Original Article

On derivatives use by equity-specialized hedge funds

Received (in revised form): 9th August 2010

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ABSTRACT This study examines the performance and risk characteristics associated with derivatives use by equity-specialized hedge funds. For equity options, the results provide little evidence for profitability of the usage, but they are found to be associated with lower risk. Equity options are likely to be used for option writing strategies given their negative association with the skewness of hedge fund returns. For equity index futures, the results show evidence that the use of equity index futures is associated with lower performance as being substitute to share restrictions.

Journal of Derivatives & Hedge Funds (2011) **17**, 42–62. doi:10.1057/jdhf.2010.21

Keywords: hedge funds; options; equity index futures

INTRODUCTION

As hedge funds are well able to use derivatives, it is motivated to investigate their use. Derivatives use by hedge funds is well investigated by Chen,¹ but the study does not consider different asset focuses of hedge funds. Considering the asset focuses may be important as, for example, hedge funds that focus on equity may use derivatives very differently in comparison to hedge funds that focus on fixed-income. This study focuses on the use of derivatives for equity as the primary asset class of a hedge fund, and examines whether such use of equity options and equity index futures is associated with their performance and risk. The use of equity options

when the primary asset class of a hedge fund is the same is hereafter defined as *the equity-specialized use of options*.

Focusing on equity-specialized use of options is reasonable as it is considering the most significant asset class of fund activities that makes derivative use for the asset class relevant. The reason to focus on equity-specialized use of options follows the study by Aragon and Martin.² The study implies that hedge funds use options for informed trading as options holdings by hedge funds include more predictive power than their stock holdings. The use of equity index futures in turn is found to be important for mutual funds by Frino *et al*³ as the study suggests

that the futures may be used to manage fund flows more efficiently. Hedge funds, contrary to mutual funds, are well capable of restricting fund flows, and in this way manage their liquidity more efficiently. Restricting fund flows by hedge funds is indeed found to be associated with their abnormal returns, and thereby higher illiquidity premium by Aragon.⁴ For hedge funds, the use of equity index futures may be seen as a substitute for restricting fund flows, and thus also associated with lower abnormal performance in accordance with lower illiquidity premium. Taking the above reasoning together, it is hypothesized that the asset-specialized use of options (equity index futures) is associated with higher (lower) performance. To test the hypotheses above, a sample of 3403 live and dead hedge funds collected from the Lipper TASS database over the period 1994–2006 is used.

The results of the study present evidence that the equity-specialized use of options can be profitable when the performance of a hedge fund is measured using the conventional Sharpe ratio. However, the results for the impact of options use by a hedge fund on its appraisal ratio, which also counts for the exposure of hedge funds to popular option writing strategies, do not provide support for profitable use of options by hedge funds. The use of equity index futures is found to be associated with lower abnormal performance consistent with the hypothesis that these derivatives are associated with lower illiquidity premium.

The remainder of this article is organized as follows: the next section reviews the literature on the derivatives use by hedge funds. The section after that is for presentation of the hypotheses of this study. The subsequent section presents data and methodology of this study. The penultimate section presents the

results of the study and the last section concludes the study.

HEDGE FUNDS AND DERIVATIVE USE

Aragon and Martin² investigate common equity and equity options use by hedge funds considering their use for hedging. In their study, they make use of a data set of Securities Exchange Commission (SEC)-required quarterly disclosures that covers the holdings of 250 hedge fund advisors over the period 1999–2005. The study evinces that options holdings by hedge funds are likely to have more predictive power than stock holdings. In the study, the greatest return predictability is found for holdings of put options having high liquidity in comparison to the underlying stock, in addition to holdings of deep-out-of-the-money options.

In the following study, Aragon and Martin⁵ make use of the same data source as in their previous study over the period 1999–2006. The results of the study imply that options use is associated with relatively high subsequent volatility on the underlying security, which can be exploited by option trading. Subsequent abnormal stock returns are also found to be positively associated with call options holdings and negatively associated with put holdings. This result clearly suggests that hedge funds use options in informed trading. Indeed, it is found that by following hedge fund options holdings, it is possible to earn annualized abnormal returns of 14.8 per cent.

Chen¹ focuses on investigating derivatives use and risk taking of hedge funds by using a large sample of hedge funds collected from the Lipper TASS database. He also notices that 71 per cent of hedge funds use derivatives, which is a

relatively high ratio in comparison to mutual funds. In general, the results of the study suggest that derivatives use by hedge funds is associated with lower risk, and derivatives are used for risk management. Yet, the implications of the study differ significantly from the study Aragon and Martin,⁵ which states 'Overall the results highlight a previously undocumented speculative role of derivatives among professional investors'.

HYPOTHESIS DEVELOPMENT

Options use and hedge fund performance

Consideration of the use of equity options by hedge funds is interesting as there is evidence for profitable option strategies, and particularly the covered call strategy, which involves writing call options against underlying equities simultaneously (see Isakov and Morard;⁶ Whaley;⁷ McIntyre and Jackson 2007;⁸ Kapadia and Szado 2007⁹). Yet, implementing options use in practice may be costly, as the study by Bauer *et al*¹⁰ suggests that option trading has a detrimental impact on the performance of individual investors.

For hedge funds, Aragon and Martin² find that the option holdings include more predictive power than their stock holdings, implying that hedge funds use options for informed trading. Informed trading by a hedge fund should follow the asset specialization of a hedge fund. This assumption should be credible, as Eichhold *et al*¹¹ show evidence for real estate investment trusts (REIT) investment trusts that their property specialization leads to outperformance. There is also similar evidence for industry specialization of mutual funds. Kacperczyk *et al*¹² present evidence that industry specialization in

mutual fund industry may be beneficial. Chen¹³ also finds that hedge funds show market timing ability in their focus market, implying that the asset specialization of a hedge fund is beneficial. In a close relation to the assumed performance-specialization relation, the results of Teo¹⁴ suggest that hedge funds focusing on the physical presence of a hedge fund close to their market leads to information advantage. The asset focus of a hedge fund would similarly lead to information advantage.

The above evidence supports the view that asset specialization results in greater likelihood of information advantage, and benefits from the use of options are seen most of all when the performance from the use of options for each asset class is examined with respect to the asset specialization of a fund.

In addition to the possibility of using options for informed trading, options and other derivatives can be used in various profitable investment strategies such as volatility trading and the covered call strategy. Some studies suggest that derivative strategies can improve portfolio performance (for example, Hill *et al*¹⁵ and Guo¹⁶). These studies, together with the possibility of using options for informed trading, lead to the following hypothesis:

Hypothesis 1: The equity-specialized use of options increases hedge fund performance.

