Original Article

An empirical analysis of short-biased hedge funds' risk-adjusted performance: A panel approach

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ABSTRACT **This article investigates the risk-adjusted performance of hedge funds that follow a short-biased strategy. We use an approach to adjust for risk, and compute the abnormal returns of short-biased hedge funds. The study uses rollover regressions of blocks of 4 years worth of monthly observations, by updating the sample every 3 months over the January 2000 – December 2008 period. The article documents that the short-run short-biased alphas and appraisal ratios, respectively, deviate significantly over time from the long-run averages computed over the full sample. Using a panel approach, the article then investigates the sources of this time variation. Results in the article show that the causes are both market- (macro) and fund-related. Specifically, we find that the market-based factors affect significantly the time variation in the risk-adjusted returns, whereas the short-biased specific characteristics mainly determine the alphas' volatility. However, neither the market-based nor the fund-specific factors appear to have much explanatory power concerning the variation in appraisal ratios.**

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Keywords: hedge funds; fund of hedge funds; short-sellers; performance; alphas; appraisal ratios

INTRODUCTION

Short-sellers play an important role in spotting firms under duress (for example, Enron,[1] Lehman, Tyco, WorldCom, and so on), while providing liquidity to financial markets to prevent market bubbles. In addition, they can recognize frauds, find overvalued stocks, and expose unethical and deceptive accounting practices. Moreover, short-sellers play an important role in asset allocation and portfolio diversification owing to their negative correlation with traditional stock market indexes. However, their performance over time has varied significantly and some were short-lived. This study documents the time-varying performance of short-biased hedge funds and investigates some of the determinants of those time-varying patterns.

Traditionally, short-biased hedge funds are not representative of the classic hedge fund strategy developed by Alfred Winslow Jones in 1949 of selling short overvalued stocks and buying undervalued stocks, while using leverage to enhance returns in both up and down markets. Often referred to as pessimists or gloom and doom managers, their research into stocks is more rigorous and meticulous than the average hedge fund or mutual fund. The firms mentioned above (for example, Enron, Lehman, Tyco and so on) were under the watchful eye of short-sellers several months before their fraudulent practices became public.

Many US publicly traded companies often come under the pressure from short-sellers, and these firms have expressed their views to the Securities and Exchange Commission (SEC) to apply a limit to the amount of trading short-sellers can carry out. As a result, during the recent credit crisis (for example, 19 September 2008[2]), the SEC ordered a ban on short-selling of 989 banking stocks/financial firms to avoid the manipulation of markets. However, according to the SEC and the NYSE, the ban failed to stop short-selling. Matsumoto[3] states that '… throughout the period, short sales averaged 24.7 percent of the overall trading in Morgan Stanley, Merrill Lynch & Co. and Goldman Sachs on NYSE Arca and in 2008, short sales averaged 37.5 percent of the overall trading on the exchange in the three companies'. Even with the ban, during the credit crunch of 2008–2009, short-biased hedge funds as a group did very well. For instance, the US$6 billion Kynikos Associates' Ursus fund produced 62 per cent net of returns in 2008.[4]

Even more recently, short-sellers have been blamed for the role played in Greece's financial crisis and its collapse in the international financial markets, as well as making big bets against the Euro. It is well known and documented that when markets experience extreme negative events, short-sellers and hedge funds are often the first ones to be blamed.[5] In a recent Bloomberg interview (3 March 2010), Jim Chanos stressed that '… hedge funds are being demonized "once again" for the failings of governments and regulators … we've seen this happen in subprime, in the banking crisis and we are now seeing it happen in the currency and sovereign debt crisis … hedge funds are being attacked as causation, and are the symptom and not the cause of the problem'.

Given their strategies, short-biased hedge funds will be inclined to perform well in bear markets and poorly in bull markets. For instance, in our sample all the short-biased hedge funds that died did so in the years before the crisis (that is, four short-biased funds died in 2003, 2005 and 2007, or 22 per cent of the funds in

our sample), but none has died during the crisis (for example, 14 funds or 78 per cent of the short-biased hedge funds in the sample). Similarly, the average monthly short-biased hedge fund return for the January 2000 – July 2007 period was 0.28 per cent, but 2.12 per cent for the August 2007 – December 2008 period.[6]

This study uses rollover regressions to obtain and document that the risk-adjusted performance of short-biased hedge funds and their respective volatilities vary over time. The study then asks and tries to answer the following questions. What macro- and market-based factors influence the performance of short-biased funds? Can size impact the performance of short-biased funds? Do large short-biased funds use less leverage than smaller ones?

