Project Title: Time aggregation properties of tail dependence between hedge funds and the equity market (practitioner summary)
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Returns on many hedge funds typically exhibit a nonlinear relationship with market returns. This nonlinearity, or asymmetry, in dependence is often of a form where returns are more strongly correlated in severely depreciating markets than in at and appreciating markets (see, e.g., Mitchell and Pulvino (2001), Agarwal and Naik (2004), and Brown and Spitzer (2006)).[1] Implications of such asymmetric dependence are important in portfolio allocation and risk management involving hedge funds. If a hedge fund investor with some existing exposure to market risk, for example, fails to incorporate such asymmetries in his portfolio decision, the investor may overstate the diversification benefits offered by hedge funds. The utility loss from the suboptimal portfolio choice can be substantial as the asymmetry becomes severe (see, e.g. Ang and Chen (2002), Patton (2004), and Hong et al. (2006)).

Despite the economic significance of its implications, our understanding of the asymmetric dependence between the market and hedge fund returns is largely due to previous empirical studies based on data reported at a monthly frequency. An interesting question thus arises: What are the type and degree of asymmetry to expect in the dependence between the longer horizon returns? In the context of hedge funds, this question is of particular importance because investing in a hedge fund often involves liquidity restrictions such as a lock-up provision or a redemption notice period or both. Given the investment horizon that the hedge fund investors operate on, learning about longer-term dependence structure between market returns and hedge fund returns is essential. In this project, we explore this issue.

Our empirical analysis proceeds in two steps. First, we construct the joint distribution of holding period returns on the market and a given hedge fund, for a series of investment

[1] Agarwal and Naik (2004) conjecture two possible sources of this nonlinearity. First, the hedge funds may employ trading strategies that lose money during the market downturns. Examples include the risk arbitrage strategy investigated by Mitchell and Pulvino (2001). Second, regardless of their trading strategy the managers could create (either directly or indirectly through dynamic trading) a payoff similar to that from writing a put option in order to improve their Sharp ratio or to respond to their incentive contract.

horizons. To span the various lockups and notice periods, the investment horizons we consider ranges from one-quarter to five-year. A common problem in hedge fund research is that hedge fund return histories are generally short, rarely extends past fifteen years; hence, examining long-horizon dependence structure is challenging due to the data limitation.[2]

We address this difficulty by employing filtered historical simulation (FHS hereafter) of Barone-Adesi et al. (1998, 1999). The FHS generates correlated pathways for the market and hedge fund returns, allows serial correlation and the time-varying volatility, and avoids assumptions about the joint conditional distribution of the market and hedge fund returns. Given that the holding period returns are computed by time-aggregating the simulated monthly return series, and that the simulated monthly returns under FHS preserve the cross-asset dependence in the original data, the joint distributions of holding period returns will contain unbiased information about the longer-term dependence structure between the market and hedge fund returns.

The next step is to uncover dependence structures embedded in the simulated joint distributions of holding period returns, for the considered investment horizons. To this end, we use the method of copulas. Copula-based approach is natural in situations where the association between the variables is of primary interest, since the effect of the dependence structure can easily be separated from that of the marginals (see Sklar (1959)).[3] In addition, copulas permit an examination of joint behavior at the tails of distribution, because measures of such tail behavior, known as tail dependence, can be directly expressed in terms of the copula associated to its joint distribution (see, e.g., Joe (1997)).

We use monthly S&P 500 and hedge fund index returns from January 1994 to May 2007 to simulate the joint distributions of holding period returns. We focus on a list of hedge fund investment strategies or styles that the earlier literature indicates have asymmetric dependence on the market, with non-zero lower tail dependence. In doing so, we address some of the suggestions of Poon et al. (2004), who propose investigating the

[2] For this reason, hedge fund research considering beyond monthly frequency is scarce.

[3] In fact, this subset of hedge funds are those, in the first place, responsible for making the asymmetric nature of hedge fund returns become part of the accepted wisdom.

time aggregating properties of extreme values, the effect of investment time horizons on tail dependence, and others.

We have some preliminary results. First, we find the same type of asymmetric dependence throughout the different time horizons; hence, regardless of the investment horizon, the market and hedge fund returns exhibit greater dependence for downside moves than for upside moves. Second, the degree (or magnitude) of asymmetry is highest at the quarterly horizon and decreases as we move to the five-yearly horizon; hence, the market and hedge fund returns have more symmetric (or less asymmetric) dependence structure at longer-horizon than at shorter-horizon. Finally, the lower tail dependence (i.e., the probability of joint negative events) is found inversely related to the length of the investment horizon; hence, such tail risk tends to diminish along with the increasing investment time horizon.

This project contributes to the literature on time interval effect on the association between variables.[4] Closest to our project are the recent work of Breymann et al. (2003) and Dias and Embrechts (2007), which studies the change in dependence structure as a function of the time horizon. These authors investigate high-frequency exchange rates, and find that the data exhibits an elliptical (thus, symmetric) dependence with successively thinner tails as the time horizon increases. Unlike these authors, we focus on the dataset characterized by asymmetric dependence structure. Less related to our work is Ang and Chen (2002), who document that the magnitude of the correlation asymmetries seems unrelated to the horizons. However, asymmetry in correlations is a complex function of asymmetries both in the marginals (i.e., skewness) as well as in the dependence structure. Our project focuses exclusively on the intrinsic association between assets and asymmetries therein.

[4] See, e.g., Levhari and Levy (1977), Levy (1972), Levy and Schwarz (1997), and Levy et al. (2001) among many others

Selected References

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