KURT
Heavy User	-0.089	-0.072	-0.039	-0.001	0.000	0.001	0.005	0.172
	(-1.37)	*(-0.97)*	*(-0.74)*	*(-0.89)*	*(-0.47)*	*(1.95)*	*(0.11)*	*(1.94)*
Light User	-0.045	-0.043	-0.030	-0.000	0.000	0.000	-0.018	-0.034
	(-1.33)	*(-1.16)*	*(-0.92)*	*(-0.05)*	*(0.20)*	*(0.68)*	*(-0.60)*	*(-0.47)*
Adjusted R^2	46.50%	39.53%	40.91%	80.91%	83.78%	53.44%	25.37%	34.33%

Table 7 continued

Panel B. User Categorized by Strategy (N=11,476)

Panel B.1. Performance Regressions (estimates in % /month)

Dependent Variables:	CAPM α	F&F α	Carhart α	F&S α	B&L α	Whaley α	Leland α
Call Writer	0.063	0.065	0.050	0.029	0.057	0.058	0.055
	(1.19)	*(1.41)*	*(1.06)*	*(0.47)*	*(0.93)*	*(0.96)*	*(1.06)*
Put Writer	-0.282	-0.085	-0.116	-0.270	-0.268	-0.266	-0.280
	(-2.19)	*(-0.85)*	*(-1.20)*	*(-1.98)*	*(-1.90)*	*(-1.88)*	*(-2.18)*
Call Buyer	-0.023	-0.004	-0.006	-0.098	0.013	-0.037	-0.022
	(-0.25)	*(-0.04)*	*(-0.05)*	*(-0.93)*	*(0.12)*	*(-0.33)*	*(-0.24)*
Put Buyer	0.047	0.130	0.071	-0.004	0.046	0.039	0.039
	(0.61)	*(1.57)*	*(0.79)*	*(-0.06)*	*(0.50)*	*(0.43)*	*(0.51)*
Adjusted R^2	17.30%	18.45%	14.79%	16.13%	18.32%	18.94%	17.59%

Panel B.2. Risk Regressions

Dependent Variables:	CAPM β	B&L β	Whaley β	STD	S-STD	IDIO	SKEW	KURT
Call Writer	-0.026	-0.017	-0.010	0.000	0.000	0.001	-0.065	0.248
	(-0.89)	*(-0.42)*	*(-0.26)*	*(0.04)*	*(0.23)*	*(1.22)*	*(-1.79)*	*(2.96)*
Put Writer	0.060	0.103	0.104	0.001	0.001	0.000	0.008	-0.199
	(1.40)	*(1.62)*	*(1.65)*	*(0.27)*	*(1.08)*	*(0.08)*	*(0.14)*	*(-1.67)*
Call Buyer	-0.039	-0.026	0.014	0.002	0.001	0.002	0.084	-0.144
	(-0.49)	*(-0.29)*	*(0.20)*	*(0.98)*	*(0.79)*	*(1.27)*	*(1.46)*	*(-1.61)*
Put Buyer	-0.174	-0.196	-0.153	-0.003	-0.002	0.001	0.107	-0.222
	(-1.69)	*(-1.75)*	*(-1.94)*	*(-1.44)*	*(-1.08)*	*(0.73)*	*(1.52)*	*(-1.57)*
Adjusted R^2	46.58%	39.63%	40.98%	80.91%	83.79%	53.43%	25.43%	34.41%

Table 7 continued

Panel C. Heavy Users Categorized by Strategy (N=11,239)							
Panel C.1. Performance Regressions (estimates in % /month)							
Dependent Variables:	CAPM α	F&F α	Carhart α	F&S α	B&L α	Whaley α	Leland α
Heavy Call Writer	0.032	0.012	-0.027	-0.016	0.037	0.039	0.027
	(0.38)	*(0.16)*	*(-0.34)*	*(-0.18)*	*(0.37)*	*(0.40)*	*(0.32)*
Heavy Put Writer	-0.265	-0.044	-0.050	-0.231	-0.314	-0.310	-0.267
	(-2.63)	*(-0.44)*	*(-0.51)*	*(-1.81)*	*(-2.48)*	*(-2.46)*	*(-2.58)*
Heavy Call Buyer	-0.320	-0.370	-0.345	-0.497	-0.350	-0.355	-0.320
	(-2.01)	*(-1.75)*	*(-1.33)*	*(-2.44)*	*(-1.80)*	*(-1.93)*	*(-2.05)*
Heavy Put Buyer	0.033	0.065	-0.015	0.011	0.054	0.021	0.031
	(0.28)	*(0.59)*	*(-0.10)*	*(0.10)*	*(0.37)*	*(0.15)*	*(0.26)*
Adjusted R^2	17.42%	19.41%	15.72%	16.37%	18.29%	18.97%	17.69%