Owing to the small number of short-biased hedge funds in the Barclay Hedge database (for example, 18 funds), their combined capital is estimated at $652 million. This article follows the standard approach in the literature and adjusts the raw returns for risk using the Fung and Hsieh[7] approach. The article then uses rollover regressions over the January 2000 – December 2008 to compare and contrast the abnormal returns, their volatility and the respective appraisal ratios obtained on subsamples of the data with those obtained for the full sample for each fund. The samples used in the rollover regressions are obtained by adding and subtracting 3 months at the end and the beginning of a 4-year period. Thus, each regression uses 48 monthly observations for each fund. The findings in the article indicate that for most short-biased funds, the risk-adjusted performance varies significantly over time. A visual inspection of Figures 1 and 2 supports this assessment. A panel approach using random effects is then employed to suggest that the determinants include both market-based and fund-specific factors. For

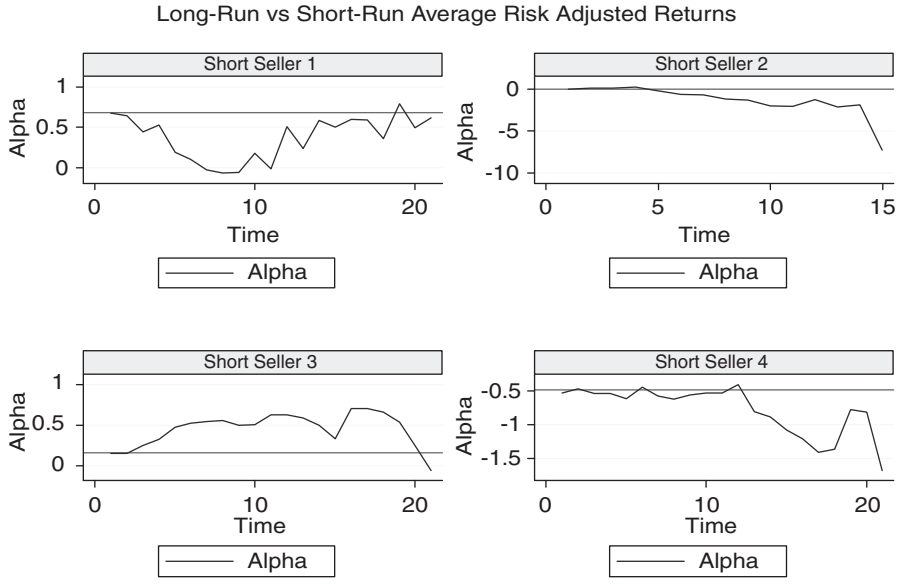

Figure 1: An example of short-run versus long-run Fung–Hsieh alphas; the horizontal line represents the average alpha for each full sample available.

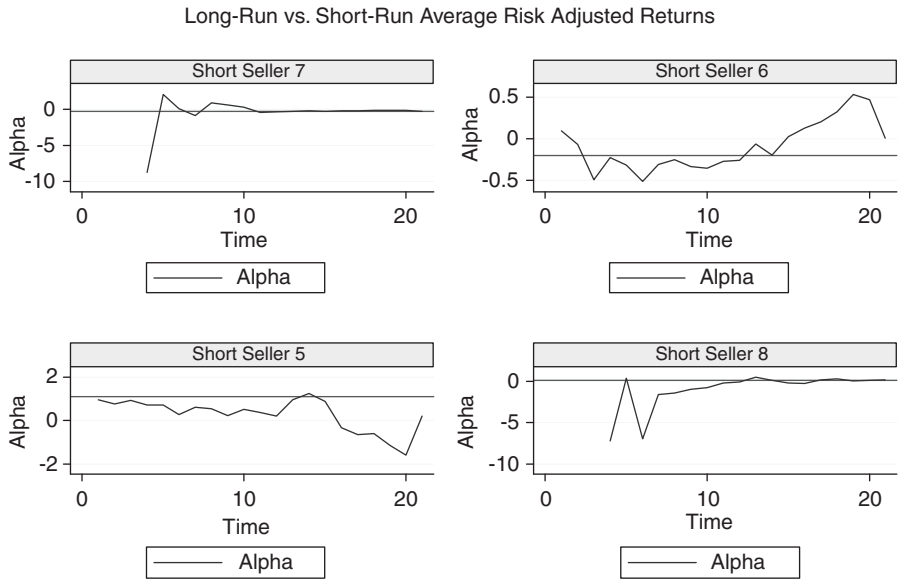

Figure 2: An example of short-run versus long-run Fung–Hsieh alphas; the horizontal line represents the average alpha for each full sample available.

instance, results in this article show that the time variation of risk-adjusted returns mainly depends on the impact of market-based factors. In contrast, the volatility of the short-biased funds' Fung–Hsieh alphas varies mainly with fund-specific factors.

The article is organized as follows. The next section discusses previous results in the literature followed by a summary of the data and details the way in which the dependent variables are constructed. The second to last section conducts the empirical analysis while the last section concludes.

LITERATURE REVIEW

Studies involving the performance of short-biased funds have been limited by the availability of the data. Yet, a few studies have produced some sharp results concerning short-biased hedge funds. For instance, short-biased funds display better market-timing abilities and security selection when compared with other strategies in the hedge fund universe.[8] In addition, Gutfleish and Atzil[9] suggest that short-sellers have better analytical abilities. This result confirms the finding of Diamond and Verrechia,[10] who observe that short-sellers, on average, possess better information than conventional long-only investors and short-sellers place their bets in companies with weakening fundamentals. There exists support that short-sellers also excel at fundamental analysis, as ascertained by Christophe *et al*[11] who find that abnormal short-selling occurs before negative earnings surprises. Another study by Lamont and Thaler[12] further confirms that short-sellers are better at finding overvalued stocks than other investment fund managers. In addition, Engelberg *et al*[13] observe that short-sellers have an advantage that stems from their aptitude to evaluate information that is publicly disseminated.

