In Search of Missing Risk Factors: Hedge Fund Return Replication with ETFs

Jun Duanmu[a], Yongjia Li[b], and Alexey Malakhov[c]

September 2014

ABSTRACT

Properly considering all potential risk factors through tradable liquid portfolios in the context of a risk based factor model is paramount to quantifying the benefits of investing in hedge funds. We attempt to span the space of potential risk factors with exchange traded funds (ETFs). We develop a methodology of hedge fund return replication with ETFs based on cluster analysis and LASSO factor selection that overcomes multicollinearity among ETFs and the data mining bias. We find that the overall out-of-sample accuracy of hedge fund replication with ETFs increases with the number of ETFs available. This is consistent with our interpretation of ETF returns as proxies to a multitude of alternative risk factors that could be driving hedge fund returns.

We further consider portfolios of "cloneable" and "non-cloneable" hedge funds, defined as top and bottom in-sample R^2 matches. We find superior risk-adjusted performance for "non-cloneable" funds, while "cloneable" funds fail to deliver significantly positive risk-adjusted performance. We conclude that our methodology provides value in both identifying skilled managers of "non-cloneable" hedge funds, and also successfully replicating out-of-sample returns that are due to alternative risk exposures of "cloneable" hedge funds, thus providing a transparent and liquid alternative to investors who may find these return patterns attractive.

JEL classification: G11, G23

Keywords: hedge funds, return replication, risk exposures, performance measurement, performance prediction.

[a] Jun Duanmu, jduanmu@walton.uark.edu, 479-575-4505, Sam M. Walton College of Business, University of Arkansas, WCOB 302, Fayetteville, AR 72701, USA.
[b] Yongjia Li, yli@walton.uark.edu, 479-575-4505, Sam M. Walton College of Business, University of Arkansas, WCOB 302, Fayetteville, AR 72701, USA.
[c] Alexey Malakhov, amalakhov@walton.uark.edu, 479-575-6118, Sam M. Walton College of Business, University of Arkansas, WCOB 302, Fayetteville, AR 72701, USA.

1. Introduction

Hedge funds have experienced tremendous growth in recent years, with more than $2.6 trillion currently invested in hedge funds globally,[1] and are now considered an essential part of alternative investment strategies by institutional investors and financial institutions. Hedge funds have been able to produce returns with relatively low correlations with major asset classes, like stocks and bonds, due to the multitude of investment opportunities available to hedge fund managers. Hedge fund managers have the flexibility to invest in non-traditional asset classes (including derivative securities), employ leverage, and engage in short sales. However, such strategies also expose investors to alternative risk factors that may not be easy to quantify, given the opacity of the hedge fund industry. It is then natural to question whether the returns earned by hedge fund managers are due to managerial skill, or merely compensation for exposure to alternative risk factors. If a significant portion of hedge fund returns comes from alternative risk factor exposures, then it is reasonable to presume that it is possible for investors to replicate that part of hedge fund returns at a lower cost by taking on these risk exposures themselves. However, such exercise hinges on the ability to identify and quantify these alternative risk factors via proxies of portfolios of tradable and liquid securities.[2] That is why the issue of choosing appropriate risk factors is central to any study of hedge fund performance, and currently there is no set of factors that is universally accepted across the literature.[3]

[1] According to Hedge Fund Research, Inc. January 21, 2014 press release.
[2] Notice that if there is no tradable option available to investors for a particular alternative risk factor, then it could be argued that hedge funds are valuable by merely providing access to that risk exposure. Such exposure through hedge funds comes at a high premium in the form of management and incentive fees.
[3] For example, return attribution studies Fung and Hsieh (2001, 2004) and Agarwal and Naik (2004) introduce new trend following and option based risk factors in addition to Fama and French (1993) and Carhart (1997) factors. On the other hand, hedge fund replication studies Hasanhodzic and Lo (2007), Amenc, Martellini, Meyfredi, and Ziemann (2010), and Giamouridis and Paterlini (2010) employ liquid index portfolios available to investors.

Properly identifying and fully accounting for all potential risk factors through tradable liquid portfolios in the context of a risk based factor model is paramount to quantifying the benefits of investing in hedge funds. If we could successfully span the entire space of alternative risk factors, then we would be able to achieve two important objectives: first, separate skill driven from risk driven hedge fund returns, thus identifying hedge fund managers who possess genuine skill (or the lack of thereof), and, second, replicate the risk driven hedge fund return component at a lower cost by avoiding hedge fund fee structure.

In this paper we attempt to span the space of potential risk factors with exchange traded funds (ETFs) from 1997 to 2012. This time period saw an explosion in ETFs available, with the number of U.S. listed passively managed ETFs going from 19 in 1997 to 1313 in 2012. During the time period of our study the ETF coverage of alternative risk factors went from almost non-existent in 1997 to being comprehensive, with ETFs currently providing access to a great variety of alternative strategies that were previously available only to hedge funds or institutional investors.[4] This provides us with a unique opportunity to investigate how the expanding space of alternative risk factors affects the quality of hedge fund replication with ETFs available at the time.

While the large number of ETFs available in the later years of our study allows for more complete spanning of the space of risk factors, it also increases potential for spurious results due to excessive data mining. We develop a new methodology for linear hedge fund return replication that overcomes multicollinearity among ETFs, and also minimizes data mining bias, while utilizing all ETFs available. Our focus on hedge fund return replication with subsequent

[4] As an example of available ETF strategies, consider ALPS U.S. Equity High Volatility Put Write Index Fund (ticker HPVW) that tracks NYSE Arca U.S. Equity High Volatility Put Write Index with an annual expense ratio of 0.95 percent. The ETF benchmark tracks the performance of options sold on a basket of 20 stocks chosen from the largest-capitalized equities that have the highest volatility, as determined by NYSE Arca Inc.

out-of-sample testing of hedge fund clones highlights the efficacy of our methodology in mitigating the data mining bias. We test the performance of our hedge fund clones in- and out-of-sample, and find that the overall accuracy of hedge fund replication with ETFs increases with the number of ETFs available. We find that in the subperiod starting in 2005, the overall out-of-sample performance of the portfolio of all hedge funds is not statistically different from the portfolio of clones. We attribute this to the sufficiently large number of available ETFs in the later years, which allow us to successfully span the space of hedge fund risk factors.

In a departure from previous hedge fund replication studies, we go beyond considering replicating hedge fund indexes or average hedge fund performance. We consider portfolios of "cloneable" and "non-cloneable" hedge funds, defined as top and bottom in-sample R^2 matches. Intuitively, we shouldn't expect success in hedge fund return replication for a truly skilled hedge fund manager who pursues investment opportunities uncorrelated with risk factors, delivering true alpha to investors. On the other hand, we fully expect success in return replication for a manager who follows a rigid formulaic strategy, like writing out of the money put options on the S&P 500 index, earning returns by exposing investors to an easily quantifiable alternative risk factor. An illustration of our success in out-of-sample return replication of a particular "cloneable" hedge fund[5] is provided in figure 1.

Consistent with the above intuition, we find that the portfolio of clones created with our procedure provides better[6] out-of-sample performance than the portfolio of "cloneable" hedge funds, which is likely due to the lower fee structure among the clones. Furthermore, the portfolio

[5] This particular (anonymous) hedge fund is in the "fixed income" self-reported style, it has an inception year of 2004, and it was active at the end of our study period. Notice that the out-of-sample comparison begins in 2008, after dropping the first two years of observations to control for the backfill bias, and after using another two years for the in-sample clone matching.
[6] Although not to the point of statistical significance.

of "cloneable" hedge funds does not produce significantly positive risk-adjusted performance, measured by the Fung and Hsieh (2004) alpha. Hence we conclude that there is no statistical evidence of managerial skill in the set of "cloneable" hedge funds, and these funds can be successfully replicated with ETFs.

Finally, the out-of-sample portfolio of "non-cloneable" hedge funds produces significantly positive mean excess returns along with a Fung and Hsieh (2004) alpha, outperforming the portfolio of clones. This can be interpreted as evidence of managerial skill among the managers of "non-cloneable" hedge funds.

We conclude that our methodology provides value in both identifying skilled managers of "non-cloneable" hedge funds, and also successfully replicating out-of-sample returns that are due to alternative risk exposures of "cloneable" hedge funds, thus providing a transparent and liquid alternative to investors who may find these return patterns attractive.[7]

2. Related literature

Our methodology directly extends the factor based hedge fund replication literature that goes back to Sharpe (1992) style analysis approach. In its original form, it constructs a replicating portfolio by relying on constrained beta coefficients from a linear regression on a set of relevant factors. Hasanhodzic and Lo (2007) apply this methodology relying on six fixed factors to replicating hedge fund returns from TASS database, and demonstrate that replication works reasonably well for Dedicated Short Bias, Equity Market Neutral, Global Macro, Managed Futures, Fund of Funds, Convertible Arbitrage, Long/Short Equity Hedge, and Multi-Strategy categories. However, their clones underperform in Event Driven and Emerging Market

[7] Notice that portfolios of "cloneable" hedge funds as well as their clones produced higher average returns and end values compared to the portfolio of "non-cloneable" hedge funds.

categories. Amenc, Martellini, Meyfredi, and Ziemann (2010) extend Hasanhodzic and Lo (2007) by considering non-linear and conditional hedge fund replication models. They don't find that going beyond linear models enhances the replication power. On the other hand, they find that selecting factors for each hedge fund category based on economic rationale yields a substantial improvement in out-of-sample replication quality.

This is an intuitive result from the perspective of the literature on hedge fund risk and performance evaluation, as we don't have an equilibrium model of hedge fund performance evaluation, and instead rely on risk based factor models that approximate the true set of hedge fund risk factors. However, it is virtually impossible to observe the true set of hedge fund risk factors due to the myriad of available strategies to hedge fund managers and the opacity of the industry, and many hedge fund risk and performance evaluation studies[8] rely on statistical techniques, like stepwise regression, to identify the dominant risk factors. More recently, Giamouridis and Paterlini (2010) and Weber and Peres (2013) employ statistical techniques in the factor based hedge fund replication context, applying stepwise, as well as RIDGE, LASSO, and LAR LASSO regressions[9] to sets of sixteen and thirty risk based factors.