Other considerations for options use and hedge fund performance

It must be also considered that the use of options by hedge funds may be associated with the risk of a hedge fund, and the risk characteristics depend on the strategy. If options are used to enhance returns, it is likely to result in a fatter left tail of

the return distribution of a hedge fund. For example, when the covered call strategy is used, an investor gives up upside potential but receives premium being left-skewed toward losses as the downside potential of the strategy remains. In general, writing options should result in more negative skewness. Analogously, if options were used to achieve protection, it would result in lower premiums as a cost protection but also higher skewness due to control of loss potential. The former kind use of options is more likely for hedge funds, as the results of Agarwal and Naik¹⁷ evince that option writing strategies resemble hedge fund returns well.

The use of options also subsumes model risk in addition to market risk. Green and Figlewski¹⁸ emphasize the heavy use of quantitative models in derivatives valuation and risk management. Simulation run by the authors evince that imperfect models and inaccurate volatility forecasts are an additional risk for option writers. This risk is especially relevant for hedge funds that extensively use quantitative models to perform their trading strategies.

Equity index futures and hedge fund performance

Considering the use of other derivatives, the use of equity index futures for cash management becomes relevant. The first study implying the use of this derivative type for cash management is the study by Koski and Pontiff,¹⁹ which shows evidence for mutual fund managers using derivatives to alleviate the impact of new fund inflows on fund risk. This result may also have relevance for hedge fund performance, as the study by Edelen²⁰ relates fund flows negatively to its alpha based on a rationale that new cash force mutual fund managers to engage in

liquidity-motivated trading instead of informed trading. When forced to engage in uninformed trading, the abnormal returns of a fund may suffer from trading costs. Equity index futures in turn are highly liquid, and can be used to adjust the exposure of the fund to the desired risk under new cash flows. Frino *et al*³ follow this rationale when investigating the use of stock index futures for the management of cash flows. They find that derivative-based management can prevent the negative impact of new cash on the alpha of a mutual fund.

In the hedge fund industry, the use of equity index futures may be a substitute for share restrictions, which can be used to manage liquidity efficiently. For instance, some less promising hedge funds may lack bargaining power to impose sufficiently restrictive redemption policy to attract investors. These funds can then use inferior financial instruments (regarding their strategy) to manage liquidity. Share restrictions that restrict fund flows are seen as proxies for illiquidity premium (see Aragon⁴), and the use of equity index futures would imply lower illiquidity premium because the instrument itself can be considered highly liquid. Low illiquidity premium would result in lower measured abnormal performance. These arguments lead to the following hypothesis, which is sensible to direct at hedge funds that focus on equity:

Hypothesis 2: The equity-specialized use of equity index futures is related to lower hedge fund performance.

DATA AND METHODOLOGY

The empirical analysis of this study begins with univariate analysis of hedge fund risk and

performance on equity-specialized use of options and index futures. Specifically, this analysis tests whether risk and performance of those hedge funds that employ this type of derivatives use differ from the remaining funds that have the same asset-specialization.

This study continues with the ordinary least squares (OLS) analysis, which is used to provide a detailed picture of the use of options and other derivatives by equity-specialized hedge funds. Other variables that may explain hedge-fund performance and risk are controlled for and presented in Table 1. The control variables chosen are mainly followed by Chen's¹ study, which presents evidence that higher minimum investments, higher incentive fees, less restrictive redemption policy, managerial ownership, the absence of lockup periods, the absence of high watermarks, and the use of auditing services are associated with the use of derivatives of hedge funds. The variables are presented in Table 1. In addition, control dummy variables are used for other asset focuses, the use of other assets, and time-effect. The dummy variables for the time-effect are annual taking the value of 1 if a hedge fund is listed in the database at least 6 months during the year.

The empirical model for the OLS analysis is the following:

$$MEASURE_{ji} = \alpha_i + \sum_{j=1}^N \lambda_j CONTROL_{ji} + \sum_{j=1}^N \beta_j DERIVATIVE_{ji} + e_i, \quad (1)$$

where $MEASURE_{ji}$ defines a risk/performance measure j of fund i ; $CONTROL_{ji}$ defines an additional control variable j of fund i , and $DERIVATIVE_{ji}$ defines a dummy variable for the use of a derivative j by fund i (1 if the derivative is used, and 0 otherwise). The

variables for derivatives use include options use for equity, fixed-income, commodity, currency. The use of derivatives that have linear payoff structures (swaps, futures and forwards) are used as variables for each above-mentioned asset classes. The use of warrants for equity and fixed-income are used as separate variables. For equities, TASS reports only the use of index futures, not other equity futures.

Performance measures used in this study are the Sharpe ratio, alpha and appraisal ratio of a hedge fund. Risk measures used in this study are the sample standard deviation, skewness, excess kurtosis, and the Cornish–Fischer expansion of the Modified Value-at-Risk (MVaR) measure. S defines skewness and K defines excess kurtosis, The Cornish–Fischer Expansion is defined as follows:

$$CF = z(\alpha) + \frac{1}{6} (z(\alpha)^2 - 1) S + \frac{1}{24} (z(\alpha)^3 - 3z(\alpha)) K - \frac{1}{36} (2z(\alpha)^3 - 5z(\alpha)) S^2, \quad (2)$$

where $z(\alpha)$ defines the critical value corresponding to the chosen confidence level, and CF defines the critical value used in the estimation of MVaR estimate. A confidence interval of 99 per cent is used in the estimation of the Cornish–Fischer expansion. The alpha is estimated from a factor model that includes the following explanatory variables:

1. the value-weight excess return on stocks listed on the US stock markets;
2. Fama and Fench's²¹ high-minus-low (HML) factor (value anomaly);
3. Fama and Fench's²¹ small-minus-big (SMB) factor (size anomaly);
4. Carhart's²² momentum factor;

Table 1: Variable definitions*Variables: Fund characteristics (dummy variables: 1 if yes)*

LNSIZE	Natural logarithm of size
LNAGE	Natural logarithm of age
MFEE	Management fee (%)
IFEE	Incentive fee (%)
HWMARK	Dummy variable for the use of a high watermark
LEVERAGED	Dummy variable for the use of leverage
PERCAPITAL	Dummy variable for manager's personal capital invested in the fund
LOCKUP	Lockup period (months)
RESTRICTION	The sum of payout and redemption periods (days, see Agarwal, Daniel and Naik 2009)
MIN	Minimum investment (USD)
AUDIT	Dummy variable to indicate whether a fund is audited (see Liang 2003)
OPENTOPUBLIC	Dummy variable to indicate whether a fund is open to public
OPENENDED	Dummy variable to indicate whether a fund is open ended