Considered as disaster capitalists, short-sellers make money in down markets and survival of this directional category is poor, with 50 per cent of the funds being reported as deceased in the MAR Hedge fund database.[14] In addition, the second-worst performance in terms of the last 12, 6 and 3 months of average monthly returns before the closing of the fund is the short-biased category.[15] However, notable short-sellers such as James S. Chanos have survived the test of time, with almost 25 years in the business. Past research by Gregoriou[14] has documented that live short-biased hedge funds with the largest assets under management have the smallest maximum drawdowns, the greatest compounded returns, the highest Sharpe ratios and the lowest standard deviation among their smaller counterparts. Furthermore, Gregoriou[14] shows that the short-biased category has a median survival lifetime of 5.41 years, which is close to that of the aggregate hedge fund categories of 5.51 years. Furthermore, he finds that short-biased funds survive longer than the sector, global emerging, global macro and global international hedge funds using the Zurich Hedge fund database from 1990 to 2001. When minimum purchase was examined, Gregoriou[14] observed that short-biased funds with less than $250 000 minimum purchase survived longer. In addition, of the nine hedge fund strategies, short-biased funds with annual redemption survived longer than the ones with shorter redemption periods.

The credit crunch of 2008/2009 affected nearly every type of investor, including well-known hedge funds and investment banks. Similarly, sophisticated investors watched their alpha evaporate during this period. In the past, before the credit crisis, academic studies had argued that hedge funds possessed performance persistence and produced alphas that were significant.[7,16,17] However, it becomes inherently harder to generate steady alpha over the long haul. Therefore, can short-term alphas be prolonged to yield long-term alphas? In this article, we investigate Fung and Hsieh[18] alphas of short-biased hedge funds during the January 2000 – December 2008, as well as during the crisis of 2007 and 2008. Although returns of long/short hedge fund managers stem from having net long or net short exposures',[7,16,19,20] short-biased hedge funds such as Kynikos' Ursus fund shorts large-cap firms, large financial firms with high likelihood of insolvency,[21] as well as technology firms experiencing high levels of 'obsolescence risk'.[22]

DATA ANALYSIS

We use the Barclay Hedge database from January 2000 until December 2008 to investigate the performance of short-biased funds using monthly net returns of all fees. We have 18 short-biased funds for which full information is available. All funds in the sample trade in the US dollar and roughly, half are onshore. Although not all funds in our sample provide full disclosure, it appears that in addition to a short portfolio exposure (that is, 91 per cent of the funds), most of them (that is, 61 per cent) also have a long portfolio exposure. Further, 94 per cent (or 17 funds) of short-biased funds in our sample geographically focus on North America, while one fund has a global market focus with exposure to Western and Eastern Europe, and Pacific Rim, respectively. In addition, while most funds do not disclose this information, it appears that a couple have the *Barclay Equity Short Bias Index* as the primary

benchmark, while four more have the S&P 500 as the primary benchmark. One short-biased fund further specifies *Nasdaq* as the secondary benchmark.

Table 1 details some summary statistics of our data, both in aggregate for all the funds and separate based on their location (for example, onshore versus offshore). The second column displays the average, average standard deviation and median of raw and biased corrected returns. As as previous research has clearly documented (see Fung and Hsieh[7]) raw hedge fund data may suffer from several potential biases, including sample selection and incubation biases. To correct for those potential biases, we report in parenthesis the sample results after we have removed the first 12 observations from each series. Surprisingly, offshore funds display a performance (that is, sample mean is 1.36 per cent) that is three times higher than that of onshore funds (that is, the mean is 0.44 per cent). Similarly, the median offshore funds' return is also higher than the onshore median return (that is, 0.48 per cent versus 0.37 per cent). In contrast, average volatilities appear quite similar for the two groups.

Further, the bias-corrected raw returns suggest that offshore funds significantly outperform onshore ones according to both the mean (that is, 1.85 per cent versus 0.32 per cent) and the median (0.78 per cent versus 0.17 per cent). However, as above, average volatilities appear roughly similar across the two groups. The typical short-biased fund in our sample has US 36.2 million under management, with the median size at US 17.9 million. The offshore short-biased funds on average have more assets under management,