Our contribution lies in expanding the universe of available risk factors by considering all available U.S. listed passively managed ETFs. We argue that these ETFs represent reasonable proxies to a multitude of alternative risk factors affecting hedge fund returns. We develop a methodology based on cluster analysis and LASSO selection methodology that overcomes multicollinearity among ETFs, and also minimizes data mining bias, resulting in parsimonious factor selection. We test the performance of our hedge fund clones in- and out-of-sample, and

[8] See, for example, Fung and Hsieh (2001), Agarwal and Naik (2004), S.D.Vrontos, I.D.Vrontos, and Giamouridis (2008), and Titman and Tiu (2011).

[9] See Hoerl and Kennard (1970), Tibshirani (1996), and Efron, Hastie, Johnstone, and Tibshirani (2004) for descriptions of RIDGE, LASSO, and LAR methodologies.

find that the overall accuracy of hedge fund replication with ETFs increases with the number of ETFs available. Our out-of-sample portfolio approach allows minimizing the hedge fund attrition bias that Ben Dor, Jagannathan, Meier, and Xu (2012) find to be a major driver of poor hedge fund index clone performance against hedge fund index benchmarks.

Another major contribution is in considering risk adjusted performance of "cloneable" and "non-cloneable" hedge funds separately, which contributes to the literature on hedge fund risk and performance evaluation.[10] Consistent with results in Titman and Tiu (2011), we find superior out-of-sample risk adjusted performance[11] for "non-cloneable" funds, while "cloneable" funds fail to deliver significantly positive risk-adjusted performance. Hence our methodology provides value in hedge fund performance evaluation by identifying skilled managers who deliver superior out-of-sample risk adjusted performance.

3. Description of data

In this study we utilize hedge fund data from Bloomberg[12] for the period 1997-2012, which includes 18,135 unique hedge funds.[13] The data are comprehensive, including fund returns net of management and performance fees, assets under management, manager information, and fund characteristics. To minimize survivorship bias, the sample includes all funds reporting during our sample period, including those that are acquired, liquidated, or chose to stop reporting. We

[10] See, for example, Jagannathan, Malakhov, and Novikov (2010), Titman and Tiu (2011), Avramov, Kosowski, Naik, and Teo (2011), Sun, Wang, and Zheng (2012), Bali, Brown, and Caglayan (2011, 2012), Avramov, Barras, and Kosowski (2013), and Jurek and Stafford (2013).
[11] As quantified by the Fung and Hsieh (2004) alpha.
[12] Bloomberg is the most common platform used by both hedge funds, who utilize news, analysis, research, and trading tools, and accredited investors, who use Bloomberg data to research hedge funds, private equity firms, and other alternative investment vehicles. Bloomberg aggregates data on live and dead funds inclusive of fund and parent company descriptions, manager and contact information, total assets under management, fees, past performance, and management style.
[13] We do not include funds of hedge funds in our sample.

partially offset the effects of backfill bias by eliminating the first 24 months of reported returns.[14] Since we require two years of data[15] to create a hedge fund clone, and at least a year to test the clone error, we only consider funds with inception dates prior to 2009, which leaves us with 3,190 unique funds. Finally, of the 3,190 funds with inception dates prior to 2009, 1,002 funds are active in our sample and 2,188 funds are inactive (i.e. acquired, liquidated or chose to stop reporting).

Panel A of table I reports summary statistics of fund returns, fees, investor liquidity measures, and fund longevity. As medians are better measures of typical funds in our database we find that the typical fund has a 1.5% management fee, a 20% incentive fee on all profits over an investor's high water mark,[16] a $250,000 minimum initial investment, and a 30 day redemption period. Unsurprisingly, active funds display higher monthly returns and assets under management and greater longevity than inactive funds. Interestingly, however, inactive funds have longer redemption periods and lockup periods. Panels B and C of table I report percentages of funds with certain characteristics and declared styles, respectively. 76% of all funds have a high water mark provision, though only 4% allow hurdle rates in addition to high water marks. 68% of funds are non-U.S. domiciled. The most common declared style is long-short equity, at 29% of all funds, while equity statistical arbitrage is the least common style, accounting for 1% of hedge funds.

[14] The 24 month backfill correction is in line with results in Jagannathan, Malakhov, and Novikov (2010) and Titman and Tiu (2011) suggesting dropping the first 25 and 27 months of returns.
[15] After deleting the first 24 months of observations.
[16] High water marks are investor relevant, that is, an investor will not be charged incentive fees until profits accrue over a previous high, net of flows. Thus, not all investors are charged incentive fees in any given year; it is partially determined by when the investor capital was employed by the fund manager. An investor whose fund shares are worth more this year than last will be charged incentive fees. An investor who suffered a loss previously will not pay incentive fees until previous losses are regained.

We collect the ETF data from Morningstar for the period 1994-2012, which contains 1,484 unique U.S. listed ETF funds. We manually check the description of each ETF, and exclude all ETFs that are not passively managed index tracking funds[17], as well as ETFs that track hedge fund style indexes; this leaves us with 1,387 unique ETFs. Then further data cleaning procedures are performed. In our study, we require ETFs to have at least 24 monthly observations starting from January. In addition, we drop those ETFs with missing management fee information. In the end, 1,313 unique ETFs for the period 1997-2012[18] are included in this study. Figure 2 reports the number of ETFs available each year in our sample period. As shown, ETFs have experienced a significant growth in our sample, from 19 ETFs available in 1997 to 1,313 ETFs available in year 2012. This implies that with the increase of the number of ETFs available, the investment opportunity set has broadened dramatically, and our hedge fund replicating process gains more accuracy when approaching the later years in our sample. In this study, we employ cluster analysis and LASSO regression procedure to find the best fit risk factors to clone real hedge fund returns, and we utilize two years of previous monthly ETF returns for the matching process. Figure 3 reports the actual number of ETFs used for each two year window. In the early years, there are relatively few ETFs around, which makes the cloning procedure less accurate. So as to provide a better picture of the replication outcome, we split our whole sample period into two subperiods, period 1997-2004 and period 2005-2012, where in the first period, we have fewer than 100 ETFs available for matching procedures, while more than 100 ETFs can be included in the cluster analysis and later LASSO matching regression in the second period. Arguably, we expect to see better matching and replications for the second period 2005-2012.

[17] Benchmark indexes that retained ETFs track may not be publicly available. Some funds track in-house indexes.
[18] There are fewer ETFs than 5 ETFs available prior to 1997, which makes our methodology meaningless in 1994-1996, and we exclude these years from further analysis.

4. Research methodology

4.a. Style analysis with ETFs

Our ETF database includes a total number of 1,313 unique ETFs across the whole sample period. In order to clone a hedge fund using the large set of risk factors, we must choose the appropriate replicating factors first. We employ a factor selection model termed "LASSO" (least absolute shrinkage and selection operator) proposed in Tibshirani (1996). For a given parameter *t*, LASSO regression identifies an optimal set of factors with non-zero coefficients such that

$$\hat{\beta}_{Lasso} = \arg\min_{\beta} \| \mathbf{r} - \mathbf{X}\beta \|^2, \quad \text{such that } \sum_{j=1}^{m} |\beta_j| \leq t. \tag{1}$$

where $\mathbf{r}$ is the vector of hedge fund monthly returns in our research and $\mathbf{X}$ is the vector of ETF monthly returns.

Conceptually, provided a set of factors, LASSO regression determines the appropriate factors to be selected through an optimization approach. In the constrained form of ordinary least squares regressions, the sum of absolute values of the beta coefficients are estimated and constrained to be smaller than a specific parameter. For a given selection parameter *t*, some of the beta coefficients could be zero if the corresponding factors reveals little or no information about the dependent variable. As a result, LASSO regression "shrinks" the set of regression factors until the beta coefficients are the solution of the optimization problem. The degree of "shrinking" depends on the chosen value of the parameter *t*, with lower values of *t* resulting in fewer factors being selected for the model. We calculate LASSO regression solutions across a range of *t* values by employing a computationally efficient least angle regression (LAR)

modification of the LASSO procedure introduced in Efron, Hastie, Johnstone, and Tibshirani (2004). Finally, we employ Schwarz (1978) Bayesian information criterion (SBC) as the model selection criterion, selecting the model with the lowest SBC value.

However, before adding all ETFs as explanatory variables in LASSO regression, we need to tackle the multicollinearity in the comprehensive set of ETFs. Although our ETFs database has factored in a broad set of trading strategies, it is not surprising that some ETFs are exposed to similar risk factors therefore exhibiting similar or even the same return patterns. And even though LASSO regression could be a powerful selection method in dealing with collinearity, it is not feasible for LASSO regressions to handle collinearity for such a large number of closely correlated ETF factors in a meaningful way.

To address this problem, we conduct cluster analysis among ETFs in order to reduce the number of ETF factors prior to running LASSO regressions. For every ETF in each cluster we calculate the distance away from the center of its cluster, as defined by the *SDI* measure from Sun, Wang, and Zheng (2012). This distance measure for an ETF *i* is calculated as one minus the correlation of the ETF's return with the mean return of all ETFs from the same cluster *I*, i.e.

$$SDI_i = 1 - corr(r_i, \mu_I),$$
$$\text{where } \mu_I = \frac{\sum_{i \in I} r_i}{count(i \in I)}. \qquad (2)$$

The lower the *SDI*, the closer the ETF is from the center of its cluster. We specify the ETF with the lowest *SDI* as a proxy for all the ETFs in the same cluster, and then we include this ETF as a replicating factor in LASSO regression. This approach allows efficient spanning of the space of

potential risk factors, while mitigating multicollinearity by maximizing the distance between ETFs used.

Because the number of ETFs changes over time and we don't know the true number of clusters, we assume that the number of clusters ranges from 1 to 100. We set the maximum number to 100 since we believe it is an efficient and sufficiently large set of investment opportunities (since there are less than 100 ETFs for years before 2003, we set the maximum number of cluster as the number of ETFs during those years). We then iteratively run cluster analysis for a hundred times and use the corresponding number of ETFs (each selected ETF is located at the center of its cluster) in LASSO regression. Consequently, after running cluster analysis and LASSO regressions, each fund would have one hundred corresponding models. We then choose the model which yields the lowest SBC score as our clone model. Such an approach minimizes data mining bias, resulting in parsimonious factor selection.