Panel C.2. Risk Regressions

Dependent Variables:	CAPM β	B&L β	Whaley β	STD	S-STD	IDIO	SKEW	KURT
Heavy Call Writer	-0.051	-0.047	-0.030	0.000	0.000	0.001	-0.071	0.344
	(-1.02)	*(-0.68)*	*(-0.48)*	*(-0.26)*	*(-0.23)*	*(1.21)*	*(-1.23)*	*(2.76)*
Heavy Put Writer	0.066	0.128	0.125	0.000	0.001	0.000	0.016	-0.198
	(1.21)	*(1.68)*	*(1.66)*	*(-0.21)*	*(0.57)*	*(0.33)*	*(0.24)*	*(-1.75)*
Heavy Call Buyer	0.052	0.128	0.152	0.003	0.001	0.003	0.111	0.231
	(0.40)	*(0.77)*	*(1.06)*	*(0.81)*	*(0.50)*	*(1.36)*	*(1.00)*	*(1.64)*
Heavy Put Buyer	-0.384	-0.405	-0.308	-0.005	-0.003	0.001	0.190	-0.047
	(-2.06)	*(-1.95)*	*(-2.36)*	*(-3.19)*	*(-1.72)*	*(0.86)*	*(1.46)*	*(-0.20)*
Adjusted R^2	46.64%	39.34%	40.71%	81.21%	84.06%	53.68%	25.48%	34.54%

Table 8
Intra-Year Risk Change in Response to Interim Performance

Panel A reports regressions of changes in risk measures from the first to the second half of the year on the peer-adjusted return of the fund during the first half of the year (*Performance*); an indicator variable indicating whether a fund used options (*Option User*), the interaction term *Performance* × *Option User*; lagged value of the risk variable in the first half of the year, and the same set of control variables used in the previous section. In Panels B, C, and D we further stratify options users into additional categories and replace the Option User dummy with new dummy variables that reflect membership into those categories. In Panel B, we categorize users by the amount of options involvement in their portfolios. This is done by ranking and sorting all options users each year into two groups based on their average portfolio fraction invested in options. Options users with an average portfolio fraction above the cross-sectional median are classified as *heavy* users and the rest, as *light* users. In Panel C, we categorize options users by their main type of strategy. This is done by classifying options users each year into four groups: (1) Call Writer, (2) Put Writer, (3) Call Buyer, and (4) Put Buyer. Funds in the Call Writer group are funds for which written calls constituted at least half of their option portfolios in the previous year. A similar approach is used to define the other three groups. In Panel D, we exclude light options users from the sample of options users and use the intersection of the previous two categorizations to classify options users into: (1) Heavy Call Writer, (2) Heavy Put Writer, (3) Heavy Call Buyer, and (4) Heavy Put Buyer. We use changes in three measures of risk, systematic risk (CAPM β), total risk (STD), and idiosyncratic risk (IDIO) to construct our dependent variable. Performance is measured as the difference between the return of a given fund and the average return of funds that share the same investment style. The regressions include time fixed effects, fund style fixed effects, based on the most recent reported style, and family fixed effects. Standard errors are clustered by fund and *t*-statistics are reported in parentheses.