Table 1: Short-biased hedge fund summary statistics

	Return (bias correction) (%)	*AUM ('000)*	*Lifetime (months)*	*Manag. fee (%)*	*Notice period (days)*	*Lock-up period (days)*	*Employees*	*Leverage (%)*
Average	0.85 (0.93)	$36 200	49.42	1.45	27.44	92.78	5.11	1.62
Std. Deviation	4.42 (4.39)	$44 500	27.11	0.45	19.53	152.44	7.28	0.96
Median	0.37 (0.39)	$17 900	45	1.35	30	0	2.5	1
Onshore funds								
Average	0.44 (0.32)	$31 700	45.6	1.48	35.2	164	3.2	1.33
Std. Deviation	3.00 (3.80)	$43 600	28.26	0.45	17.96	176.43	2.39	0.65
Median	0.23 (0.17)	$10 200	33.5	1.50	30	90	2.5	1
Offshore funds								
Average	1.36 (1.85)	$44 800	47	1.34	19.57	4.29	8.43	2
Std. Deviation	4.72 (4.85)	$51 100	19.50	0.46	18.46	11.34	10.95	1.16
Median	0.48 (0.78)	$19 700	54	1.20	30	0	5	1.5

Note: *The Bias Correction* of raw returns implies the elimination of the first 12 months of observations from the sample.

according to both the mean and the median. On average, a typical short-biased fund in our sample is around 4 years old, with offshore funds being, on average, 2 months older than onshore ones. In addition, the median lifetime of offshore funds is 9 months higher than that of onshore ones.

The management fees practiced by the two types of short-biased funds appear relatively similar. On average though, the onshore funds charge management fees that are 13 basis points higher than the ones charged by offshore funds. Further, both the notice and lock-up periods are higher for onshore funds. For instance, the average notice period for onshore funds is 35.2 days, whereas for offshore funds it is 19.57 days. Similarly, the lock-up period is 164 days for onshore funds relative to approximately only 4 days for offshore funds. In addition, the median onshore lock-up period is 90 days, whereas the median offshore one is zero. The average number of employees appears almost three times larger for offshore funds than for onshore ones; in addition, according to the median, offshore funds have twice more employees than onshore short-biased funds. Finally, offshore funds appear more leveraged than onshore ones according to both the mean and the median.

Therefore, Table 1 suggests that while offshore and onshore funds have similar lifetimes and management fees, they appear to have a different performance, size, notice and lock-up periods. Next, we want to investigate how short-biased fund performance evolved over time. Two steps are required for this analysis. First, we adjust the raw returns for risk using the Fung–Hsieh[7] approach. Second, we employ rollover regressions over the analysis period to compute the short-term abnormal returns (that is, Fung–Hsieh alphas), their volatility and appraisal ratios, respectively.

We calculate the monthly Fung–Hsieh alphas or the abnormal returns as fund excess returns minus the factor realizations times loadings estimated sequentially over each sample period. Thus, we have:

$$\begin{aligned}\alpha_{it} = r_{it} &- \beta_{1i}(PTFSBD) + \beta_{2i}(PTFSFX) \\ &+ \beta_{3i}(PTFSCOM) + \beta_{4i}(Equity\ Mkt\ Factor) \\ &+ \beta_{5i}(Bond\ Factor) + \beta_{6i}(Credit\ Spread) \\ &+ \beta_{7i}(Size\ Spread) \qquad (1)\end{aligned}$$

where $i = 1, \ldots, N$ funds, $t = 1, \ldots, T$ months, α_{it} is the abnormal return (Fung–Hsieh alpha) of fund i for month t, r_{it} is the fund return in excess of the risk-free rate (for example, 1-month T-bill rate), *PTFSBD* is the return of the *PTFS* bond lookback straddle, *PTFSFX* is the return of the *PTFS* currency lookback straddle, *PTFSCOM* is the return of the commodity lookback straddle, *Bond Factor* is the change in the monthly market yield of the 10-year treasury constant maturity yield, *Equity Mkt Factor* is the Standard & Poors 500 index monthly total return, *Credit Spread* is the monthly change in the Moody's Baa yield less 10-year treasury constant maturity yield, and *Size Spread* is the CRSP small decile return less S&P500 total return on CRSP.

The rollover regressions are using blocks of 4 years worth of monthly observations (that is, each sample has 48 observations) whereby the sample is updated every 3 months. Specifically, at every step we eliminate the first 3 months at the beginning of the sample and subsequently add three observations at the end of the sample. This process continues until the end of the sample period is reached for each fund.

Figures 1 and 2 display the long-run and the short-run risk-adjusted returns using the procedures described above. To economize on space, we show the graphs only for the first eight short-biased funds in the sample. The horizontal line denotes the long-run risk-adjusted abnormal return or the Fung–Hsieh alphas obtained using the full sample available for each fund. A quick inspection of the two figures shows that short-run alphas may or may not converge to the long-run value, and that over time short-run values may diverge significantly from the long-run mean. For instance, while for short-biased funds 1, 3, 7 and 8 it appears unambiguously that short-run alphas' mean convert to the long-run ones, this pattern does not appear sufficiently clear for the rest. For instance, the graphs for short-biased funds 2 and 4 clearly suggest divergence from the long-run mean. Short-biased funds 5 and 6 appear to revert to the long-run mean, but the evidence is not very strong.

The mixed picture of Figures 1 and 2 requires a further investigation of those time-varying patterns. The next section performs this analysis.