The basic model for LASSO regression is as follows:

$$r_{i,gross} - r_f = \beta_1(ETF_1 - r_f) + \beta_2(ETF_2 - r_f) + ... + \beta_{100}(ETF_{100} - r_f) + \varepsilon_i \qquad [M]$$

where $r_{i,gross}$ is the gross monthly return of fund i, and r_f is the risk free rate proxied by the monthly return of the 30-day U.S. Treasury bill. We use gross hedge fund returns[19] on the left hand side, since we try replicating hedge fund return patterns that are driven by exposure to alternative risk factors. Otherwise, the true factor risk driven hedge fund returns would be altered if we consider them net-of-fees, and hence the matched ETF risk profile would not reflect the true factor risk exposures. We also suppress the intercept in regressions because intercept captures the management fees incorporated in hedge fund returns and we have already added

[19] See Appendix A for details on the gross returns calculations.

back the fees. In a slight departure from Sharpe (1992) style analysis methodology, we don't restrict beta coefficients to be positive or add up to one, as imposing such restrictions would likely result in model misspecification in the context of hedge funds that are free to take leverage and short positions.[20]

In order to quantify the dynamic nature of hedge funds' investment activities, we run the LAR LASSO methodology for model [M] for every hedge fund in our data over a set of two year windows, rolling them annually over the sample period. We consider adjusted-R^2 and SBC values from these matching regressions as in-sample proxies of the "overall quality" of our matching procedure. We interpret higher R^2 and lower SBC values as indicators of our methodology's success in capturing hedge fund risk factors, and thus potential for cloning hedge fund returns with ETFs.

However, the ultimate goal is to test the predictive power of the methodology, as to validate the in-sample explanatory power manifested by high R^2 and low SBC values. For each hedge fund, we consider the corresponding ETF matches selected through the previous two year window LASSO regression and their coefficients, and then construct the hedge fund clone by loading selected ETFs with regression determined weights. The hedge fund clone performance after the matching period is then given by

$$CloneRet_{i,t} = r_{f,t} + \sum_{j=1}^{n} \beta_{j,t-1}(ETF_{j,t} - r_{f,t}), \qquad (3)$$

where $\beta_{j,t-1}$ is the coefficient from the previous two year window LASSO selected ETF j. We rely on net-of-fees returns for both hedge funds and their ETF matches in our out-of-sample

[20] ter Horst, Nijman, and de Roon (2004) demonstrate that imposing unwarranted style based constraints can lead to biased risk exposure estimates.

analysis,[21] as we compare future returns from an investor perspective. Finally, we address the survivorship bias among hedge funds by constructing out-of-sample portfolios and rebalancing them when hedge funds drop out of the database.

4.b. "Cloneable" and "non-cloneable" hedge funds

In a departure from previous hedge fund replication studies, we go beyond exploring aggregate characteristics of clones versus hedge funds they replicate. Instead we concentrate on comparing "cloneable" and "non-cloneable" hedge funds, defined as top and bottom in-sample R^2 matches. We argue that the success in hedge fund replication depends on a hedge fund manager's style, and that properly deconstructing that style is paramount for assessing the true value of a hedge fund for investors. For example, if a hedge fund manager has genuine ability and pursues a unique strategy uncorrelated with identifiable risk factors in a "non-cloneable" fund, then we shouldn't expect success in replicating such fund performance. On the other hand, if a manager pursues algorithmic strategies highly correlated with risk factors in a "cloneable" fund, then we expect success in out-of-sample replication, as our hedge fund clone would deliver a similar risk and return profile, but at a lower cost compared to the "cloneable" fund. Furthermore, it would be unlikely to find evidence of superior risk adjusted managerial skill in "cloneable" funds in the context of a return attribution model, as their performance would be driven mostly by factor risk exposures.

5. Empirical results

5.a. Matching regressions

Our matching (or "cloning") procedure is based on in-sample LAR LASSO regressions for model [M], with the best model chosen according to the Schwarz Bayesian Criterion (SBC), as

[21] Where we consider the performance of hedge funds and their clones past the two year matching period.

described in the previous section. Table II reports the results for annual rolling two-year matching regressions from 1997 to 2011.[22] To highlight the effect of the broadened investment opportunity set for our matching procedure, we also consider subperiods of 1997-2003 and 2003-2011 separately.[23] The results confirm our expectation of better matching in later years, reflecting a greater degree of success in spanning the space of available risk factors as more ETFs become available. On average, in 1997-2003 there are only 45 ETFs available, and the average matching R^2 is 0.42, while in 2003-2011 there are 365 ETFs available for the matching regressions, and the average R^2 is 0.57. We also observe that the mean SBC has declined through time, from 59.47 in 1997-2003 to 45.81 in 2003-2011. This suggests that matching quality has improved along with the broadened investment opportunity set, as more ETFs become available. Lastly, the average number of factors selected by the LAR LASSO procedure is 2.22 for the whole sample period, which indicates that our methodology results in a parsimonious factor selection.

5.b. Out-of-sample clone performance

As noted before, our methodology of running LASSO regressions on a variable number of ETFs, and using SBC or a statistical model selection does minimizes data mining bias and yields a parsimonious factor selection. However, the ultimate test of our methodology lies in considering out-of-sample performance of hedge fund clones versus hedge funds they replicate. As described in the methodology section, we construct a hedge fund clone as a linear combination of model selected ETFs with the matching regression determined weights. Then the out-of-sample performance of a hedge fund clone is given by the equation (3). It is important to

[22] While our date extends until 2012, we don't use 2012 in matching regressions, as we need at least one year of data for out-of-sample tests of our matches.

[23] We chose 2003 as the break year, since it is the first year when there are more than 100 ETFs available, which allows full utilization of our methodology based on a variable number of ETF clusters up to 100.

reiterate that out-of-sample, we rely on net-of-fees returns for both hedge funds and their ETF clones, as we compare out-of-sample returns from an investor perspective.[24] Finally, we calculate tracking errors as the differences in returns between the clone and the corresponding hedge fund, i.e.

$$TrackingError_{i,t} = CloneRet_{i,t} - HedgeFundRet_{i,t}. \qquad (4)$$

Table III reports the results of comparing out-of-sample performance of hedge funds and their clones for one year following each two year in-sample matching period. Consistent with in-sample results, reported in table II, the average out-of-sample accuracy has increased over the years with the average mean tracking error going from -0.63 in 1999-2004 to -0.05 in 2005-2012, and average tracking error volatility going from 4.31 in 1999-2004 to 3.54 in 2005-2012.[25] This is consistent with improved matching quality in the later years, as more ETFs become available to span the set of potential hedge fund risk factors.

5.c. Cloneable and non-cloneable hedge funds

While the results in table III indicate that the performance of clones is comparable with performance of hedge funds in aggregate, they hide a wide discrepancy among individual funds. In this section we consider two groups of hedge funds, selected as top and bottom in-sample R^2 matches. We define the funds that are well matched with high R^2 as "cloneable", and the funds with relatively low matching R^2 as "non-cloneable".

As our methodology allows to effectively span the space of potential risk factors, the R^2 could be viewed as a proxy for how easily quantifiable or "decipherable" the investment strategy

[24] Recall that the in-sample matching regressions rely on gross returns, as we want to get closest possible matches to "true" hedge fund strategies, as carried out by hedge fund managers.

[25] The choice of 2004 as the out-of-sample break year is consistent with 2003 being the in-sample break year, since it is the first year when out-of-sample predictions based on more than 100 ETFs available.

of a hedge fund manager is. Moreover, there is a fundamental difference in risk profiles between the top and bottom R^2 groups of hedge funds. For example, it is plausible that a manager of a cloneable (i.e. high R^2) fund generates returns by simply loading up on risk factors, identifiable with our methodology, while a manager of a non-cloneable (i.e. low R^2) fund likely has genuine ability and pursues a truly unique strategy uncorrelated with identifiable risk factors. Hence we don't expect success in replicating out-of-sample performance of non-cloneable funds, while we fully expect success in replication of cloneable funds, as our clones would deliver similar risk and return profiles, but at a lower cost compared to the cloneable funds.

We consider cloneable and non-cloneable hedge funds and their clones based on their in-sample LASSO R^2 rank, on both quartile and quintile bases. Tables IV and V report in-sample characteristics of cloneable and non-cloneable funds for quartile and quintile cutoffs, while tables VI and VII report out-of-sample results for cloneable and non-cloneable hedge funds[26] and their clones. We pay particular attention to the results from the second time period of our study, when we can more successfully span the space of hedge fund risk factors with more than 100 ETFs available.

Consistent with full sample results from table II, the overall quality[27] of in-sample matches increases over time for both cloneable and non-cloneable funds, as more ETFs become available for spanning the space of potential risk factors. However, on average, cloneable funds register larger magnitudes of increases in the matching R^2 and decreases in SBC compared to non-cloneable funds. Another striking feature of tables IV and V is the difference in skewness of net

[26] Defined as top and bottom quartiles in tables IV and VI, and quintiles in tables V and VII.
[27] As reflected by higher in-sample R^2 and lower SBC values from matching regressions.

returns between cloneable and non-cloneable funds, with the overall average skewness of -0.23 for cloneable funds, and 0.11 for non-cloneable funds.[28]

Next we study the out-of-sample performance of clones for cloneable and non-cloneable fund groups, which is arguably the most meaningful comparison, since our definitions of "cloneable" and "non-cloneable" funds are based on R^2 from in-sample matching regressions. Tables VI and VII report the results of comparing out-of-sample performance of both groups of hedge funds and their clones for one year following each two year in-sample matching period. Overall, cloneable funds yield higher quality out-of-sample matches with closer means and smaller volatilities of tracking errors compared to non-cloneable funds. This difference is especially pronounced in the second part of our study period, which is consistent with the previous results showing increased effectiveness of our methodology when the number of available ETFs exceeds 100.[29]

It is important to point out that we rely on gross returns for the in-sample matching with the objective to fully account for all the risk factors inherent in the strategies pursued by hedge fund managers, or, in other words, to "decipher" any passive strategies being used by hedge fund managers. On the other hand, we use net-of-fees returns in our out-of-sample analysis, as we compare returns form an investor perspective. This means that we shouldn't expect a 100% out-of-sample match, even if we were 100% successful in uncovering the true passive strategy of a hedge fund manager, since our ETF based clone has a much lower fee structure compared to the hedge fund being cloned. In fact, if we were indeed successful in "deciphering" of the true

[28] Based on table IV for quartile cutoffs. The skewness results for quintile cutoffs are -0.24 for cloneable funds, and 0.07 for non-cloneable funds, reported in table V.