Variables: Derivatives use dummy variables (dummy variables: 1 if yes)

E_OPTIONS	Equity options
F_OPTIONS	Fixed-income options
C_OPTIONS	Commodity options
CUR_OPTIONS	Currency options
E_WARRANTS	Equity warrants
F_WARRANTS	Fixed-income warrants
E_OTHER	Other equity derivatives than options or warrants
F_OTHER	Other fixed-income derivatives than options or warrants
C_OTHER	Other commodity derivatives than options
CUR_OTHER	Other currency derivatives than options

Variables: Performance and risk

SHARPE	Sharpe ratio
ALPHA	Alpha
APPRAISAL	Appraisal ratio
MEAN	Mean return (arithmetic)
STDEV	Standard deviation of returns
SKEW	Skewness of returns
EXKURT	Excess kurtosis of returns
CF	Cornish–Fischer expansion on returns

This table presents variable definitions of this study.

5. primitive trend following factors (PTFS) for equities, interest rates, bonds, currency and commodities by Fung and Hsieh²³;
6. the end of the month difference in the VIX implied volatility;
7. returns in excess of risk-free rate on CBOE S&P 500 Buy Write Index, CBOE S&P 500 2 per cent OTM Buy Write Index, and CBOE S&P 500 Put Write Index.²⁴

Data for hedge funds are collected from the Lipper TASS hedge fund database and downloaded in November 2007. The data period is from January 1994 to December 2006. The sample consists of 3403 live and dead hedge funds that have at least 24 months return history, and report net-of-fee monthly returns in US dollars. Hedge fund returns between January and October 2007 are excluded, which results in an annually complete sample, and late reporting bias is reduced (see Tiu²⁵). Missing observations for some control variables reduce the adjusted sample size for the OLS analysis to 3382 observations in total except for univariate analysis. All returns are in excess of the risk-free rate. The rate is calculated over 1 month US T-bill rate of return from Ibbotson Associates for which the data are downloaded from Kenneth French's webpage.

Table 2 presents descriptive statistics of this study for the full sample. The average alpha for all funds is 0.5 per cent, and the distribution of alphas is positively skewed (skewness 2.97). The average skewness is 0.07, implying that the returns of an average fund are not concentrated in the left tail of its return distribution.

RESULTS

Univariate analysis

Table 3 presents a univariate analysis of equity-specialized options use of a hedge fund

on its performance and risk measures. The test statistics suggest that equity-specialized equity options users on average achieve better performance than nonusers. However, the difference in performance is not statistically significant for alpha, and the statistical significance is weaker for the appraisal ratio. This finding is not surprising as the Sharpe ratio cannot account for nonlinear characteristics, and alpha is estimated using the empirical risk factors that include simple option writing strategies. The results also suggest that equity option users have lower risk and higher returns.

The results for the use of equity index futures are in line with Hypothesis 2 when Sharpe and appraisal ratios are used as their users show significantly higher performance than non-users. For abnormal returns, however, the results are not statistically significant. However, control variables are not yet used, which may affect the results significantly.

Multivariate analysis of derivatives use

Table 4 presents the results for the impact of the use of derivatives on the mean and standard deviation estimates of hedge funds. In addition, in the sample of equity-specialized funds, the use of other derivatives than options and warrants for equity and commodity have a statistically significant and negative impact on the mean return of a hedge fund. The regression statistics of standard deviation on derivatives use provide support for risk management consistent use of derivatives by hedge funds. The use of these options by equity-specialized funds is associated with lower standard deviation by 0.425 per cent. The latter result is consistent with those of Chen,¹

Table 2: Descriptive statistics

	<i>LNSIZE</i>	<i>LNAGE</i>	<i>IFEE</i>	<i>HMARK</i>	<i>MFEE</i>	<i>MIN</i>	<i>RESTRICTION</i>
Mean	17.17	7.62	18.85	0.63	1.47	782 321.30	46.71
Maximum	22.49	10.58	50.00	1.00	8.00	25 000 000.00	700.00
Minimum	3.40	6.55	0.00	0.00	0.00	0.00	0.00
SD	1.73	0.57	5.08	0.48	0.72	1 303 007.00	37.93
Skewness	−0.48	0.26	−1.57	−0.53	2.49	7.96	2.69
Kurtosis	5.22	2.47	13.01	1.28	15.76	117.33	33.99

	<i>LOCKUP</i>	<i>STDEV</i>	<i>MEAN</i>	<i>CF</i>	<i>SKEW</i>	<i>EXKURT</i>
Mean	3.60	4.13	0.92	−2.46	0.07	3.38
Maximum	48.00	73.69	7.81	9.96	7.65	109.03
Minimum	0.00	0.05	−6.68	−7.60	−10.11	−1.33
SD	6.22	3.64	0.89	1.07	1.27	7.20
Skewness	1.88	4.36	0.58	1.75	−1.15	6.93
Kurtosis	7.43	55.55	11.79	21.61	13.94	70.53

	<i>SHARPE</i>	<i>APPRAISAL</i>	<i>ALPHA</i>
Mean	0.24	0.26	0.50
Maximum	7.88	12.35	26.96
Minimum	−0.80	−5.23	−11.57
SD	0.36	0.62	1.36
Skewness	6.82	4.29	2.97
Kurtosis	106.84	70.36	62.04

This table presents descriptive statistics of non-dummy variables used in this study.

and implies that equity-specialized use of equity options may decrease the risk of a hedge fund.

Table 5 presents the results for the impact of derivatives use on the Sharpe ratio, alpha and appraisal ratio of a hedge fund. The results provide support for Hypothesis 1 as the impact of the equity-specialized use of options increases a Sharpe ratio by 0.023, and the impact is statistically significant at the 5 per cent level. In contrast to the use of equity options, the

use of other currency derivatives than options has a statistically significant (10 per cent level) and negative impact on the Sharpe ratio of equity-specialized funds. Equity-specialized funds may use these derivatives to hedge currency-related risk, and therefore this finding is slightly surprising. This result is in contrast to the viewpoint that the primary purpose for using derivatives is risk management. Alternatively, the result may suggest that hedging is expensive and difficult to practise.