EMPIRICAL ANALYSIS: A PANEL APPROACH

To increase the number of observations given the limited number of cross-sections available, we use a panel approach. We employ an extensive set of control variables in addition to the fund-specific ones.

Specifically, given that some short-biased funds have market indices such as the S&P 500 and Nasdaq as primary and secondary benchmarks, respectively, one would expect that macro and hedge fund-specific indices will be correlated with the evolution of short-run Fung–Hsieh alphas over time. We list and discuss those variables in Table 2.

We compute the control variables in the same manner as our dependent variables. Specifically, we compute their moving averages by deleting the first three and subsequently adding three observations at the end of the 4-year period. We limit the analysis to a panel regression under the assumption of random effects, as our fund-specific variables are constant over time. We believe that the extensive set of explanatory variables eliminates the possibility of omitted variable bias. However, inference needs to be performed with great care given the potential multicollinearity issues among the market and hedge fund indices used in the analysis. Table 3 displays the results when the dependent variables are the Fung–Hsieh alphas. We have 226 observations corresponding to 14 funds for which we have full information.

First, the results in Table 3 suggest that risk-adjusted returns vary with the macro factors only. Thus, the fund-specific variables do not appear to be significant at any of the conventional significance levels. In contrast, with few exceptions the macro and broad-based hedge fund indices are important for the time variation observed in the short-run Fung–Hsieh alphas. Interestingly, with the exception of the coefficients on the *S&P 500*, *Russell 2000 Growth*, *CISDM-CASAM Long-Short* and *HFN Short* indices that are positive, all the other variables have negative coefficients. For instance, the *Barclays Aggregate US Bond Index*, the change in inflation and the *CITI 6 month T-bill* rates, the returns on *NYSE, Nasdaq*, *Russell 2000 Value*, *Fama-French HML*, *CSFB Short-Seller*, *CSFB Long-Short* and *Greenwich Short*,

Table 2: Variables

Barclays Aggregate US Bond Index	Previously known as the Lehman Aggregate Bond Index is a broad index maintained by Barclays Capital and represents the investment grade bonds traded in the United States.
CPI	Denotes the monthly changes in the prices paid by urban consumers for a representative set of goods and services.
CITI 6 Month T-Bill	The rate of interest on Treasury bills and is the discount (that is, the discount is effectively the interest earned by holding these instruments) expressed as a percentage of the issue price. *NYSE*, *S&P 500* and *Nasdaq* measure the performance of the respective indices.
Russell 2000 Value Index	Measures the performance of the small-cap value segment of the US equity universe. The Index is revised annually to ensure that the larger stocks do not distort the performance and characteristics of the true small-cap ones and that the chosen companies continue to reflect value characteristics.
Russell 2000 Growth Index	Measures the performance of the small-cap growth segment of the US equity universe.
Fama–French HML (High Minus Low)	Is the average return on two value portfolios minus the average return on two growth portfolios (for example, $HML=\frac{1}{2}$ (*Small Value* + *Big Value*)$-\frac{1}{2}$ (*Small Growth* + *Big Growth*)).
Fama–French SMB (Small Minus Big)	Is the average return on three small portfolios minus the average return on three big portfolios (for example, $SMB=\frac{1}{3}$ (*Small Value* + *Small Neutral* + *Small Growth*)$-\frac{1}{3}$ (*Big Value* + *Big Neutral* + *Big Growth*)).
CISDM-CASAM Long–Short Index	Reflects the median performance of equity long/short hedge fund managers reporting to the CASAM-CISDM database. Its objective is to provide an estimate of the rate of return to equity long/short managers who take long and short equity positions, depending on the manager's view of the markets.
CSFB Short-Seller Index	Represents a long position in undervalued stocks combined with a short position in overvalued stocks.
CSFB Long–Short Index	Represents stock positions with a strategically net short bias, profiting from declining stock prices of companies suffering from fraud or deteriorating financial conditions.
EDHEC Long–Short Index	Summarizes Long/Short Equity funds that invest in both long and short equity portfolios. Finally, *EDHEC Long/Short* summarizes short positions of overvalued stocks or stocks with anticipated disappointing earnings.

Source: US Department of Labor www.dol.gov; Professor Kenneth French's website http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/; www.russell.com; www.standardandpoors.com; www.nasdaq.com; www.nyse.com; www.hfr.com; www.edhec-risk.com; www.barclayhedge.com; www.pertrac.com; www.bnet.com; www.wikipedia.org.