[29] In fact, there is almost no difference in the overall accuracy of out-of-sample clone performance between cloneable and non-cloneable funds in 1999-2004, as we don't have enough ETFs to span the space of potential hedge fund risk factors.

strategy of a hedge fund, the ETF clone should have a positive mean tracking error due to the fee structure advantage. Hence it is not surprising to see positive average tracking errors for cloneable funds in 2005-2012, when our ETF matching methodology has the most power.

Notice that cloneable funds demonstrate negative average skewness both in- and out-of-sample during the time period when applying our ETF matching methodology yields the most meaningful results, i.e. in 2005-2012. While it is not possible to unequivocally claim an underlying reason for this phenomenon, it is certainly consistent with the interpretation that cloneable hedge funds mostly load up on exotic risk factors with asymmetric payoffs,[30] while providing very little in terms of truly active portfolio management. Furthermore, the fact that the clones of "cloneable" hedge funds also demonstrate negative average out-of-sample skewness could be interpreted as our methodology's success in "deciphering" strategies of cloneable funds, and producing clones with similar risk and return profiles.

Finally, tables VI and VII demonstrate that our methodology could not provide a good in-sample match for non-cloneable funds, and the clones were not successful in delivering comparable out-of-sample performance.[31] This is consistent with the interpretation of truly active hedge fund management of non-cloneable funds that could be of benefit to potential investors. However, the non-cloneable hedge funds have almost one and a half time higher average attrition rate than cloneable funds, which could be indicative of higher risks, not quantifiable with our methodology, among non-cloneable hedge funds.[32]

[30] Payoffs from such strategies, like writing out of the money put options on the S&P 500 index, may look pretty attractive from the point of not very sophisticated investors.
[31] As clones yielded negative average tracking errors, high tracking error volatility, and could not match the skewness of non-cloneable funds.
[32] This is consistent with Bollen (2013) findings of higher probability of failure for zero-R^2 hedge funds.

5.d. Out-of-sample portfolio analysis

We now concentrate on out-of-sample portfolio tests for the following reasons. First, by considering all funds up until the moment of their disappearance from the database, we minimize the effects of the survivorship bias. Second, the portfolio approach allows for out-of-sample risk adjusted performance evaluation of hedge funds and their clones over long periods of time.

We form portfolios on December 31, 1998. We invest the same dollar amount into each fund within a portfolio in the beginning, and follow its net-of-fees performance until December 31, 2012, rebalancing it once a year based on updated LASSO regression matches. When a portfolio fund disappears from the database we redistribute the remaining capital in the fund equally amongst surviving portfolio funds.[33] This procedure produces a time series of 168 monthly returns for each portfolio, allowing us to evaluate long term portfolio performance across various economic conditions, including the most recent financial crisis of 2008 - 2009. We then calculate end dollar values based upon a $1 initial investment, mean excess monthly returns, Sharpe ratios, Fung and Hsieh (2004) alphas,[34] information ratios, skewness, and attrition rates for each time series of monthly portfolio returns from January 1999 until December 2012. In addition, we also examine the out-of-sample performance in two different time spans so as to reflect the nature of the booming ETF industry. The first period is from 1999 to 2004, where we have fewer than 100 ETFs that could be used for the matching procedure, while the second period is from 2005 to 2012, where we have more than 100 ETFs, resulting in comprehensive coverage of the space of potential hedge fund risk factors. Hence we expect to observe increased replicating quality in the second period.

[33] This is somewhat conservative as it is possible that a fund simply choses to stop reporting to the database, which is likely for well performing funds that are no longer accepting new investor flows. However, without returns data we obviously cannot keep the fund in the portfolio.
[34] See Appendix B for details on Fung and Hsieh (2004) alpha calculation.

Table VIII reports out-of-sample performance results for the portfolio of all available hedge funds. For the whole sample period, our clones fail to compete with real hedge fund returns in every performance measure. However when digging into the details, we observe that these unfavorable results are driven by the inferior clone performance in the first period, 1999-2004. This confirms our suggestion that the quality of replication is highly influenced by the number of available ETFs. Looking at the first period performance alone, we find that real hedge funds deliver significantly better returns than the clones, which is consistent with our previous observations of the matching quality in the first period being worse than in the second. In the second period of 2005-2012, we find that the clones do reasonably well in terms of producing similar return patterns and skewness, almost the same monthly excess returns, as well as pretty close risk adjusted measures, i.e. Fung and Hsieh (2004) alphas, Sharpe ratios, and information ratios. We then conclude that our matching methodology can produce hedge fund clones that on average deliver similar payoffs to real hedge funds, given a broad selection of ETFs representing potential hedge fund risk factors.

5.e. Out-of-sample portfolio analysis for cloneable and non-cloneable funds

We now apply the out-of-sample portfolio approach to analyzing portfolios of cloneable and non-cloneable hedge funds, defined as top and bottom R^2 from in-sample LASSO regression matches. We form portfolios of cloneable and non-cloneable hedge funds and their clones based on their in-sample R^2 rank, on both quartile and quintile basis. Tables IX and X report top and bottom quartile portfolio comparisons for the whole period and two subperiods. Tables XI and XII repeat the analysis for top and bottom quintiles. While clone portfolios underperform both cloneable and non-cloneable hedge fund portfolios over the whole 1999-2012 period, this is mostly driven by the poor quality of the ETF investment opportunity set in the first subperiod of

1999-2004. This is further confirmed in panel A of tables X and XII, dedicated to the analysis of the first subperiod of 1999-2004.

The out-of-sample portfolio analysis for the second subperiod of 2005-2012 yields some interesting results, presented in panel B of tables X and XII. We find that the portfolio of clones delivers slightly better out-of-sample performance, with a very similar risk and skewness profile, compared to the portfolio of cloneable hedge funds. However, both hedge funds and clones fail to deliver statistically significant Fung and Hsieh (2004) alphas. This implies that hedge fund managers of cloneable hedge funds mostly produce returns driven by risk factors, and do not add value to their managed portfolio, at least not statistically. From this perspective it is not surprising that our ETF clones can replicate, or even slightly improve,[35] the overall performance of cloneable hedge funds.

On the other hand, the portfolio of non-cloneable hedge funds outperforms the portfolio of ETF clones, and produces a statistically significant Fung and Hsieh (2004) alpha, though delivering lower returns than portfolios of cloneable hedge funds and of their ETF clones.[36] This is consistent with non-cloneable hedge fund managers adding value through actively managing their funds. Furthermore, the active investment management skills of these managers seem to be truly unique, and cannot be replicated with ETFs, or by simply taking positions in well defined risk factors. However, as mentioned before, the non-cloneable hedge funds have almost one and a half time higher average attrition rate than cloneable funds, which could be indicative of high hidden risks associated with their active management style.[37] Unfortunately, these risks might be

[35] Such an improvement is likely driven by the ETFs lower fee structure compared to their benchmark hedge funds.
[36] Positive alpha production for low R^2 hedge funds is also consistent with results in Titman and Tiu (2011).
[37] This is consistent with Bollen (2013) findings of higher probability of failure for zero-R^2 hedge funds.

impossible to quantify, given that the investment styles of managers of non-cloneable hedge funds cannot be well explained with our methodology.

We conclude that our methodology provides value in both identifying skilled managers of non-cloneable hedge funds, and also successfully replicating out-of-sample returns that are due to alternative risk exposures of cloneable hedge funds, thus providing a transparent and liquid alternative to investors who may find these return patterns attractive.

5.f. Hedge fund styles

Here we investigate in depth what kinds of hedge funds can or cannot be replicated. We rely on hedge fund styles to tackle this question, as hedge fund managers pursue different types of investment opportunities, and it is certain that in some specific investment categories ETFs could be better suited to resemble the performance of hedge funds.

We form different portfolios based on manager claimed styles and then investigate the hedge fund and clone performances. We exclude the hedge fund styles with fewer than 300 fund-year observations in the entire sample period. Twelve styles are then included in this study: CTA/Managed Futures, Distressed Securities, Emerging Market Equity, Equity Market Neutral, Long Bias Equity, Long/Short Equity, Macro, Multiple Styles, Convertible Arbitrage, Fixed Income, Fixed Income Arbitrage, and Merger Arbitrage. We then calculate out-of-sample performance of hedge fund style portfolios and corresponding clone portfolios that are formed by following the methodology described in section 5.d. Table XIII presents the results the entire period 1999-2012, and Table XIV presents separate results for the first period 1999-2004 and for the second period 2005-2012. For the whole period performance, hedge funds deliver superior

risk-adjusted performances to clones, and as discussed above, clone performances are dragged by the low matching quality in the first period.

We now focus only on the second period results. Table XIV Panel B reports the out-of-sample performance of hedge funds and clones in the second period 2005-2012, when we are able to produce better matches due to the broadened investment opportunity set. For styles as Distressed Securities, Long/Short Equity, and Multiple Style, our clones are able to deliver similar risk-adjusted returns as real hedge funds do. For styles as Emerging Market Equity, Equity Market Neutral, Long Bias Equity, Convertible Arbitrage, Fixed Income, and Fixed Income Arbitrage, the clones actually outperform their real hedge fund pairs. In other word, the clones outperform their real hedge fund benchmarks in 6 out of 12 styles, and tie in 3 out of 12 styles. Only in styles of CTA/Managed Futures, Macro, and Merger Arbitrage do clones underperform real hedge fund benchmarks.

6. Conclusion

We develop a methodology of hedge fund return replication with ETFs based on cluster analysis and LAR LASSO factor selection that overcomes multicollinearity among ETFs and also minimizes data mining bias, resulting in parsimonious factor selection. We test the performance of our hedge fund clones in- and out-of-sample, and find that the overall out-of-sample accuracy of hedge fund replication with ETFs increases with the number of ETFs available. This is consistent with our interpretation of ETF returns as proxies to a multitude of alternative risk factors that could be driving hedge fund returns.

We further consider portfolios of "cloneable" and "non-cloneable" hedge funds, defined as top and bottom in-sample R^2 matches. We find that the portfolio of clones created with our

procedure provides better out-of-sample performance than the portfolio of "cloneable" hedge funds. We find superior risk-adjusted performance for "non-cloneable" funds, while "cloneable" funds fail to deliver significantly positive risk-adjusted performance, which is consistent with our success in cloning them. This approach contributes to the literature on hedge fund risk and performance evaluation, enabling investors to identify skilled managers who deliver superior out-of-sample performance.