Table 3: Univariate analysis of derivatives use

<i>AE_options</i>	<i>Sharpe</i>	<i>Appraisal</i>	<i>Alpha</i>	<i>Mean</i>
No (795)	0.16	0.17	0.42	0.89
Yes (1059)	0.22	0.21	0.46	0.99
<i>t</i> -statistic	<i>5.01</i>	1.93	<i>0.52</i>	<i>2.24</i>
Probability	0.000	0.053	0.606	0.025
<i>AE_options</i>	<i>Skew</i>	<i>Stdev</i>	<i>Exkurt</i>	<i>CF</i>
No (795)	0.19	4.92	2.43	−2.39
Yes (1059)	0.12	4.46	3.23	−2.47
<i>t</i> -statistic	<i>1.29</i>	<i>2.74</i>	<i>−3.33</i>	<i>1.66</i>
Probability	0.198	0.006	0.001	0.098
<i>AE_other</i>	<i>Sharpe</i>	<i>Appraisal</i>	<i>Alpha</i>	<i>Mean</i>
No (132)	0.22	0.20	0.47	1.00
Yes (117)	0.16	0.17	0.39	0.84
<i>t</i> -statistic	<i>5.19</i>	<i>1.77</i>	<i>1.40</i>	<i>3.64</i>
Probability	0.000	0.077	0.162	0.000
<i>AE_Other</i>	<i>Skew</i>	<i>Stdev</i>	<i>Exkurt</i>	<i>CF</i>
No (132)	0.12	3.94	2.85	−2.45
Yes (117)	0.20	4.60	2.96	−2.41
<i>t</i> -statistic	<i>−1.45</i>	<i>−4.82</i>	<i>−0.47</i>	<i>−0.86</i>
Probability	0.148	0.000	0.639	0.391

Panel A of this table presents the univariate analysis (equality of means) of equity-specialized options use. Panel B of this table presents the univariate analysis of asset-specialized equity index futures use. *t*-statistics are given in italics, and the level of statistical significance is presented below the *t*-statistics. The number of observations for funds using the derivative (Yes) and funds not using the derivative (No) is presented in parentheses on the right of the indicator. The highest mean is given in bold face. The sample includes 1854 funds.

The results for alpha and appraisal ratio are different in relation to the results of the Sharpe ratio. Specifically, the asset-specialized use of equity options does not have a statistically significant impact on alpha, which is consistent with the univariate analysis, and the impact is rather negative according to these statistics. This result clearly implies that the empirical factor model is capable of accounting for the positive performance impact of the asset-specialized use of equity options. The results for performance ratios and the standard deviation are similar to those presented by Aragon and Martin⁵ for hedge fund advisors using options and not using options (see Table 12 of the study by Aragon and Martin²). The difference in their study is that their information regarding options use is from (SEC)-required Form 13F portfolio disclosures while this study uses information from the TASS database. This result implies that the voluntary presented information in the TASS database is reliable.

The results also provide evidence for Hypothesis 2 as the test statistics for alpha also suggest that the equity-specialized use of index futures is associated with poorer performance. Specifically, this use has a statistically significant and negative impact so that the use of these derivatives decreases the alpha of a hedge fund by −0.188 per cent. The result is not consistent with those of the univariate analysis.

Table 6 presents the results for the impact of derivatives use on skewness, excess kurtosis and the Cornish–Fischer expansion with 99 per cent confidence level, which accounts for both skewness and excess kurtosis. The regression statistics of the skewness of a hedge fund return distribution on derivatives use suggest that the equity-specialized use of options is generally associated with lower skewness having

Table 4: Regression statistics of mean return and risk measures on derivatives use

Dep. var.: MEAN Variable	All			Equity			Dep. var.: STDEV Variable			All			Equity		
	Coef.	t		Coef.	t		Coef.	t		Coef.	t		Coef.	t	
C	-2.734***	-4.68		-2.161***	-2.71	C	3.806*	1.66		3.806*	1.66		10.505***	4.26	
LNSIZE	0.064***	6.28		0.074***	5.31	LNSIZE	-0.282***	-6.89		-0.282***	-6.89		-0.258***	-5.13	
LNAGE	0.300***	3.81		0.196**	1.82	LNAGE	0.449	1.31		0.449	1.31		-0.439	-1.26	
HMARK	0.000	-0.01		0.073	1.50	HMARK	-0.333**	-2.39		-0.333**	-2.39		-0.389**	-2.16	
IFEE	0.009***	2.89		0.005	1.18	IFEE	0.049***	4.48		0.049***	4.48		0.030**	2.02	
MFEE	0.036	1.41		0.043	1.10	MFEE	0.229**	2.00		0.229**	2.00		0.128	0.95	
LEVERAGED	0.079**	2.57		0.098**	2.36	LEVERAGED	0.554***	5.24		0.554***	5.24		0.824***	5.64	
LOCKUP	0.010***	3.97		0.008**	2.15	LOCKUP	0.035***	3.88		0.035***	3.88		0.044***	3.42	
MININVESTMENT	0.000***	-3.17		0.000**	-2.14	MININVESTMENT	0.000***	-3.10		0.000***	-3.10		0.000**	-2.05	
RESTRICTION	0.002***	4.38		0.003***	3.14	RESTRICTION	0.000	0.01		0.000	0.01		0.002	0.69	
AUDIT	-0.008	-0.19		0.027	0.43	AUDIT	-0.211	-1.33		-0.211	-1.33		-0.207	-0.98	
PERCAPITAL	0.072**	2.49		0.108***	2.62	PERCAPITAL	0.141	1.20		0.141	1.20		0.343**	2.34	
OPENTOPUBLIC	-0.069*	-1.68		-0.014	-0.22	OPENTOPUBLIC	-0.047	-0.36		-0.047	-0.36		0.153	0.80	
OPENENDED	0.005	0.14		0.020	0.42	OPENENDED	-0.038	-0.35		-0.038	-0.35		-0.182	-1.21	
AE_OPTIONS	-0.023	-0.63		0.012	0.26	AE_OPTIONS	-0.159	-1.18		-0.159	-1.18		-0.425**	-2.36	
AF_OPTIONS	-0.159***	-2.95		-0.223***	-2.61	AF_OPTIONS	-0.427**	-2.24		-0.427**	-2.24		-0.490	-1.52	
AC_OPTIONS	0.076	0.79		-0.017	-0.10	AC_OPTIONS	0.429	0.99		0.429	0.99		0.271	0.62	
ACUR_OPTIONS	-0.018	-0.30		0.001	0.01	ACUR_OPTIONS	0.216	0.96		0.216	0.96		0.357	1.05	
AE_WARRANTS	0.073	1.53		0.099	1.63	AE_WARRANTS	0.354**	2.27		0.354**	2.27		0.454**	2.31	
AF_WARRANTS	-0.037	-0.63		-0.010	-0.11	AF_WARRANTS	0.198	0.86		0.198	0.86		0.133	0.36	
AE_OTHER	-0.095**	-2.41		-0.113**	-2.14	AE_OTHER	-0.260*	-1.69		-0.260*	-1.69		-0.132	-0.67	
AF_OTHER	0.096*	1.79		0.141*	1.72	AF_OTHER	0.146	0.82		0.146	0.82		0.282	1.01	
AC_OTHER	-0.167*	-1.84		-0.350**	-2.00	AC_OTHER	0.537*	1.87		0.537*	1.87		0.401	0.94	

