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Tail risk in hedge funds: A unique view from portfolio holdings☆

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ABSTRACT

We develop a new systematic tail risk measure for equity-oriented hedge funds to examine the impact of tail risk on fund performance and to identify the sources of tail risk. We find that tail risk affects the cross-sectional variation in fund returns and that investments in both tail-sensitive stocks and options drive tail risk. Moreover, leverage and exposure to funding liquidity shocks are important determinants of tail risk. We find evidence of some funds being able to time tail risk exposure prior to the 2008–2009 financial crisis.

1. Introduction

Hedge funds are often described as pursuing trading strategies that generate small positive returns most of the time before incurring a substantial loss akin to “picking up pennies in front of a steam roller” or “selling earthquake insurance” (Duarte et al., 2007; Stulz, 2007). Hedge funds, therefore, are likely to be exposed to substantial systematic tail risk, i.e., they can incur substantial losses in times of market downturns when investors’ marginal utility is very high. As an illustration, Fig. A.1 in the Appendix plots monthly returns for the Hedge Fund Research Equal-Weighted Hedge Fund Strategy Index from 1998 to

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2012. The two worst return realizations occur in August 1998 and October 2008, which coincide with periods of severe equity market downturns (the Russian financial crisis in 1998 and the bankruptcy of Lehman Brothers in 2008, respectively). Limited research has been conducted on whether hedge funds are exposed to tail risk and, if so, how hedge funds' investments and trading strategies contribute to tail risk and how it affects hedge fund performance. Our paper fills this void in the literature by using equity-oriented hedge fund return data as well as the mandatorily reported 13F quarterly equity and option holdings of hedge fund firms to examine the sources and performance implications of tail risk.[1] We ask four questions: First, does tail risk explain the cross-sectional and time series variation in equity-oriented hedge fund performance? Second, is tail risk related to certain observable fund characteristics and funds' exposure to funding liquidity shocks? Third, does tail risk in hedge funds arise from their dynamic trading strategies or from their investments in stocks that are sensitive to equity market crashes or both? Fourth, can hedge funds time tail risk by altering their positions in equities and options before market crashes?

We address these questions by deriving a nonparametric estimate for hedge funds' systematic tail risk based on their reported returns. This tail risk measure is defined as the lower tail dependence of hedge funds' returns and the market return, scaled by the ratio of the absolute value of their respective expected shortfalls (ES). The lower tail dependence is defined as the conditional probability that an individual hedge fund has its worst individual return realizations exactly at the same time that the equity market has its worst return realizations. We show that this tail risk measure has significant predictive power for the cross section of equity-oriented hedge fund strategies. In principle, our investigation can be extended to non-equity hedge funds, too, but we restrict ourselves to equity funds to link tail risk with the underlying holdings that are available only for equity positions in the Thomson Reuters database. We find that the return spread between the portfolios of hedge funds with the highest and the lowest past tail risk amounts to 4.68% per annum after controlling for the risk factors in the widely used Fung and Hsieh (2004) seven-factor model. These spreads are robust to controlling for other risks that have been shown to influence hedge fund returns: correlation risk (Buraschi et al., 2014), liquidity risk (Aragon, 2007; Sadka, 2010; Teo, 2011), macroeconomic uncertainty (Bali et al., 2014), volatility risk (Bondarenko, 2004; Agarwal, Bakshi, and Huij, 2009), and rare disaster concerns (Gao et al., 2014). In addition, results from multivariate regressions confirm that tail risk predicts future fund returns even after controlling for various fund characteristics such as fund size, age, standard deviation, delta, past yearly excess return, management and incentive fees, minimum investment, lockup and restriction period, and indicator variables for offshore domicile, leverage, high-water mark, and hurdle rate, as well as univariate risk measures such as skewness, kurtosis, value at risk (VaR), and market beta. The predictability of future returns extends as far as six months into the future.

In addition to explaining the cross-sectional variation in fund performance, tail risk has an impact on the time series variation in aggregate fund performance. The return of a portfolio that is long in funds with high tail risk and short in funds with low tail risk explains a significant fraction of the time series variation in aggregate equity hedge fund performance. We observe that accounting for tail risk in fund-level time series regressions attenuates fund alphas and improves the explanatory power compared with the Fung and Hsieh (2004) model.

We conduct a number of robustness checks to show that our results are not sensitive to several choices that we make in our empirical analysis. Our results are stable when we change the estimation horizon of tail risk, compute tail risk using different cutoff values, use *VaR* instead of *ES* in computing tail risk, change the weighting procedure in portfolio sorts from equal weighting to value weighting, and account for delisting returns of funds that leave the database. Our results also remain stable when we compute tail risk with daily instead of monthly returns using data for a subsample of funds that report daily data to Bloomberg, use returns reported after the listing date of a subsample of funds from the Lipper TASS database, and unsmooth fund returns using the Getmansky et al. (2004) procedure.

We investigate the determinants of tail risk of funds, i.e., why some funds are more exposed to tail risk than others and which fund characteristics are associated with high tail risk. We reach several findings that are consistent with the prior literature on the relation between risk-taking behavior and contractual features of hedge funds. First, the managerial incentives stemming from the incentive fee call option are positively related to funds' tail risk. This result is consistent with the risk-inducing behavior associated with the call option feature of incentive fee contracts (Brown et al., 2001; Goetzmann et al., 2003; Hodder and Jackwerth, 2007). Second, tail risk is negatively associated with past performance, i.e., worse performing fund managers engage in greater risk-taking behavior. This finding is similar to the increase in the propensity to take risks following poor performance as shown in Aragon and Nanda (2012). Finally, both the lockup period and leverage exhibit a significant positive relation with tail risk. Since funds with a longer lockup period are likely to invest in more illiquid securities (Aragon, 2007), this finding suggests that funds that make such illiquid investments are more likely to be exposed to higher tail risk. Levered funds can use derivatives and short-selling techniques to take state-contingent bets that can exacerbate tail risk in such funds.

We also use the bankruptcy of Lehman Brothers in September 2008 as a quasi-natural experiment that led to an exogenous shock to the funding of hedge funds by prime brokers. This event allows us to examine a causal relation between funding liquidity risk and tail risk. We

[1] Institutional investors including hedge funds that exercise investment discretion over $100 million of assets in 13F securities are required to disclose their long positions in 13F securities (common stocks, convertible bonds, and options) on a quarterly basis. They are not required to report any short positions (see Griffin and Xu, 2009; Aragon and Martin, 2012; Agarwal, Fos, and Jiang, 2013; Agarwal, Jiang, Tang and Yang, 2013).