We conclude that our methodology provides value in both identifying skilled managers of "non-cloneable" hedge funds, and also successfully replicating out-of-sample returns that are due to alternative risk exposures of "cloneable" hedge funds, thus providing a transparent and liquid alternative to investors who may find these return patterns attractive.

Appendix A: Gross returns adjustments for ETFs and hedge funds

Given the fact that Bloomberg only provides net returns for individual hedge funds (net-of-fees, i.e. net of performance and management fees), and Morningstar provides net returns for ETFs (net of management fee), it would be less accurate to import the net returns into our matching model. So as to provide the real return series, we make adjustments to net asset returns and transfer them into estimated gross returns for both hedge funds and ETFs.

We estimate the gross returns for ETFs by adding back the reported management fees from Morningstar:

$$Gross\_ETF_{i,t} = Net\_ETF_{i,t} + \frac{Management\_Fee_{i,t}}{12}, \qquad \text{(A1)}$$

where $Net\_ETF_{i,t}$ is the reported net-of-fee ETF return from Morningstar, and $Management\_Fee_{i,t}$ is the specific ETF management fee.

We adopt the following steps to estimate the gross hedge fund return. We collect the fund management fees from Bloomberg for every individual hedge fund and add them back to the net hedge fund returns. We then adjust for the performance fees using LIBOR as the hurdle rate, collecting LIBOR returns from January 1997 to December 2012 from British Bankers' Association. We use the following equation to calculate the gross hedge fund returns[38]:

$$Gross\_Ret_{i,t} = \begin{Bmatrix} Net\_Ret_{i,t} + \dfrac{Management\_Fee_{i,t}}{12}, & \text{if } Net\_Ret_{i,t} \le LIBOR_t \\ \dfrac{Net\_Ret_{i,t} - LIBOR_t}{1 - Performance\_Fee_{i,t}} + \dfrac{Management\_Fee_{i,t}}{12} + LIBOR_t, & \text{otherwise} \end{Bmatrix}, \quad \text{(A2)}$$

where $Net\_Ret_{i,t}$ is the reported net-of-fee hedge fund return from Bloomberg, $Management\_Fee_{i,t}$ is the fund manager stated management fee, and $Performance\_Fee_{i,t}$ is the fund manager stated performance fee.

Appendix B: Calculating Fung and Hsieh (2004) alpha

While Fung and Hsieh (2004) specify the seven factor model, the updated specification on David Hsieh's web site[39] includes eight tradable portfolio factors such that

$$r_i - r_f = \alpha_i + \beta_{i1} SP500 + \beta_{i2} EM + \beta_{i3} 10Year + \beta_{i4} SizeSpread + \\ + \beta_{i5} CreditSpread + \beta_{i6} BondTrend + \beta_{i7} ComTrend + \beta_{i8} FxTrend + \varepsilon_i, \quad \text{(FH)}$$

where r_i is the monthly return of fund i, r_f is a risk free rate proxied by the monthly return of the 30-day U.S. Treasury bill. *SP500* is the market risk premium proxied by the S&P 500 index return minus the risk free rate. *EM* is the MSCI Emerging Market index return minus the risk free rate. *10Year* is the monthly excess return of a 10-year U.S. treasury bond, proxied by the 10-

[38] We do not adjust for the "high water mark" provision here, since we do not have reliable information regarding to the cash flow of individual hedge fund, nor a complete data on assets under management for every hedge fund.
[39] See http://faculty.fuqua.duke.edu/~dah7/HFData.htm.

year U.S. Treasury bond portfolio return from the Center for Research in Security Prices (CRSP), minus the risk free rate. *SizeSpread* is an equity-based risk factor, the Russell 2000 Index return minus the S&P 500 Index return. *CreditSpread* is a fixed income-based risk factor, calculated as the total return on the Citi BBB corporate bond index minus the total return on the Fama U.S. Treasury bond portfolio as per CRSP. Both portfolios are comprised of bonds with maturities of 10 years or more. *BondTrend, ComTrend,* and *FxTrend* are excess returns on trend following factors constructed of look-back straddles on futures contracts of bonds, commodities, and currencies, respectively. All factors are therefore arbitrage (zero cost) portfolios. All returns and yields data are from Bloomberg, while trend-following risk factors are courtesy of David Hsieh's website.

References

Agarwal, V., and N.Y. Naik. 2004. Risk and Portfolio Decisions Involving Hedge Funds. *Review of Financial Studies* 17: 63–98.

Amenc, N., L. Martellini, J.-C. Meyfredi, and V. Ziemann. 2010. Passive Hedge Fund Replication – Beyond the Linear Case. *European Financial Management* 16: 191–210.

Avramov, D., L. Barras, and R. Kosowski. 2013. Hedge Fund Return Predictability under the Magnifying Glass. *Journal of Financial and Quantitative Analysis* 48: 1057–83.

Avramov, D., R. Kosowski, N.Y. Naik, and M. Teo. 2011. Hedge Funds, Managerial Skill, and Macroeconomic Variables. *Journal of Financial Economics* 99: 672–92.

Bali, T.G., S.J. Brown, and M.O. Caglayan. 2011. Do Hedge Funds' Exposures to Risk Factors Predict Their Future Returns? *Journal of Financial Economics* 101: 36–68.

Bali, T.G., S.J. Brown, and M.O. Caglayan. 2012. Systematic Risk and the Cross Section of Hedge Fund Returns. *Journal of Financial Economics* 106: 114–31.

Ben Dor, A., R. Jagannathan, and I. Meier. 2012. What Drives the Tracking Error of Hedge Fund Clones? *Journal of Alternative Investments* 15: 54–74.

Bollen, N.P.B. 2013. Zero-R^2 Hedge Funds and Market Neutrality. *Journal of Financial and Quantitative Analysis* 48: 519–47.

Efron, B., T. Hastie, I. Johnstone, and R. Tibshirani. 2004. Least Angle Regression. *Annals of Statistics* 32: 407–499.

Fung, W., and D.A. Hsieh. 2001. The Risk in Hedge Fund Strategies: Theory and Evidence from Trend Followers. *Review of Financial Studies* 14: 313–41.

Fung, W., and D.A. Hsieh. 2004. Hedge Fund Benchmarks: A Risk-Based Approach. *Financial Analysts Journal* 60: 65–80.

Giamouridis, D., and S. Paterlini. 2010. Regular(ized) Hedge Fund Clones. *Journal of Financial Research* 3: 223–47.

Hasanhodzic, J., and A. W. Lo. 2007. Can Hedge-Fund Returns Be Replicated? The Linear Case. *Journal of Investment Management* 5: 5–45.

Hoerl, A. E., and R. Kennard, 1970, Ridge Regression: Biased Estimation for Nonorthogonal Problems, *Technometrics* 8: 27–51

Jagannathan, R., A. Malakhov, and D. Novikov. 2010. Do Hot Hands Exist among Hedge Fund Managers? An Empirical Evaluation. *Journal of Finance* 65: 217–55.

Jurek J., and E. Stafford. 2013. The Cost of Capital for Alternative Investments. *Working Paper,* Princeton University and Harvard Business School.

Schwarz, G. 1978. Estimating the Dimension of a Model. *Annals of Statistics* 6: 461–464.

Sharpe, W.F. 1992. Asset Allocation: Management Style and Performance Management. *Journal of Portfolio Management* 18: 7–19.

Sun, Z., A. Wang, and L. Zheng. 2012. The Road Less Traveled: Strategy Distinctiveness and Hedge Fund Performance. *Review of Financial Studies* 25: 96–143.

ter Horst, J. R., T. E. Nijman, and F. A. De Roon. 2004. Evaluating Style Analysis. *Journal of Empirical Finance* 11: 29–53.

Tibshirani, R. 1996. Regression Shrinkage and Selection via the Lasso. *Journal of the Royal Statistical Society B* 58: 267–88.

Titman, S., and C. Tiu. 2011. Do the Best Hedge Funds Hedge? *Review of Financial Studies* 24: 123–68.

Vrontos, S.D., I.D. Vrontos, and D. Giamouridis. 2008. Hedge Fund Pricing and Model Uncertainty, *Journal of Banking and Finance* 32: 741–53.

Weber, V., and F. Peres. 2013. Hedge Fund Replication: Putting the Pieces Together, *Journal of Investment Strategies* 3: 61-119.

Figure 1: An Example of Hedge Fund and Clone Out-of-Sample Returns

The figure presents the out-of-sample comparison of an anonymous hedge fund and its clone, constructed according to our in-sample matching methodology. This hedge fund is in the "fixed income" self-reported style, it has an inception year of 2004, and it was active at the end of our study period. The out-of-sample comparison begins in 2008, after dropping the first two years of observations to control for the backfill bias, and after using another two years for the in-sample clone matching.