Table 4 Continued

Dep. var.: MEAN Variable	All		Equity		Dep. var.: STDEV Variable		All		Equity	
	Coef.	<i>t</i>	Coef.	<i>t</i>			Coef.	<i>t</i>	Coef.	<i>t</i>
ACUR_OTHER	0.008	0.15	-0.064	-0.85	ACUR_OTHER		-0.017	-0.10	-0.298	-1.19
Strategy dummies	Yes	—	Yes	—	Strategy dummies		Yes	—	Yes	—
Time dummies	Yes	—	Yes	—	Time dummies		Yes	—	Yes	—
Asset dummies	Yes	—	Yes	—	Asset dummies		Yes	—	Yes	—
Adjusted <i>R</i> -squared	0.17	—	0.20	—	Adjusted <i>R</i> -squared		0.28	—	0.32	—
<i>F</i> -statistic	14.33	—	10.27	—	<i>F</i> -statistic		25.94	—	18.05	—
Durbin-Watson stat	1.91	—	1.95	—	Durbin-Watson stat		1.90	—	1.91	—
<i>N</i>	3382	—	1841	—	<i>N</i>		3382	—	1841	—

This table presents the parameter estimates of the cross-sectional analysis for the mean return and risk estimates of hedge funds. The model for the cross-sectional analysis is the following:

$$MEASURE_{E_{ji}} = \alpha + \sum_{j=1}^N \lambda_j CONTROL_{L_{ji}} + \sum_{j=1}^N \beta_j DERIVATIVE_{E_{ji}} + e, \quad (1)$$

where $MEASURE_{E_{ji}}$ defines a mean return or a risk measure j of fund i ; $CONTROL_{L_{ji}}$ defines an additional control variable j of fund i , and $DERIVATIVE_{E_{ji}}$ defines a dummy variable for the use of a derivative j by fund i (1 if the derivative is used, otherwise 0). Asset dummies include controls for assets and primary assets in which hedge funds report investing. This table also presents the Durbin-Watson test for the first-order serial correlation. The standard errors are White (1980) heteroskedasticity robust t -statistics are given in italics. See Table 1 for definitions of the variables.

★ refers to a statistical significance at the 10 per cent level; ★★ refers to a statistical significance at the 5 per cent level; ★★★ refers to a statistical significance at the 1 per cent level.

Table 5: Regression statistics of performance measures on derivatives use

Variable	SHARPE		ALPHA		APPRAISAL	
	Coef.	t	Coef.	t	Coef.	t
<i>Full sample</i>						
C	-0.634**	-2.24	-4.309***	-4.01	-0.952*	-1.75
LN SIZE	0.034***	11.52	0.067***	3.90	0.049***	7.32
LN AGE	0.052	1.30	0.436***	2.86	0.046	0.61
H MARK	0.000	-0.03	0.039	0.66	0.012	0.44
IFEE	0.000	-0.08	0.017***	3.25	0.002	0.82
MFEE	-0.001	-0.15	0.121**	2.34	0.028**	2.10
LEVERAGED	0.008	0.60	0.101**	2.10	0.031	1.35
MIN INVESTMENT	0.000	-0.96	0.000**	-2.17	0.000	-0.13
RESTRICTION	0.001***	3.86	0.002**	2.31	0.002***	3.40
LOCKUP	0.002**	2.18	0.007**	2.11	0.002	1.24
AUDIT	-0.009	-0.63	-0.062	-0.86	-0.010	-0.33
PERCAPITAL	0.009	0.81	0.037	0.76	0.013	0.66
OPENTOPUBLIC	-0.051***	-3.54	-0.151**	-2.59	-0.111***	-4.29
OPENENDED	0.013	0.89	0.051	1.08	0.041	1.53
AE_OPTIONS	-0.003	-0.26	-0.021	-0.37	0.005	0.25
AF_OPTIONS	-0.041	-1.53	-0.040	-0.54	-0.050	-1.09
AC_OPTIONS	0.044	1.94	-0.078	-0.43	-0.003	-0.07
ACUR_OPTIONS	-0.026	-1.62	0.050	0.52	-0.018	-0.53
AE_WARRANTS	-0.007	-0.59	-0.004	-0.05	-0.052**	-2.15
AF_WARRANTS	-0.019	-0.94	0.035	0.39	0.033	0.83
AE_OTHER	0.015	1.26	-0.173***	-2.61	-0.003	-0.12
AF_OTHER	-0.025	-1.00	0.052	0.69	-0.004	-0.08
AC_OTHER	-0.049**	-2.23	0.138	0.98	0.010	0.19
ACUR_OTHER	0.000	0.03	0.021	0.27	-0.012	-0.38
Strategy dummies	Yes	—	Yes	—	Yes	—