Table 3: Random effects GLS regression - dependent variable: Fung–Hsieh alphas

Variable	*Coefficient*	*(Robust std. error)*	*Variable*	*Coefficient*	*(Robust std. error)*
Barclay Bond Index	−1071.63**	(547.75)	Lifetime	−0.06	(0.05)
Unemployment Rate	28.65	(32.35)	Domicile	0.72	(6.91)
CPI	−733.25*	(411.35)	Log (AUM)	0.81	(2.64)
Citi 6 Month T-bill	−1567.24**	(782.11)	Open	2.98	(3.85)
US Bond Index	102.72	(80.75)	Management Fee	3.54	(5.74)
NYSE	−1048.54**	(502.21)	Performance Fee	−0.25	(1.26)
SP500	1763.35**	(760.46)	Leverage	2.02	(4.69)
Nasdaq	−550.76**	(249.91)	Log(Minimum Investment)	−1.15	(5.59)
Russell 2000 Value	−14 875.89**	(5198.51)	Lockup Period	−0.01	(0.01)
Russell 2000 Growth	377.22*	(231.22)	Redemption Frequency	−0.35	(2.64)
Fama–French HML	−31.84**	(14.82)	Notice period	0.01	(0.25)
Fama–French SMB	66.90	(69.68)	Number Employees	−1.06	(1.10)
CISDM-CASAM Long-Short	1011.79**	(451.64)	US Investor	1.32	(6.39)
CSFB Short Seller	−114.80***	(27.72)	Intercept	83.02	(121.62)
CSFB Long-Short	−305.69***	(114.04)			
Greenwich Short	−174.92***	(59.17)			
HFN Long Short	464.97	(361.72)			
HFN Short	1323.09**	(566.34)			
EDHEC Long Short	−291.46	(341.05)			
EDHEC Short	−114.46	(78.53)			
N	226				
R^2	0.238				

The *Barclays Bond Index* represents the investment grade bonds traded in the United States. *Citi 6 Month T-Bill* is the rate of interest on Treasury bills. *Russell 2000 Value Index* measures the performance of the small-cap value segment of the US equity universe. The *Russell 2000 Growth Index* measures the performance of the small-cap growth segment of the US equity universe. *Fama–French HML* is the average return on two value portfolios minus the average return on two growth portfolios (for example, $HML = \frac{1}{2}(Small\ Value + Big\ Value) - \frac{1}{2}(Small\ Growth + Big\ Growth)$). *Fama–French SMB* is the average return on three small portfolios minus the average return on three big portfolios. The *CISDM-CASAM Long–Short* Index reflects the median performance of equity long/short hedge fund managers reporting to the CASAM CISDM database. *CSFB Short-Seller* – Bottom-up stock pickers that are long undervalued stocks and short overvalued stocks, with top down views expressed with a net long or short bias. *CSFB Long-Short* – Bottom-up stock pickers with a strategically net short bias, profiting from declining stock prices of companies suffering from fraud or deteriorating financial conditions. *EDHEC Long Short* – Long/Short Equity funds invest in both long and short equity portfolios.

The short-seller-specific independent variables include among others: *Lifetime* (Short-seller life measured in months), *Domicile* (1 for onshore funds), *Log (AUM)* (natural logarithm of Assets under Management), *Open* (1 if the fund accepts new investors), *Management Fee* (measured in percentages), *Performance Fee* (measured in percentages), *US Investor* (1 if investors are American residents).

Significance levels: *10 per cent; **5 per cent; ***1 per cent.

respectively, vary negatively with risk-adjusted returns. Those results are consistent either with strategies that are long the market in boom economic times, and/or short the market in bear markets. On average, it appears that in contrast with improvements of the *Russell 2000 Value* performance that have a negative impact on the short-biased funds' short-run alphas, increases of the performance of small-cap growth stocks impact positively the short-biased funds' abnormal returns. Further, one can note that the returns on the *S&P 500* in contrast with those of *Nasdaq* and *NYSE* are positively associated with the alpha returns. Thus, it appears that the short-biased funds risk-adjusted returns vary positively with the smaller market indices such as the S&P 500, and negatively with the broader market indices (that is, *NYSE* and *Nasdaq*). Higher inflation and interest rates, respectively, have a negative impact on short-biased fund performance. Finally, the fact that most short-biased indices are negatively correlated with the risk-adjusted performance of short-biased funds in our sample suggests that increased competition reduces the returns of individual funds.

Second, Table 4 investigates the determinants of the time-varying patterns in the volatility of the Fung–Hsieh alphas. Overall, the explanatory power of our control variables is much better in Table 4 than in Table 3 (for example, the R^2 is 0.837 in Table 3 versus 0.238 in Table 3). This finding is consistent with previous research that has had more success at explaining the volatility of returns than the returns themselves.

In contrast to the findings in Table 3, the results of Table 4 suggest that the volatility of short-biased fund performance is solely determined by fund-specific factors. Thus, none of the market or short-biased indices appear to have any significant impact. In contrast, the coefficients on almost all of the fund-specific control variables appear significant at the conventional significance levels. For instance, onshore short-biased funds seem to have volatilities that are higher by 1.56 percentage points than those of offshore ones. The volatility of risk-adjusted returns decreases with the size of the assets under management and is lower for funds that are still open (that is, the funds accept new investors). Those results make sense as larger funds may want to purse strategies that are less risky to preserve alpha. Similarly, open funds may have more cash than closed ones, which may lead to lower return volatility for the open ones. In contrast a higher required minimum initial investment increases volatility. Both management and performance fees affect positively the volatility of the Fung–Hsieh alphas. In contrast, a higher lock-up period decreases volatility. A possible explanation for this result might be provided by the fact that a higher lock-up period limits the ability of short-biased funds to pursue riskier strategies. Similarly, a higher notice period decreases short-biased funds' returns volatility. Finally, if short-biased fund investors are US residents, then the volatility of the Fung–Hsieh alphas is lower. This result has the expected sign if one agrees that US investors, on average, tend be more risk-averse than non-US investors. Note that the leverage amount does not appear to be significant.