Table 8 continued

	Δ CAPM β	Δ STD	Δ IDIO
Panel A. Options Users as a Group (N=13,457)			
Performance	-3.5923	-0.0836	0.0726
	(-5.67)	*(-5.29)*	*(4.88)*
Option User	-0.0750	-0.0006	0.0001
	(-2.90)	*(-0.86)*	*(0.15)*
Performance*Option User	3.7111	-0.0841	0.0002
	(1.26)	*(-1.27)*	*(0.00)*
Adjusted R^2	22.02%	86.05%	36.93%
Panel B. Options Users Categorized by Level of Usage (N=13,457)			
Performance	-3.5874	-0.0834	0.0727
	(-5.67)	*(-5.28)*	*(4.89)*
Heavy User	-0.1085	-0.0009	0.0003
	(-2.86)	*(-1.11)*	*(0.37)*
Light User	-0.0530	-0.0004	-0.0001
	(-2.19)	*(-0.45)*	*(-0.13)*
Performance*Heavy User	2.8687	-0.1934	-0.0610
	(0.83)	*(-2.19)*	*(-0.94)*
Performance*Light User	4.6252	0.0308	0.0643
	(1.37)	*(0.34)*	*(0.77)*
Adjusted R^2	26.20%	86.06%	36.93%
Panel C. Options Users Categorized by Strategy Type (N=13,457)			
Performance	-3.5765	-0.0835	0.0750
	(-5.67)	*(-5.27)*	*(5.01)*
Call Writer	0.0026	0.0008	0.0009
	(0.11)	*(0.83)*	*(1.35)*
Put Writer	-0.0416	0.0003	-0.0003
	(-0.81)	*(0.15)*	*(-0.33)*
Call Buyer	-0.0343	0.0010	-0.0002
	(-0.71)	*(0.81)*	*(-0.19)*
Put Buyer	-0.0768	-0.0017	0.0006
	(-1.23)	*(-1.26)*	*(0.55)*
Performance*Call Writer	-1.8549	-0.1595	0.0216
	(-0.82)	*(-1.28)*	*(0.29)*
Performance*Put Writer	-5.4385	-0.0879	-0.2275
	(-0.94)	*(-0.41)*	*(-1.47)*
Performance*Call Buyer	-3.0398	-0.2542	-0.1365
	(-0.47)	*(-1.90)*	*(-0.87)*
Performance*Put Buyer	10.8949	-0.0148	0.0000
	(3.79)	*(-0.15)*	*(0.00)*
Adjusted R^2	26.23%	86.05%	36.94%

Table 8 continued

Panel D. Heavy Options Users Categorized by Strategy Type (N=13,298)			
Performance	-3.5255	-0.0805	0.0767
	(-5.64)	*(-5.14)*	*(5.15)*
Heavy Call Writer	-0.0486	0.0010	0.0000
	(-1.48)	*(0.83)*	*(0.02)*
Heavy Put Writer	-0.1509	-0.0049	-0.0021
	(-4.03)	*(-3.69)*	*(-1.79)*
Heavy Call Buyer	0.0041	-0.0006	0.0012
	(0.07)	*(-0.22)*	*(0.61)*
Heavy Put Buyer	-0.1349	-0.0025	0.0012
	(-1.22)	*(-1.26)*	*(0.58)*
Performance*Heavy Call Writer	-5.7188	-0.2680	0.0297
	(-1.98)	*(-1.87)*	*(0.34)*
Performance*Heavy Put Writer	-10.3250	-0.2749	-0.4619
	(-1.32)	*(-1.04)*	*(-2.24)*
Performance*Heavy Call Buyer	3.0238	-0.3925	-0.2117
	(0.35)	*(-2.38)*	*(-1.02)*
Performance*Heavy Put Buyer	11.8802	-0.0909	-0.1101
	(3.65)	*(-0.84)*	*(-1.26)*
Adjusted R^2	26.45%	86.33%	37.35%

Appendix A

Table 1
Relation between Option Usage and Raw Returns

This table reports coefficient estimates from regressions of fund raw returns of options users on the fraction of portfolio positions in options. Control variables include: portfolio fraction invested in common stocks, portfolio fraction invested in bonds, the log of total net assets measured in millions of dollars; expense ratio; fund's age in years; a load dummy, and portfolio turnover. Estimation is conducted employing the Fama-Macbeth methodology. Every period, we estimate the cross-sectional regression of fund returns on the fraction of portfolio positions in options. The resulting time-series of coefficients is used to compute a mean and standard error which is corrected for autocorrelation using the Newey-West correction. *t*-statistics are presented in parentheses.

	Dependent Variable: Monthly Fund Return		
Independent Variables	1	2	3
Option Portfolio Fraction	-0.025	-0.018	-0.022
	(-2.50)	*(-2.01)*	*(-2.18)*
Controls	No	Yes	Yes
Style Fixed Effects	No	No	Yes
Average Adjusted R^2	3.67%	23.86%	33.75%

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