Table 5 Continued

<i>Variable</i>	<i>SHARPE</i>		<i>ALPHA</i>		<i>APPRAISAL</i>	
	<i>Coef.</i>	<i>t</i>	<i>Coef.</i>	<i>t</i>	<i>Coef.</i>	<i>t</i>
Time dummies	Yes	—	Yes	—	Yes	—
Asset dummies	Yes	—	Yes	—	Yes	—
Adjusted <i>R</i> -squared	0.23	—	0.07	—	0.12	—
<i>F</i> -statistic	19.76	—	5.62	—	9.34	—
Durbin–Watson stat	1.94	—	1.90	—	1.91	—
<i>N</i>	3382	—	3382	—	3382	—
<i>Equity sample</i>						
<i>C</i>	−0.904***	−4.75	−3.022**	−2.37	−1.068**	−2.25
LN <i>SIZE</i>	0.032***	8.42	0.074***	3.59	0.039***	4.64
LN <i>AGE</i>	0.087***	3.20	0.160	0.91	0.061	0.90
H <i>MARK</i>	0.022*	1.93	0.075	1.09	0.005	0.24
I <i>FEE</i>	0.001	1.09	0.021***	3.39	0.008***	3.35
M <i>FEE</i>	0.002	0.30	0.175***	2.80	0.048***	2.85
LEVERAGED	−0.003	−0.32	0.006	1.32	0.000	0.16
MININVESTMENT	−0.001	−0.62	0.000	−1.53	0.000	1.12
RESTRICTION	0.000	0.82	0.002**	2.22	0.001**	2.32
LOCKUP	0.001**	2.50	0.053	0.56	−0.001	−0.04
AUDIT	−0.013	−0.91	0.058	0.96	0.007	0.33
PERCAPITAL	0.016	1.70	−0.015	−0.18	−0.049*	−1.81
OPENTOPUBLIC	−0.033***	−2.62	0.117	1.82	0.035	1.38
OPENENDED	−0.001	−0.05	0.086	1.36	0.022	0.91
AF_OPTIONS	0.023**	2.00	−0.026	−0.34	0.006	0.25
AF_OPTIONS	−0.024	−1.15	0.070	0.60	0.035	0.97
AC_OPTIONS	−0.015	−0.61	−0.275	−1.32	−0.071	−1.38

ACUR_OPTIONS	-0.015	-0.76	0.132	1.02	0.003	0.06
AE_WARRANTS	-0.001	-0.09	0.075	0.83	-0.013	-0.52
AF_WARRANTS	-0.004	-0.18	0.066	0.48	0.040	0.99
AE_OTHER	-0.018	-1.52	-0.188**	-2.29	-0.040	-1.61
AF_OTHER	-0.009	-0.46	0.000	0.00	-0.008	-0.21
AC_OTHER	-0.032	-1.07	-0.017	-0.07	0.021	0.32
ACUR_OTHER	-0.032*	-1.77	-0.046	-0.48	-0.036	-1.00
Strategy dummies	Yes	—	Yes	—	Yes	—
Time dummies	Yes	—	Yes	—	Yes	—
Asset dummies	Yes	—	Yes	—	Yes	—
Adjusted <i>R</i> -squared	0.33	—	0.07	—	0.13	—
<i>F</i> -statistic	19.39	—	3.64	—	6.32	—
Durbin–Watson stat	1.86	—	1.88	—	1.90	—
<i>N</i>	1841.00	—	1841.00	—	1841.00	—

This table presents parameter estimates of cross-sectional analysis for performance estimates of hedge funds. The model for the cross-sectional analysis is the following (Model 2):

$$MEASURE_{ji} = \alpha + \sum_{j=1}^N \lambda_j CONTROL_{ji} + \sum_{j=1}^N \beta_j DERIVATIVE_{ji} + \epsilon, \quad (1)$$

where $MEASURE_{ji}$ defines a performance measure j of fund i ; $CONTROL_{ji}$ defines an additional control variable j of fund i , and $DERIVATIVE_{ji}$ defines a dummy variable for the use of a derivative j by fund i (1 if the derivative is used, otherwise 0). Asset dummies include controls for assets and primary assets in which hedge funds report investing. This table also presents the Durbin–Watson test for the first-order serial correlation. *t*-statistics are given in italics. The standard errors are White (1980) heteroskedasticity robust. *t*-statistics are given in italics. See Table 1 for definitions of the other variables.

★ refers to a statistical significance at the 10 per cent level; ** refers to a statistical significance at the 5 per cent level; *** refers to a statistical significance at the 1 per cent level.

Table 6: Regression statistics of higher moments on derivatives use

Variable	EXKURT		CF		SKEW	
	Coef.	t	Coef.	t	Coef.	t
<i>Full sample</i>						
C	-7.553**	-2.39	-2.240***	-3.84	0.348	0.49
LNSIZE	0.045	0.67	-0.006	-0.54	-0.025*	-1.93
LNAGE	1.590***	3.34	-0.012	-0.14	-0.062	-0.61
HMARK	-0.877**	-2.12	-0.173***	-3.23	-0.092	-1.40
IFEE	0.066***	3.43	0.010***	2.65	0.013***	3.02
MFEE	0.058	0.34	0.069**	2.48	0.060	1.83
LEVERAGED	0.042	0.17	-0.040	-0.94	-0.018	-0.39
MININVESTMENT	-0.022	-0.98	0.003	0.90	0.007*	1.81
RESTRICTION	0.000	1.43	0.000**	1.98	0.000	-1.12
LOCKUP	0.003	0.72	0.001**	2.13	0.002**	2.45
AUDIT	-0.082	-0.35	-0.018	-0.41	-0.024	-0.47
PERCAPITAL	0.400	1.40	-0.031	-0.80	-0.072	-1.52
OPENTOPUBLIC	-0.013	-0.04	0.027	0.54	-0.003	-0.05
OPENENDED	0.258	0.95	-0.078*	-1.89	-0.091*	-1.91
AE_OPTIONS	0.497**	2.03	-0.066	-1.50	-0.068	-1.42
AF_OPTIONS	0.414	0.69	-0.210***	-2.71	-0.235**	-2.52
AC_OPTIONS	-0.110	-0.23	-0.070	-0.84	0.032	0.32
ACUR_OPTIONS	0.454	0.95	0.066	0.77	0.052	0.56
AE_WARRANTS	0.126	0.49	0.095*	1.88	0.095*	1.69
AF_WARRANTS	-0.809	-1.45	-0.037	-0.38	0.013	0.13
AE_OTHER	0.140	0.57	0.042	0.88	0.056	1.09
AF_OTHER	0.194	0.42	-0.115*	-1.67	-0.110	-1.33
AC_OTHER	-1.060	-1.52	0.001	0.01	0.094	0.78
ACUR_OTHER	-0.446	-1.17	0.038	0.54	0.039	0.50
Strategy dummies	Yes	—	Yes	—	Yes	—

