Journal of Banking & Finance 56 (2015) 103–122

Contents lists available at ScienceDirect

Journal of Banking & Finance

journal homepage: www.elsevier.com/locate/jbf

# Hedge fund return predictability; To combine forecasts or combine information?

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ARTICLE INFO

*Article history:*
Received 6 April 2014
Accepted 13 March 2015
Available online 25 March 2015

*JEL classification:*
G11
G12
C22
C53

*Keywords:*
Forecast combination
Combining information
Prediction
Hedge funds
Portfolio construction

ABSTRACT

While the majority of the predictability literature has been devoted to the predictability of traditional asset classes, the literature on the predictability of hedge fund returns is quite scanty. We focus on assessing the out-of-sample predictability of hedge fund strategies by employing an extensive list of predictors. Aiming at reducing uncertainty risk associated with a single predictor model, we first engage into combining the individual forecasts. We consider various combining methods ranging from simple averaging schemes to more sophisticated ones, such as discounting forecast errors, cluster combining and principal components combining. Our second approach combines information of the predictors and applies kitchen sink, bootstrap aggregating (bagging), lasso, ridge and elastic net specifications. Our statistical and economic evaluation findings point to the superiority of simple combination methods. We also provide evidence on the use of hedge fund return forecasts for hedge fund risk measurement and portfolio allocation. Dynamically constructing portfolios based on the combination forecasts of hedge funds returns leads to considerably improved portfolio performance.



## 1. Introduction

Hedge funds have attracted a great deal of attention during the last fifteen years. High net-worth individuals or institutional investors seek premium returns in these alternative asset classes. The recent launch of investable hedge fund indices allowed a larger proportion of small- to medium-sized investors to gain access to this type of investment and boosted the interest in studying hedge fund investments. Following unconventional trading strategies, these funds have traditionally outperformed other investment strategies partly due to the weak correlation of their returns with those of other financial securities. However, the recent financial crisis revealed the interdependencies of these funds with the rest of the financial industry and the risks posed to the financial system via their exposure to common risk factors (Bussiere et al., 2014).

The rapid growth in the hedge fund industry over the last years and the availability of hedge fund data from commercial data providers has led to a substantial number of both theoretical and applied papers on hedge funds. Our paper is related to two strands of literature on hedge funds: (i) papers focusing on the risk-return characteristics of hedge funds[1] and (ii) papers directly investigating hedge fund return predictability.

In the first strand of the literature, Bali et al. (2011) exploit the hedge funds' exposures to various financial and macroeconomic risk factors. The authors find a positive (negative) and significant link between default premium beta (inflation beta) and future hedge fund returns. Titman and Tiu (2011) regress individual hedge fund returns on a group of risk factors and find that funds with low R-squares of returns on factors have higher Sharpe ratios. Bali et al. (2012) investigate the extent to which aggregate risk measures explain the cross-sectional dispersion of hedge fund returns. The authors find that systematic risk has the greatest role in explaining the cross-section of future fund returns. Sun et al. (2012) construct a measure of the distinctiveness of a fund's investment strategy (SDI) and find that higher SDI is associated with better subsequent performance of hedge funds.

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[1] A partial list of earlier studies includes Fung and Hsieh (1997, 2000, 2001, 2004), Ackermann et al. (1999), Liang (1999, 2001), Mitchell and Pulvino (2001), Agarwal and Naik (2000, 2004), Kosowski et al. (2007), Bali et al. (2007), Fung et al. (2008), Patton (2009), Jagannathan et al. (2010) and Aggarwal and Jorion (2010).

http://dx.doi.org/10.1016/j.jbankfin.2015.03.004
0378-4266/

Papers in the second strand are most closely related to ours and include Amenc et al. (2003), Hamza et al. (2006), Wegener et al. (2010), Avramov et al. (2011, 2013) and Olmo and Sanso-Navarro (2012). Amenc et al. (2003) were the first to investigate return predictability in the hedge fund industry. The authors employ multi factor models based on a variety of economic variables and find significant evidence of hedge fund predictability. In a subsequent study, Hamza et al. (2006) consider both a broader set of risk factors and a longer time series and also find evidence in favour of predictability. More recently, Wegener et al. (2010) address the issue of non-normality, heteroskedasticity and time-varying risk exposures in predicting excess returns of four hedge fund strategies. Avramov et al. (2011) find that macroeconomic variables, specifically the default spread and the Chicago Board Options Exchange volatility index (VIX), substantially improve the predictive ability of the benchmark linear pricing models used in the hedge fund industry. Employing time-varying conditional stochastic dominance tests, Olmo and Sanso-Navarro (2012) forecast the relative performance of hedge fund investment styles one period ahead. Avramov et al. (2013) analyze both in and out of sample individual hedge fund return predictability and find that the predictability pattern largely reflects differences in key hedge fund characteristics, such as leverage or capacity constraints. The authors show that a simple strategy that combines the funds' return forecasts obtained from individual predictors delivers superior performance. The aforementioned studies on return predictability are directly linked to the market timing literature. For example, Chen and Liang (2007) examine the ability of fund managers to time both returns and volatility and find that find evidence of timing ability at both the aggregate and fund levels, which is relatively strong in bear and volatile market conditions. More recently, Cao et al. (2013) investigate how hedge funds manage their liquidity risk by responding to aggregate liquidity shocks and find that hedge fund managers have the ability to time liquidity by increasing portfolio market exposure when equity market liquidity is high. In a similar mode, Bali et al. (2014) address macroeconomic risk and find that directional hedge fund managers have the ability to time macroeconomic changes by increasing (decreasing) portfolio exposure to macroeconomic risk factors when macroeconomic uncertainty is high (low).