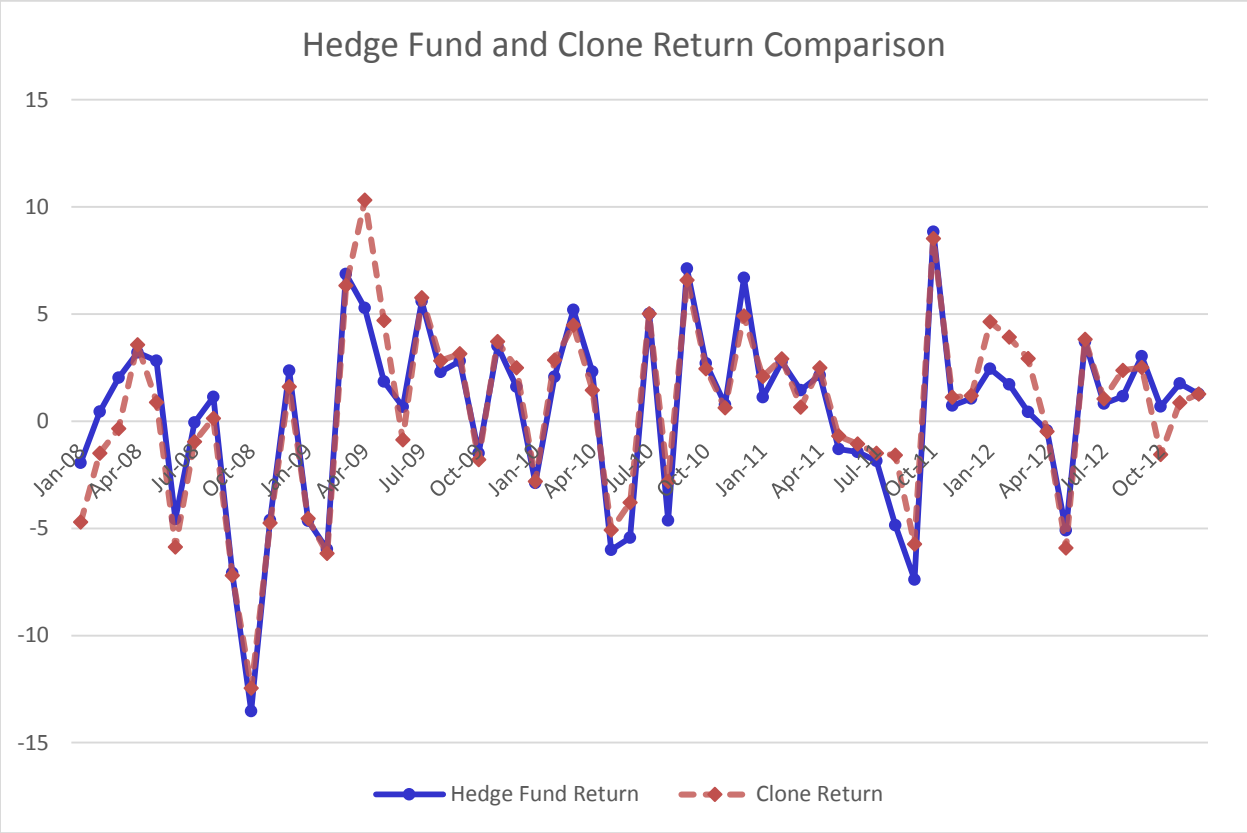

Figure 2: Number of ETFs Available, 1999-2012
Number of ETFs available each year from 1999 to 2012 is reported. ETF data is collected from Morningstar.

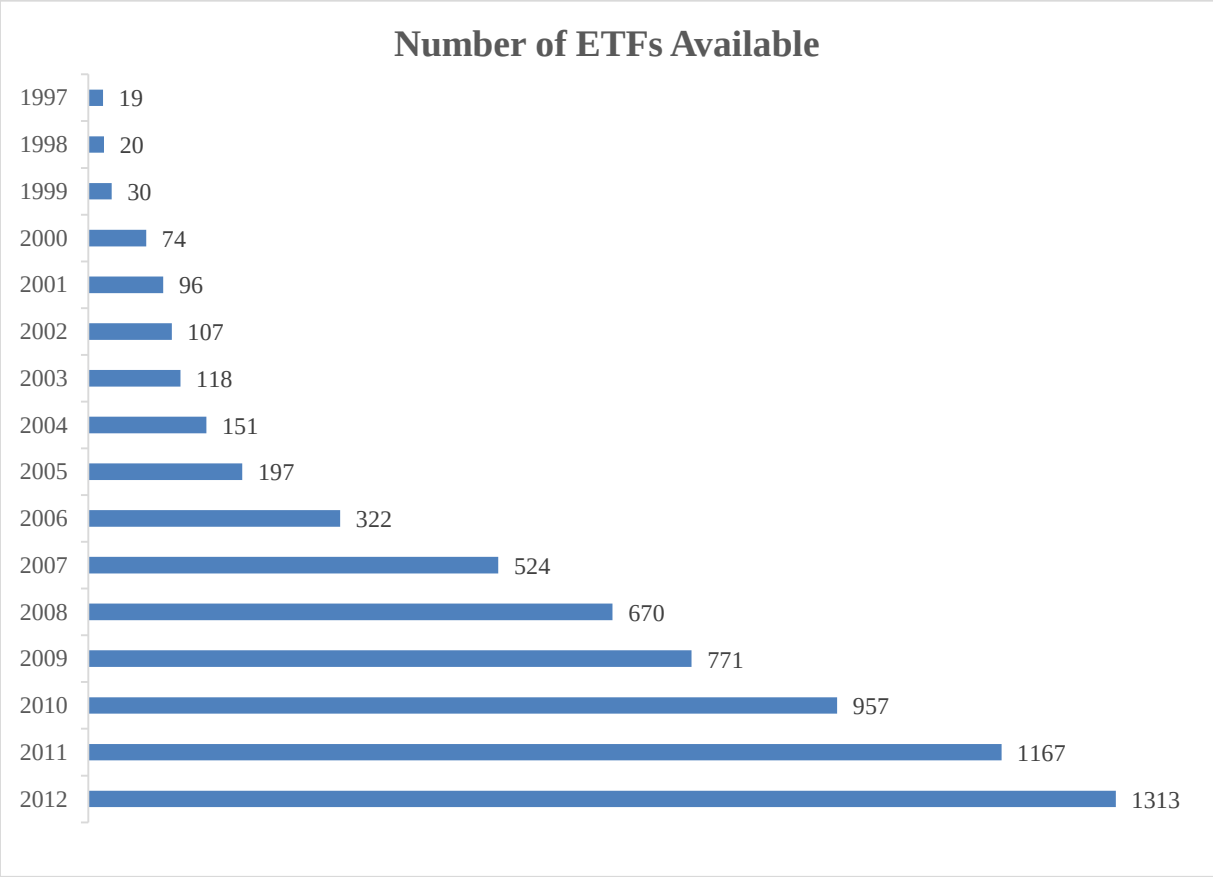

Figure 3: Number of ETFs used
Number of ETFs used in LASSO matching regressions is reported. ETF data is collected from Morningstar.

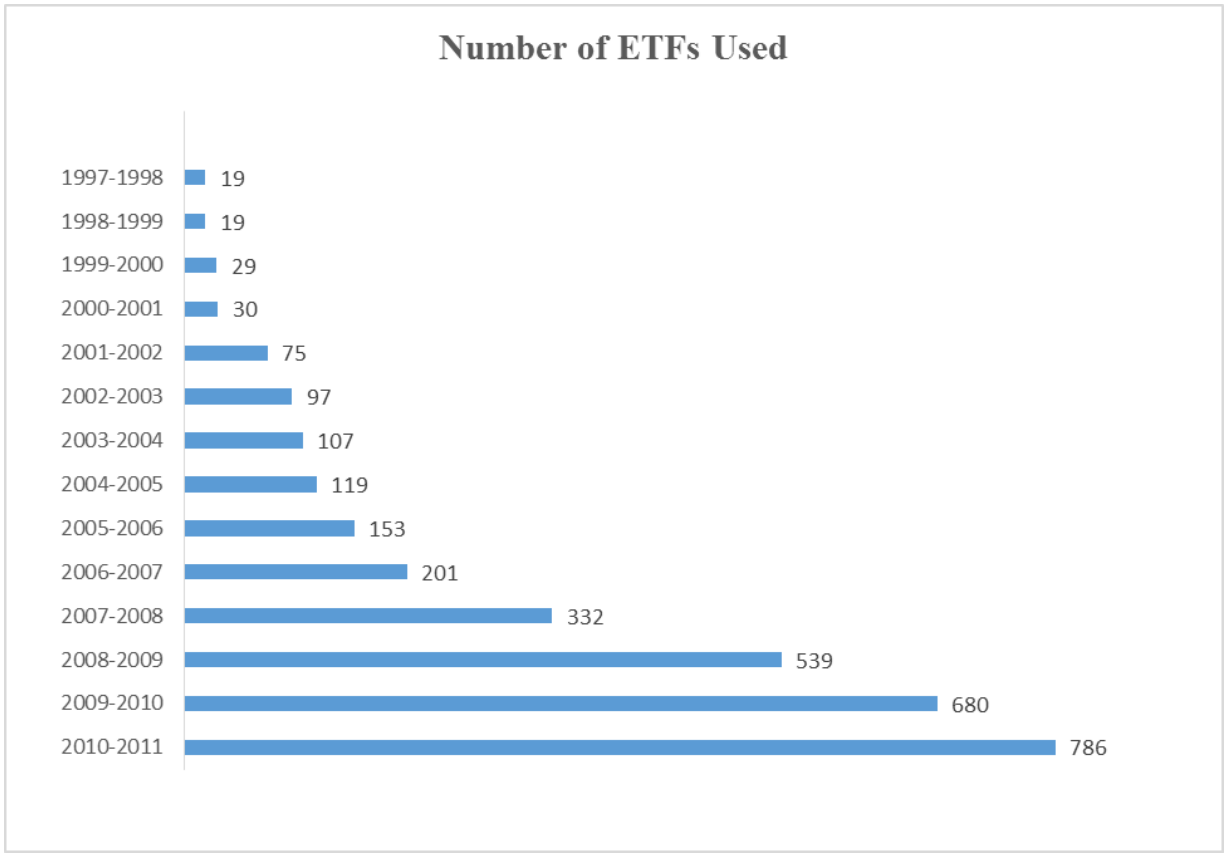

Table I: Summary Statistics of Hedge Funds

Summary statistics of all hedge funds 1997-2012, reporting as of March, 2013. Panel A reports returns, fees, investor liquidity measures, and fund longevity. Panel B reports means of indicator variables for fund characteristics while panel C reports self-declared fund styles.