Time dummies	Yes	—	Yes	—	Yes	—
Asset dummies	Yes	—	Yes	—	Yes	—
Adjusted <i>R</i> -squared	0.12	—	0.09	—	0.12	—
<i>F</i> -statistic	9.66	—	7.44	—	9.49	—
Durbin–Watson stat	1.83	—	1.90	—	1.84	—
<i>N</i>	3382	—	3382	—	3382	—
<i>Equity sample</i>						
<i>C</i>	−7.510**	−2.22	−2.227***	−2.91	−0.015	−0.02
LNSIZE	0.014	0.20	0.005	0.39	−0.007	−0.52
LNAGE	1.028**	2.12	−0.054	−0.51	−0.060	−0.52
HMARK	−0.306	−0.83	−0.093	−1.38	−0.081	−1.10
IFEE	0.082***	4.14	0.008**	2.09	0.017***	3.64
MFEE	0.180	0.75	0.093**	2.15	0.111**	2.45
LEVERAGED	0.168	0.63	−0.056	−0.97	−0.062	−1.11
MININVESTMENT	−0.012	−0.51	−0.001	−0.11	0.001	0.16
RESTRICTION	0.000***	−2.84	0.000	−0.67	0.000	−1.48
LOCKUP	0.000	0.09	0.000	0.28	0.001	1.03
AUDIT	−0.384	−1.23	−0.017	−0.29	0.010	0.15
PERCAPITAL	0.107	0.39	−0.040	−0.76	−0.011	−0.20
OPENTOPUBLIC	0.430	1.02	0.127	1.58	0.108	1.38
OPENENDED	−0.004	−0.01	−0.036	−0.61	−0.020	−0.34
AE_OPTIONS	0.344	1.15	−0.093	−1.53	−0.153**	−2.57
AF_OPTIONS	−0.233	−0.35	0.025	0.19	−0.011	−0.09
AC_OPTIONS	0.233	0.43	−0.050	−0.44	0.074	0.57
ACUR_OPTIONS	0.711	1.16	−0.050	−0.38	−0.014	−0.11
AE_WARRANTS	0.218	0.74	0.126**	2.09	0.111	1.66
AF_WARRANTS	−0.073	−0.10	−0.017	−0.11	−0.084	−0.59
AE_OTHER	0.060	0.19	0.064	1.00	0.126*	1.94
AF_OTHER	−0.009	−0.02	−0.245**	−2.49	−0.185*	−1.79

Table 6 *Continued*

<i>Variable</i>	<i>EXKURT</i>		<i>CF</i>		<i>SKEW</i>	
	<i>Coef.</i>	<i>t</i>	<i>Coef.</i>	<i>t</i>	<i>Coef.</i>	<i>t</i>
AC_OTHER	0.418	0.53	−0.090	−0.51	−0.076	−0.42
ACUR_OTHER	−0.189	−0.40	0.002	0.02	−0.037	−0.35
Strategy dummies	Yes	—	Yes	—	Yes	—
Time dummies	Yes	—	Yes	—	Yes	—
Asset dummies	Yes	—	Yes	—	Yes	—
Adjusted <i>R</i> -squared	0.05	—	0.07	—	0.08	—
<i>F</i> -statistic	2.99	—	3.551	—	4.21	—
Durbin–Watson stat	1.94	—	1.944	—	1.88	—
<i>N</i>	1841	—	1841	—	1841	—

This table presents the parameter estimates of cross-sectional analysis for Value-at-Risk estimates of hedge funds. The model for the cross-sectional analysis is the following (Model 2):

$$MEASURE_{E_{ji}} = \alpha + \sum_{j=1}^N \lambda_j CONTROL_{ji} + \sum_{j=1}^N \beta_j DERIVATIVE_{E_{ji}} + e, \quad (1)$$

where $MEASURE_{E_{ji}}$ defines a measure associated with higher moments j of fund i ; $CONTROL_{ji}$ defines an additional control variable j of fund i , and $DERIVATIVE_{E_{ji}}$ defines a dummy variable for the use of a derivative j by fund i (1 if the derivative is used, otherwise 0). Asset dummies include controls for assets and primary assets in which hedge funds report investing. This table also presents the Durbin–Watson test for the first-order serial correlation. The standard errors are White (1980) heteroskedasticity robust t -statistics are given in italics. t -statistics are given in italics. See Table 1 for definitions of the variables.

★ refers to a statistical significance at the 10 per cent level; ★★ refers to a statistical significance at the 5 per cent level; ★★★ refers to a statistical significance at the 1 per cent level.

an impact of -0.153 on skewness. As hedge fund returns are found to exhibit negative skewness, these findings provide evidence that the use of options may be associated with the asymmetry.²⁶ Incentive fee and management fee, by contrast, have a positive impact on the skewness for equity-specialized funds. The result may be interpreted such that investors are in a way compensated by higher upside volatility than downside for paying higher compensations to hedge fund managers.

The use of equity options is found to have a positive impact on kurtosis in the sample of all funds but not in the sample of equity-specialized funds. This result seemingly explains why the results for equity-specialized use of options do not present statistically significant association with the measured Cornish–Fischer expansion.

Further analysis

The lack of support for Hypothesis 2 in the univariate analysis is a concern of bias associated with the inclusion of variables in the multivariate analysis. Further analysis is performed by testing the use equity index futures separately for two subsamples. The first group of strategies (Group 1) includes all equity-based strategies that more likely manage their liquidity using equity index futures. These strategies are the Dedicated Short Bias, Event-driven, Long/Short Equity, Emerging Market and Equity Market Neutral strategies. The second group of strategies (Group 2) includes the remaining strategies that may use equity index futures for their primary strategy, or do not invest heavily in equities. These strategies are the Managed Futures, Global/Macro, Convertible Arbitrage and Fixed-income strategies. The logic of this test is that the use of

equity index futures and its liquidity characteristic has no relevance for some strategies that use the futures primarily to perform their trading. Consequently, the statistical significance of the results may be weak when hedge fund strategies are not controlled. The result for these groups and hedge fund performance are presented in Table 7, which clearly demonstrates that the negative relation between the index futures and the alpha of a hedge fund is negative and statistically significant for the first group that potentially may use these derivatives for liquidity management.

It is also tested using logistic regression analysis whether the use of equity index futures coincidences negatively with the use of share restrictions (lockup period and restriction period). This characteristic would confirm that these derivatives would provide further evidence that these derivatives would be used as a substitute to share restrictions. The results are available upon request. The results imply that the use of equity index futures has statistically significant and negative coincidence restriction and lockup period of a fund at the 1 per cent level.