Third, Table 5 shows the results when the dependent variables are the appraisal ratios. Unfortunately, the explanatory power of this regression is small (for example, R^2 is 0.271) and only one variable appears significant. Thus, in contrast to the result in Table 4,

Table 4: Random effects GLS regression: Fung–Hsieh alpha volatility

Variable	*Coefficient*	*(Robust std. error)*	*Variable*	*Coefficient*	*(Robust std. error)*
Barclay Bond Index	−36.27	(40.23)	Lifetime	0.005	(0.003)
Unemployment Rate	2.31	(2.37)	Domicile	1.56***	(0.51)
CPI	−28.88	(30.38)	Log (AUM)	−0.36*	(0.20)
Citi 6 Month T-bill	−51.84	(57.47)	Open	−1.77***	(0.29)
US Bond Index	4.96	(5.90)	Management Fee	2.29***	(0.435)
NYSE	−38.15	(36.87)	Performance Fee	0.16*	(0.09)
SP500	53.80	(55.88)	Leverage	−0.13	(0.35)
Nasdaq	−17.09	(36.87)	Log(Minimum Investment)	0.74*	(0.43)
Russell 2000 Value	−210.13	(381.69)	Lockup Period	−0.002**	(0.001)
Russell 2000 Growth	15.95	(16.99)	Redemption Frequency	0.01	(0.19)
Fama–French HML	0.19	(1.09)	Notice period	−0.06***	(0.01)
Fama–French SMB	−3.15	(5.19)	Number Employees	0.19**	(0.08)
CISDM-CASAM Long-Short	23.84	(33.16)	US Investor	−1.70***	(0.48)
CSFB Short Seller	−0.58	(2.06)	Intercept	1.80	(8.99)
CSFB Long-Short	−3.35	(8.41)			
Greenwich Short	−2.34	(4.37)			
HFN Long Short	21.42	(26.61)			
HFN Short	37.98	(41.60)			
EDHEC Long Short	−16.47	(25.09)			
EDHEC Short	−5.95	(5.72)			
N	207				
R^2	0.837				

The *Barclays Bond Index* represents the investment grade bonds traded in the United States. *Citi 6 Month T-Bill* is the rate of interest on Treasury bills. *Russell 2000 Value Index* measures the performance of the small-cap value segment of the US equity universe. The *Russell 2000 Growth Index* measures the performance of the small-cap growth segment of the US equity universe. *Fama–French HML* is the average return on two value portfolios minus the average return on two growth portfolios (for example, $HML = \frac{1}{2}(Small\ Value + Big\ Value) - \frac{1}{2}(Small\ Growth + Big\ Growth)$). *Fama–French SMB* is the average return on three small portfolios minus the average return on three big portfolios. The *CISDM-CASAM Long–Short* Index reflects the median performance of equity long/short hedge fund managers reporting to the CASAM CISDM database. *CSFB Short-Seller* – Bottom-up stock pickers that are long undervalued stocks and short overvalued stocks, with top down views expressed with a net long or short bias. *CSFB Long-Short* – Bottom-up stock pickers with a strategically net short bias, profiting from declining stock prices of companies suffering from fraud or deteriorating financial conditions. *EDHEC Long Short* – Long/Short Equity funds invest in both long and short equity portfolios.

The short-seller-specific independent variables include among others: *Lifetime* (Short-seller life measured in months), *Domicile* (1 for onshore funds), *Log (AUM)* (natural logarithm of Assets under Management), *Open* (1 if the fund accepts new investors), *Management Fee* (measured in percentages), *Performance Fee* (measured in percentages), *US Investor* (1 if investors are American residents).

Significance levels: *10 per cent; **5 per cent; ***1 per cent.

Table 5: Random effects GLS regression – Dependent variable: Appraisal ratio

Variable	*Coefficient*	*(Robust std. error)*	*Variable*	*Coefficient*	*(Robust std. error)*
Barclay Bond Index	55.97	(62.29)	Lifetime	−0.01	(0.01)
Unemployment Rate	−5.19	(3.67)	Domicile	0.49	(0.79)
CPI	52.42	(47.04)	Log (AUM)	0.19	(0.31)
Citi 6 Month T-bill	75.30	(88.98)	Open	0.51	(0.46)
US Bond Index	−5.36	(9.14)	Management Fee	0.16	(0.67)
NYSE	47.48	(57.08)	Performance Fee	−0.07	(0.14)
SP500	−62.42	(86.52)	Leverage	0.26	(0.55)
Nasdaq	18.26	(28.43)	Log(Minimum Investment)	−0.36	(0.66)
Russell 2000 Value	81.60	(590.95)	Lockup Period	0.002⋆	(0.001)
Russell 2000 Growth	−19.15	(26.31)	Redemption Frequency	−0.19	(0.31)
Fama–French HML	−0.45	(1.69)	Notice period	0.001	(0.029)
Fama–French SMB	8.61	(8.04)	Number Employees	−0.092	(0.131)
CISDM-CASAM Long-Short	−16.83	(51.33)	US Investor	−0.22	(0.75)
CSFB Short Seller	1.29	(3.19)	Intercept	−16.29	(13.92)
CSFB Long-Short	2.82	(13.02)			
Greenwich Short	2.27	(6.76)			
HFN Long Short	−38.35	(41.20)			
HFN Short	−40.02	(64.41)			
EDHEC Long Short	18.51	(38.85)			
EDHEC Short	0.06	(8.86)			
N	207				
R^2	0.271				