Given the long set of candidate predictors, suggested by the extant literature, we address the issue of constructing improved hedge fund returns forecasts by carefully integrating the information content in them. We proceed in two directions; combination of forecasts and combination of information. Combination of forecasts combines forecasts generated from simple models each incorporating a part of the whole information set, while combination of information brings the entire information set into one super model to generate an ultimate forecast (Huang and Lee, 2010). We employ a variety of combination of forecasts and information methodologies and evaluate their predictive ability in a pure out-of-sample framework for the period 2004–2013, which contains the recent financial crisis period that plagued the hedge fund industry. To anticipate our key results, our statistical evaluation findings suggest that simple combination of forecasts techniques work better than more sophisticated and computationally intensive combination of information ones. However, the utility gains a mean–variance investor would have can be large irrespective of the model employed. Furthermore, we compare the performance of our forecasting approaches with respect to their ability to construct optimal hedge fund portfolios in a mean-variance and mean–CVaR framework. Overall, forecasting hedge fund returns leads to improved portfolio performance, while combination of forecasts proves to be the superior approach. More importantly, simple combining schemes can generate portfolios with high average returns and low risk. Focusing on the recent financial crisis period, which is quite diverse, due to elevated credit, liquidity and systemic risk, our findings point to improved performance of the combination of information methods. Even in these adverse market conditions, forecasting returns can generate portfolios with high average returns and low risk.

The remainder of the paper is organized as follows. Section 2 describes the predictive models and the forecasting approaches we follow. Our dataset, the framework for forecast evaluation and our empirical findings are presented in Section 3. Section 4 discusses the approaches we employ to construct optimal hedge fund portfolios, presents the portfolio performance measures used in our empirical analysis and reports the results of our investment exercise. Section 5 repeats the analysis for the 2007–2009 financial crisis and Section 6 summarizes and concludes.

## 2. Predictive models and forecast construction

In this section, we describe the forecasting approaches we follow. To facilitate the exposition of our approaches, we first describe the design of our forecast experiment. Specifically, we generate out-of-sample forecasts of hedge fund returns using a recursive (expanding) window. We divide the total sample of $T$ observations into an in-sample portion of the first $K$ observations and an out-of-sample portion of $P = T - K$ observations used for forecasting. The estimation window is continuously updated following a recursive scheme, by adding one observation to the estimation sample at each step. As such, the coefficients in any predictive model employed are re-estimated after each step of the recursion. Proceeding in this way through the end of the out-of-sample period, we generate a series of $P$ out-of-sample forecasts for the hedge fund indices returns. The first $P_0$ out-of-sample observations serve as an initial holdout period for the methods that require one. In this respect, we evaluate $T - (K + P_0) = P - P_0$ forecasts of the hedge fund returns over the post-holdout out-of-sample period.

### 2.1. Univariate models

First we consider all possible conditional mean predictive regression models with a single predictor of the form

$$r_{t+1} = \beta_0 + \beta_i x_{it} + \beta_{N+1} r_t + \varepsilon_{t+1}, \; i = 1, \ldots, N, \tag{1}$$

where $r_{t+1}$ is the observed return on a hedge fund index at time $t+1$, $x_{it}$ are the $N$ observed predictors at time $t$, and the error terms $\varepsilon_{t+1}$ are assumed to be independent with mean zero and variance $\sigma^2$. Given the significant autocorrelation present in the majority of hedge fund returns, the set of potential predictors contains the lagged (one-month) return as well. Eq. (1) is the standard prediction model, which links the forecast of one-period ahead hedge fund return to its current return and a candidate predictor variable. When no predictive variable is included in Eq. (1), we get the benchmark AR(1) model which serves as a natural benchmark for the forecast evaluation.

### 2.2. Forecast combination

Combining forecasts, introduced by Bates and Granger (1969), is often found to be a successful alternative to using just an individual forecasting method. Forecast combinations may be preferable to methods based on an ex-ante best individual forecasting model due to at least three reasons (see Timmerman, 2006, for a survey). First, combining individual models' forecasts can reduce uncertainty risk associated with a single predictive model (Hendry and Clements, 2004). Similarly to the simple portfolio diversification argument, combining models based on different information sets