CONCLUSION

Derivatives use by hedge funds is recently investigated by Aragon and Martin^{4,5} and Chen.¹ This study focuses on the use of equity options and equity index futures by equity-specialized hedge funds. The results of the study present evidence that equity-specialized option use is negatively associated with skewness of the return distribution of a hedge fund. This risk characteristic technically implies that option writing strategies rather than option buying strategies dominate the asset-specialized option

Table 7: The relation between the use of equity index futures and hedge fund performance

Variable	SHARPE		SHARPE _D		ALPHA		APPRAISAL	
	Coef.	<i>t</i>	Coef.	<i>t</i>	Coef.	<i>t</i>	Coef.	<i>t</i>
C	−0.620**	−2.18	−0.565*	−1.77	−4.343***	−4.07	−0.915*	−1.68
LNSIZE	0.033***	11.52	0.035***	10.23	0.068***	3.98	0.048***	7.29
LNAGE	0.052	1.29	0.050	1.13	0.435***	2.86	0.046	0.60
HMARK	−0.001	−0.05	−0.022	−0.98	0.042	0.70	0.015	0.54
IFEE	0.000	−0.02	0.000	0.25	0.016***	3.22	0.002	0.84
MFEE	−0.001	−0.19	−0.003	−0.35	0.120**	2.33	0.027**	2.05
LEVERAGED	0.002	0.15	−0.002	−0.13	0.106**	2.22	0.026	1.12
MINIMUM (USmillion\$)	−0.005	−1.30	−0.004	−0.67	−0.025**	−2.05	−0.002	−0.17
RESTRICTION	0.001***	3.89	0.002***	3.97	0.002**	2.31	0.002***	3.37
LOCKUP	0.002**	2.24	0.003**	2.37	0.007**	1.99	0.002	1.22
AUDIT	−0.011	−0.74	−0.010	−0.58	−0.060	−0.83	−0.011	−0.36
PERCAPITAL	0.006	0.61	0.000	0.00	0.039	0.81	0.011	0.54
OPEN	−0.051***	−3.55	−0.054***	−3.34	−0.151***	−2.58	−0.111***	−4.34
OPENENDED	0.014	0.93	0.011	0.59	0.052	1.13	0.041	1.55
G1	−0.013	−1.23	−0.010	−0.80	−0.173**	−2.54	−0.033	−1.42
G2	0.023	0.86	0.026	0.77	−0.145	−1.07	0.036	0.75
Strategy dummies	Yes	—	Yes	—	Yes	—	Yes	—
Time dummies	Yes	—	Yes	—	Yes	—	Yes	—
Asset dummies	Yes	—	Yes	—	Yes	—	Yes	—
Adjusted <i>R</i> -squared	0.225	—	0.194	—	0.069	—	0.116	—
<i>F</i> -statistic	22.79	—	19.07	—	6.58	—	10.90	—
Durbin–Watson stat.	1.94	—	1.97	—	1.90	—	1.91	—

This table presents the parameter estimates of the cross-sectional analysis for the performance and risk estimates of hedge funds. The model for the cross-sectional analysis is the following (Model 3):

$$MEASURE_{ji} = \alpha + \sum_{j=1}^N \lambda_j CONTROL_{ji} + \beta_1(G1)_i + \beta_2(G2)_i + e,$$

where $MEASURE_{ji}$ defines a measure associated with higher moments j of fund i ; $CONTROL_{ji}$ defines an additional control variable j of fund i ; $(G1)_i$ defines a dummy variable on whether a hedge fund uses equity index futures and belongs to strategy group 1 (1 if yes), and $(G2)_i$ defines a dummy variable on whether a hedge fund uses equity index futures and belongs to strategy group 2 (1 if yes). Strategy group 1 includes the dedicated short bias, event-driven, equity long/short, emerging market and equity market neutral strategies. Strategy group 2 includes the managed futures, global macro, convertible arbitrage, and fixed-income arbitrage strategies. Asset dummies include controls for assets and primary assets in which hedge funds report investing. The sample includes 3382 hedge funds. This table also presents the Durbin–Watson test for the first-order serial correlation. The standard errors are White (1980) heteroskedasticity robust. *t*-statistics are given in italics. See Table 1 for definitions of the variables.

* refers to a statistical significance at the 10 per cent level; ** refers to a statistical significance at the 5 per cent level; *** refers to a statistical significance at the 1 per cent level.

use by hedge funds. Equity-specialized use of options is also found to be associated with higher Sharpe ratio, but the association with the other performance measures is not statistically significant.

The results of this study provide implications regarding the use of options by highly sophisticated investors. Options use by hedge funds does not seem to lead to poorer performance, as found for individual investors according to the evidence by Bauer *et al.*¹⁰ However, it would still be much more sensible just to invest in simple buy-and-hold option strategies and do it yourself. For example, Whaley⁷ suggests that these strategies can be profitable even after accounting for skewness and kurtosis of the returns.

The results for the use of equity index futures provide support that these derivatives are associated with weaker abnormal performance of a hedge fund. The explanation for this result is that equity index futures are used as a substitute for share restrictions to manage liquidity of a fund efficiently and that their users earn less illiquidity premium. Further analysis reveals that the results are evident for hedge fund strategies, which are likely to manage illiquid assets but not for the remaining strategies, and confirms that the use of equity index futures has a statistically significant and negative relation with share restrictions.

For further studies, it would be interesting to consider the use of derivatives associated with the financial crisis 2008. Especially, if equity index futures are used for managing liquidity of a fund, it is reasonable to find out whether the users of these derivatives were better at managing liquidity than hedge funds emphasizing the use of share restrictions amid the crisis.

ACKNOWLEDGEMENTS

I gratefully acknowledge helpful comments by Kam C. Chan, James Cummings, Francis In, Juha Joenväärä, Jussi Nikkinen, Jukka Tiusanen, Mika Vaihekoski, Sami Vähämaa, Janne Äijö and the seminar participants at the University of Vaasa, the SFM Conference in Kaohsiung, the SWFA 47th Annual Meeting in Houston, the NFN workshop in Bergen and 21st Australasian Finance & Banking Conference. I thank the Evald and Hilda Nissi Foundation, the Finnish Savings Banks Foundation, the Finnish Foundation for Economic and Technology Sciences, the Academy of Finland (project #117083), the Marcus Wallenberg Foundation, the Finnish Foundation for the Advancement of Securities Markets, and Foundation for Economic Education for generous financial support. This article was previously entitled the use of options and hedge fund performance, asset-specialized and leverage-driven use of options and hedge fund performance, and the use of options and hedge fund risk characteristics. All remaining errors are mine.

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