The *Barclays Bond Index* represents the investment grade bonds traded in the United States. *Citi 6 Month T-Bill* is the rate of interest on Treasury bills. *Russell 2000 Value Index* measures the performance of the small-cap value segment of the US equity universe. The *Russell 2000 Growth Index* measures the performance of the small-cap growth segment of the US equity universe. *Fama–French HML* is the average return on two value portfolios minus the average return on two growth portfolios (for example, $HML = \frac{1}{2}(Small\ Value + Big\ Value) - \frac{1}{2}(Small\ Growth + Big\ Growth)$). *Fama–French SMB* is the average return on three small portfolios minus the average return on three big portfolios. The *CISDM-CASAM Long–Short* Index reflects the median performance of equity long/short hedge fund managers reporting to the CASAM CISDM database. *CSFB Short-Seller* – Bottom-up stock pickers that are long undervalued stocks and short overvalued stocks, with top down views expressed with a net long or short bias. *CSFB Long-Short* – Bottom-up stock pickers with a strategically net short bias, profiting from declining stock prices of companies suffering from fraud or deteriorating financial conditions. *EDHEC Long Short* – Long/Short Equity funds invest in both long and short equity portfolios.

The short-seller-specific independent variables include among others: *Lifetime* (Short-seller life measured in months), *Domicile* (1 for onshore funds), *Log (AUM)* (natural logarithm of Assets under Management), *Open* (1 if the fund accepts new investors), *Management Fee* (measured in percentages), *Performance Fee* (measured in percentages), *US Investor* (1 if investors are American residents).

Significance levels: ⋆10 per cent; ⋆⋆5 per cent; ⋆⋆⋆1 per cent.

we find that the lock-up period affects positively the appraisal ratio.

CONCLUSION

Given the limited data available on short-biased funds, this study uses rollover regressions and a panel approach to increase the number of observations to investigate the time variation of short-biased funds' risk-adjusted performance. We use a data set provided by Barclay Hedge that covers the January 2000 – December 2008 period. We have information on 18 hedge funds that follow a short-biased strategy. We adjust the funds' raw returns for risk using the Fung–Hsieh[7] approach. The rollover regressions employ blocks of 4 years worth of monthly observations, where at each step the sample is updated by eliminating and adding 3 months at the beginning and end of each sample, respectively. A comparison of the short-run Fung–Hsieh alphas (obtained from the rollover regressions) with their long-run average (based on the full sample available) indicates that in the short-run the performance of short-biased funds deviates significantly from the long-run behavior. This finding is not surprising given that short-biased funds are generally expected to perform better in negative market environments. Indeed, in our sample, short-biased funds register an average monthly return of 0.28 per cent during the January 2000 – July 2007 period, but a 2.12 per cent monthly return during the August 2007 – December 2008 period.

The article uses then a panel approach to investigate the causes of short-biased funds change in performance over time. We propose an extensive set of control variables that includes both macro- and market-based indices, but also fund-specific factors. The set of independent variables is constructed similarly to the dependent variables using moving averages of 4 years worth of monthly observations. As fund-specific factors are fixed over time, the study limits to a random effects panel regression. However, we believe that the set of control variables is sufficiently large to eliminate the possibility of omitted variable bias.

The results of the panel regressions suggest that the market-based factors mainly affect the Fung–Hsieh alphas, whereas the fund-specific factors mainly influence the volatility of the abnormal returns. Specifically, we find that higher interest and inflation rates negatively affect short-biased fund performance. Further, evidence suggests that risk-adjusted returns vary negatively with the broader market indices like *NYSE* and *Nasdaq*, but positively with the smaller market indices such as the *S&P 500*. In addition, the individual short-biased funds' Fung–Hsieh alphas are negatively influenced by the increased competition reflected by the higher returns of hedge fund indices.

With regard to the volatility of the Fung–Hsieh alphas, we find evidence that those larger and still open display lower volatility. Similarly, higher lock-up and notice periods have a negative impact on short-biased funds' volatility of returns. In contrast, higher management and performance fees increase short-biased funds' risk. A descriptive analysis further strengthens the fact that results are different for onshore and offshore funds. Unfortunately, our control variables have limited power to explain the variation of short-biased hedge fund appraisal ratios.

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