Panel A

	Full Sample (3,190 unique funds)				
	Mean	Median	10th pct	90th pct	Std
Monthly return	0.76	0.65	-4.25	5.60	56.48
Assets ($M)	243.86	28.47	2.02	337.83	2,153.37
Min Invest ($M)	1.19	0.25	0.03	1	14.63
Mgmt Fee (%)	1.46	1.5	0.8	2	0.71
Perf Fee (%)	17.41	20	4.4	20	6.69
Hurdle Rate (%)	0.32	0	0	0	1.64
Lockup Period (days)	78.29	0	0	360	179.20
Redemption Notice (days)	5.01	0	0	30	15.61
Redemption Period (days)	60.42	30	30	90	58.93
Longevity (months)	109.65	103	53	179	45.65

	Active Funds (1,002 unique funds)				
	Mean	Median	10th pct	90th pct	Std
Monthly return	1.04	0.68	-4.61	6.19	88.63
Assets ($M)	375.61	50.61	3.92	634.77	2,757.83
Min Invest ($M)	0.58	0.25	0.02	1	1.91
Mgmt Fee (%)	1.43	1.5	0.8	2	0.67
Perf Fee (%)	17.60	20	7.75	20	6.50
Hurdle Rate (%)	0.40	0	0	0	1.72
Lockup Period (days)	67.44	0	0	360	178.62
Redemption Notice (days)	9.84	0	0	30	20.69
Redemption Period (days)	54.39	30	15	90	52.37
Longevity (months)	130.08	122	79	204	43.00

	Inactive Funds (2,188 unique funds)				
	Mean	Median	10th pct	90th pct	Std
Monthly return	0.58	0.63	-4.01	5.20	5.48
Assets ($M)	177.25	20.99	1.53	243.00	1,768.02
Min Invest ($M)	1.50	0.25	0.03	1	17.95
Mgmt Fee (%)	1.48	1.5	0.75	2	0.72
Perf Fee (%)	17.31	20	0.1	20	6.78
Hurdle Rate (%)	0.28	0	0	0	1.60
Lockup Period (days)	84.53	0	0	360	179.28
Redemption Notice (days)	2.54	0	0	0	11.47
Redemption Period (days)	63.85	30	30	90	62.10
Longevity (months)	95.61	89	44	157	41.86

Table I cont.: Summary Statistics of Hedge Funds

Panel B - Indicator	% of Funds		
	Full Sample	Active Funds	Inactive Funds
High Water Mark	0.76	0.87	0.71
Hurdle Rate	0.04	0.07	0.03
Offshore (non-US)	0.68	0.68	0.68
Liquidated	0.29	0.00	0.42
Acquired	0.02	0.00	0.03

Panel C - Fund Styles	% of Funds		
	Full Sample	Active Funds	Inactive Funds
Long/Short Equity	0.29	0.34	0.27
CTA/Managed Futures	0.11	0.16	0.09
Multi Style	0.11	0.07	0.12
Macro	0.08	0.08	0.08
Undisclosed	0.07	0.05	0.08
Equity Market Neutral	0.07	0.05	0.08
Long Bias Equity	0.05	0.06	0.05
Emerging Market Equity	0.03	0.04	0.02
Emerging Market Debt	0.02	0.02	0.02
Distressed Securities	0.04	0.02	0.05
Merger_Arb	0.02	0.02	0.02
Fixed Income_Arb	0.03	0.03	0.03
Convertible_Arb	0.03	0.02	0.03
Fixed_Income	0.03	0.02	0.03
Capital Structure_Arb	0.02	0.01	0.02
Equity Statistical_Arb	0.01	0.00	0.02

Table II: LASSO Matching Regression Results

LASSO matching regression results are reported. Regressions are run over 24 months window. LASSO adjusted-R^2, SBC and number of matched LASSO regressors are reported for each matching window. Standard deviations are reported in parentheses.

Year	Number of Hedge Funds	Number of ETFs Used	Adj. R^2	SBC	Number of Regressors	Adj. R^2	SBC	Number of Regressors	Adj. R^2	SBC	Number of Regressors
1997-1998	234	19	0.41	62.10	1.75	0.41	62.10	1.75			
			(0.26)	(36.03)	(1.05)	(0.26)	(36.03)	(1.05)			
1998-1999	306	19	0.41	66.50	1.85	0.41	66.50	1.85			
			(0.23)	(37.86)	(1.18)	(0.23)	(37.86)	(1.18)			
1999-2000	410	29	0.41	64.30	2.10	0.41	64.30	2.10			
			(0.22)	(39.04)	(1.26)	(0.22)	(39.04)	(1.26)			
2000-2001	539	30	0.38	61.35	1.93	0.38	61.35	1.93			
			(0.23)	(37.73)	(1.15)	(0.23)	(37.73)	(1.15)			
2001-2002	690	75	0.45	50.36	1.97	0.45	50.36	1.97			
			(0.23)	(36.24)	(1.16)	(0.23)	(36.24)	(1.16)			
2002-2003	932	97	0.47	52.22	2.14	0.47	52.22	2.14			
			(0.25)	(37.03)	(1.33)	(0.25)	(37.03)	(1.33)			
2003-2004	1125	107	0.53	46.07	2.26				0.53	46.07	2.26
			(0.23)	(35.00)	(1.37)				(0.23)	(35.00)	(1.37)
2004-2005	1390	119	0.52	34.85	2.13				0.52	34.85	2.13
			(0.24)	(32.85)	(1.30)				(0.24)	(32.85)	(1.30)
2005-2006	1667	153	0.51	32.48	2.13				0.51	32.48	2.13
			(0.24)	(31.14)	(1.37)				(0.24)	(31.14)	(1.37)
2006-2007	1889	201	0.56	34.87	2.43				0.56	34.87	2.43
			(0.23)	(31.98)	(1.51)				(0.23)	(31.98)	(1.51)
2007-2008	1918	332	0.63	50.82	2.79				0.63	50.82	2.79
			(0.27)	(30.90)	(1.72)				(0.27)	(30.90)	(1.72)
2008-2009	1675	539	0.59	62.87	2.59				0.59	62.87	2.59
			(0.25)	(29.03)	(1.54)				(0.25)	(29.03)	(1.54)
2009-2010	1230	680	0.63	54.52	2.72				0.63	54.52	2.72
			(0.25)	(29.98)	(1.57)				(0.25)	(29.98)	(1.57)
2010-2011	1072	786	0.57	49.98	2.29				0.57	49.98	2.29
			(0.24)	(28.98)	(1.36)				(0.24)	(28.98)	(1.36)
Average			**0.51**	**51.66**	**2.22**	**0.42**	**59.47**	**1.96**	**0.57**	**45.81**	**2.42**

Table III: Out-of-Sample Individual Matches

Summary statistics of out-of-sample individual matching of hedge funds and clones are reported. Attrition rate, mean tracking error and tracking error volatility are reported for each one year predicting window.

Year	Number of ETFs Used	Number of Hedge Funds		Attrition Rate	Tracking Error		Tracking Error		Tracking Error	
		Start	End		Mean	Volatility	Mean	Volatility	Mean	Volatility
1999	19	234	218	6.84%	-0.93	5.05	-0.93	5.05		
2000	19	306	297	2.94%	-0.52	5.24	-0.52	5.24		
2001	29	410	393	4.15%	-0.80	4.86	-0.80	4.86		
2002	30	539	499	7.42%	-0.27	4.14	-0.27	4.14		
2003	75	690	630	8.70%	-1.39	3.54	-1.39	3.54		
2004	97	932	840	9.87%	0.15	3.04	0.15	3.04		
2005	107	1125	1027	8.71%	0.04	2.74			0.04	2.74
2006	119	1390	1238	10.94%	0.02	2.53			0.02	2.53
2007	153	1667	1449	13.08%	-0.13	2.92			-0.13	2.92
2008	201	1889	1458	22.82%	-0.09	5.41			-0.09	5.41
2009	332	1918	1581	17.57%	-0.59	4.33			-0.59	4.33
2010	539	1675	1370	18.21%	-0.12	3.48			-0.12	3.48
2011	680	1230	1053	14.39%	0.28	3.92			0.28	3.92
2012	786	1072	904	15.67%	0.23	3.02			0.23	3.02
Average				**11.52%**	**-0.30**	**3.87**	**-0.63**	**4.31**	**-0.05**	**3.54**

Table IV: Cloneable and Non-Cloneable Funds - Matching Regression Results, Quartiles

Summary statistics of in-sample matching regressions are reported. LASSO Adj. R^2, SBC and number of matched LASSO regressors are reported for each matching window. Skewness reports the mean skewness of individual hedge fund net returns for each matching window. Panel A reports the matches with LASSO Adj. R^2 on the top quartile. Panel B reports the matches with LASSO Adj. R^2 on the bottom quartile.

Panel A: In-Sample Matches, "Cloneable" Funds (Top R^2 Quartile)

Year	Number of ETFs Used	Number of Hedge Funds	Adj. R^2	SBC	Number of Regressors	Skewness	Adj. R^2	SBC	Number of Regressors	Skewness	Adj. R^2	SBC	Number of Regressors	Skewness
1997-1998	19	59	0.76	53.24	2.68	-0.95	0.76	53.24	2.68	-0.95				
1998-1999	19	77	0.71	70.41	3.03	-0.52	0.71	70.41	3.03	-0.52				
1999-2000	29	103	0.70	66.63	3.43	0.52	0.70	66.63	3.43	0.52				
2000-2001	30	135	0.69	62.26	2.98	0.24	0.69	62.26	2.98	0.24				
2001-2002	75	173	0.76	49.55	3.03	-0.19	0.76	49.55	3.03	-0.19				
2002-2003	97	233	0.80	41.65	3.33	-0.22	0.80	41.65	3.33	-0.22				
2003-2004	107	282	0.82	33.51	3.42	0.21					0.82	33.51	3.42	0.21
2004-2005	119	348	0.82	23.93	3.44	-0.15					0.82	23.93	3.44	-0.15
2005-2006	153	417	0.82	24.58	3.48	-0.14					0.82	24.58	3.48	-0.14
2006-2007	201	473	0.85	19.17	3.98	0.01					0.85	19.17	3.98	0.01
2007-2008	332	480	0.93	35.20	4.46	-1.28					0.93	35.20	4.46	-1.28
2008-2009	539	419	0.89	58.12	3.97	-0.61					0.89	58.12	3.97	-0.61
2009-2010	680	308	0.91	44.71	4.08	0.01					0.91	44.71	4.08	0.01
2010-2011	786	268	0.86	40.88	3.24	-0.14					0.86	40.88	3.24	-0.14
Average			**0.81**	**44.56**	**3.47**	**-0.23**	**0.74**	**57.29**	**3.08**	**-0.19**	**0.86**	**35.01**	**3.76**	**-0.26**

Panel B: In-Sample Matches, "Non-Cloneable" Funds (Bottom R^2 Quartile)

Year	Number of ETFs Used	Number of Hedge Funds	Adj. R^2	SBC	Number of Regressors	Skewness	Adj. R^2	SBC	Number of Regressors	Skewness	Adj. R^2	SBC	Number of Regressors	Skewness
1997-1998	19	59	0.09	73.61	1.00	0.20	0.09	73.61	1.00	0.20				
1998-1999	19	77	0.12	65.96	1.04	0.16	0.12	65.96	1.04	0.16				
1999-2000	29	103	0.13	48.33	1.07	0.11	0.13	48.33	1.07	0.11				
2000-2001	30	135	0.11	51.44	1.01	0.20	0.11	51.44	1.01	0.20				
2001-2002	75	173	0.16	52.68	1.12	0.14	0.16	52.68	1.12	0.14				
2002-2003	97	233	0.15	58.11	1.10	0.19	0.15	58.11	1.10	0.19				
2003-2004	107	282	0.22	52.59	1.19	0.18					0.22	52.59	1.19	0.18
2004-2005	119	348	0.20	37.73	1.12	0.11					0.20	37.73	1.12	0.11
2005-2006	153	417	0.20	33.60	1.16	0.04					0.20	33.60	1.16	0.04
2006-2007	201	473	0.24	45.72	1.29	-0.02					0.24	45.72	1.29	-0.02
2007-2008	332	480	0.24	58.73	1.28	-0.06					0.24	58.73	1.28	-0.06
2008-2009	539	419	0.23	63.00	1.30	0.09					0.23	63.00	1.30	0.09
2009-2010	680	308	0.26	57.76	1.34	0.05					0.26	57.76	1.34	0.05
2010-2011	786	268	0.24	59.36	1.37	0.10					0.24	59.36	1.37	0.10
Average			**0.18**	**54.19**	**1.17**	**0.11**	**0.13**	**58.36**	**1.06**	**0.17**	**0.23**	**51.06**	**1.26**	**0.06**

Table V: Cloneable and Non-Cloneable Funds - Matching Regression Results, Quintiles

Summary statistics of in-sample matching regressions are reported. LASSO Adj. R^2, SBC and number of matched LASSO regressors are reported for each matching window. Skewness reports the mean skewness of individual hedge fund net returns for each matching window. Panel A reports the matches with LASSO Adj. R^2 on the top quintile. Panel B reports the matches with LASSO Adj. R^2 on the bottom quintile.

Panel A: In-Sample Matches, "Cloneable" Funds (Top R^2 Quintile)

Year	Number of ETFs Used	Number of Hedge Funds	Adj. R^2	SBC	Number of Regressors	Skewness	Adj. R^2	SBC	Number of Regressors	Skewness	Adj. R^2	SBC	Number of Regressors	Skewness
1997-1998	19	47	0.78	51.40	2.77	-1.02	0.78	51.40	2.77	-1.02				
1998-1999	19	62	0.74	70.18	3.18	-0.45	0.74	70.18	3.18	-0.45				
1999-2000	29	82	0.72	64.17	3.57	0.49	0.72	64.17	3.57	0.49				
2000-2001	30	108	0.72	62.22	3.17	0.16	0.72	62.22	3.17	0.16				
2001-2002	75	138	0.79	49.24	3.12	-0.16	0.79	49.24	3.12	-0.16				
2002-2003	97	187	0.82	42.30	3.48	-0.26	0.82	42.30	3.48	-0.26				
2003-2004	107	225	0.83	32.00	3.64	0.19					0.83	32.00	3.64	0.19
2004-2005	119	278	0.84	21.44	3.58	-0.17					0.84	21.44	3.58	-0.17
2005-2006	153	334	0.85	22.92	3.69	-0.15					0.85	22.92	3.69	-0.15
2006-2007	201	378	0.87	16.79	4.13	0.03					0.87	16.79	4.13	0.03
2007-2008	332	384	0.94	32.67	4.63	-1.26					0.94	32.67	4.63	-1.26
2008-2009	539	335	0.90	56.24	4.07	-0.59					0.90	56.24	4.07	-0.59
2009-2010	680	246	0.93	41.90	4.21	-0.03					0.93	41.90	4.21	-0.03
2010-2011	786	216	0.88	39.16	3.31	-0.16					0.88	39.16	3.31	-0.16
Average			**0.83**	**43.05**	**3.61**	**-0.24**	**0.76**	**56.59**	**3.21**	**-0.21**	**0.88**	**32.89**	**3.91**	**-0.27**

Panel B: In-Sample Matches, "Non-Cloneable" Funds (Bottom R^2 Quintile)

Year	Number of ETFs Used	Number of Hedge Funds	Adj. R^2	SBC	Number of Regressors	Skewness	Adj. R^2	SBC	Number of Regressors	Skewness	Adj. R^2	SBC	Number of Regressors	Skewness
1997-1998	19	47	0.07	68.73	1.00	0.05	0.07	68.73	1.00	0.05				
1998-1999	19	62	0.11	59.58	1.03	0.06	0.11	59.58	1.03	0.06				
1999-2000	29	82	0.11	47.16	1.01	0.00	0.11	47.16	1.01	0.00				
2000-2001	30	108	0.10	53.29	1.00	0.17	0.10	53.29	1.00	0.17				
2001-2002	75	138	0.14	54.18	1.08	0.09	0.14	54.18	1.08	0.09				
2002-2003	97	187	0.13	60.53	1.06	0.17	0.13	60.53	1.06	0.17				
2003-2004	107	225	0.19	52.81	1.15	0.17					0.19	52.81	1.15	0.17
2004-2005	119	278	0.17	38.24	1.06	0.08					0.17	38.24	1.06	0.08
2005-2006	153	334	0.17	34.03	1.11	0.06					0.17	34.03	1.11	0.06
2006-2007	201	378	0.21	45.78	1.23	-0.03					0.21	45.78	1.23	-0.03
2007-2008	332	384	0.20	57.89	1.20	-0.06					0.20	57.89	1.20	-0.06
2008-2009	539	336	0.20	62.62	1.22	0.06					0.20	62.62	1.22	0.06
2009-2010	680	246	0.22	59.95	1.24	0.01					0.22	59.95	1.24	0.01
2010-2011	786	215	0.20	62.41	1.26	0.07					0.20	62.41	1.26	0.07
Average			**0.16**	**54.09**	**1.12**	**0.07**	**0.11**	**57.24**	**1.03**	**0.09**	**0.20**	**51.72**	**1.18**	**0.05**

Table VI: Cloneable and Non-Cloneable Funds - Out-of-Sample Performance of Individual Matches, Quartiles

Summary statistics of out-of-sample individual matching of hedge funds and clones formed on the basis of LASSO Adj. R^2 are reported. Attrition rate, mean tracking error and tracking error volatility are reported for each one year predicting window. Skewness reports the mean skewness of individual hedge fund and clone net returns for one year predicting window. Panel A reports the matches with LASSO Adj. R^2 on the top quartile. Panel B reports the matches with LASSO Adj. R^2 on the bottom quartile.

Panel A: Out-of-Sample Matches, "Cloneable" Funds (Top R^2 Quartile)

Year	Number of ETFs Used	Number of Hedge Funds		Attrition Rate	Tracking Error		Skewness		Tracking Error		Skewness		Tracking Error		Skewness	
		Start	End		Mean	Volatility	Hedge Funds	Clones	Mean	Volatility	Hedge Funds	Clones	Mean	Volatility	Hedge Funds	Clones
1999	19	59	55	6.78%	-1.15	4.85	0.33	0.14	-1.15	4.85	0.33	0.14				
2000	19	77	75	2.60%	-0.78	5.61	0.45	0.43	-0.78	5.61	0.45	0.43				
2001	29	103	97	5.83%	-0.57	5.33	-0.02	-0.28	-0.57	5.33	-0.02	-0.28				
2002	30	135	129	4.44%	-0.09	4.16	-0.06	0.13	-0.09	4.16	-0.06	0.13				
2003	75	173	157	9.25%	-0.97	3.16	0.30	0.01	-0.97	3.16	0.30	0.01				
2004	97	233	211	9.44%	0.48	2.52	-0.04	-0.55	0.48	2.52	-0.04	-0.55				
2005	107	282	261	7.45%	0.19	2.21	-0.19	-0.24					0.19	2.21	-0.19	-0.24
2006	119	348	316	9.20%	0.10	2.17	-0.08	-0.35					0.10	2.17	-0.08	-0.35
2007	153	417	373	10.55%	-0.08	2.72	-0.20	-0.19					-0.08	2.72	-0.20	-0.19
2008	201	473	391	17.34%	0.18	4.49	-0.47	-0.53					0.18	4.49	-0.47	-0.53
2009	332	480	404	15.83%	-0.41	4.00	-0.06	-0.18					-0.41	4.00	-0.06	-0.18
2010	539	419	367	12.41%	0.49	2.99	-0.18	-0.29					0.49	2.99	-0.18	-0.29
2011	680	308	258	16.23%	0.35	4.15	0.04	-0.17					0.35	4.15	0.04	-0.17
2012	786	268	238	11.19%	0.27	2.62	-0.57	-1.06					0.27	2.62	-0.57	-1.06
Average				**9.90%**	**-0.14**	**3.64**	**-0.05**	**-0.22**	**-0.51**	**4.27**	**0.16**	**-0.02**	**0.13**	**3.17**	**-0.21**	**-0.38**

Panel B: Out-of-Sample Matches, "Non-Cloneable" Funds (Bottom R^2 Quartile)

Year	Number of ETFs Used	Number of Hedge Funds		Attrition Rate	Tracking Error		Skewness		Tracking Error		Skewness		Tracking Error		Skewness	
		Start	End		Mean	Volatility	Hedge Funds	Clones	Mean	Volatility	Hedge Funds	Clones	Mean	Volatility	Hedge Funds	Clones
1999	19	59	52	11.86%	-0.36	5.52	-0.07	0.08	-0.36	5.52	-0.07	0.08				
2000	19	77	76	1.30%	-0.34	5.01	0.31	-0.04	-0.34	5.01	0.31	-0.04				
2001	29	103	95	7.77%	-0.69	3.56	0.00	0.09	-0.69	3.56	0.00	0.09				
2002	30	135	123	8.89%	-0.47	3.41	-0.05	0.05	-0.47	3.41	-0.05	0.05				
2003	75	173	157	9.25%	-1.45	3.24	0.30	-0.02	-1.45	3.24	0.30	-0.02				
2004	97	233	207	11.16%	-0.27	3.44	0.10	0.08	-0.27	3.44	0.10	0.08				
2005	107	282	251	10.99%	-0.11	2.94	-0.03	-0.11					-0.11	2.94	-0.03	-0.11
2006	119	348	297	14.66%	-0.20	2.87	0.18	-0.31					-0.20	2.87	0.18	-0.31
2007	153	417	349	16.31%	-0.42	2.87	0.00	-0.06					-0.42	2.87	0.00	-0.06
2008	201	473	338	28.54%	-0.50	5.77	-0.25	-0.47					-0.50	5.77	-0.25	-0.47
2009	332	480	385	19.79%	-0.60	4.13	0.21	0.18					-0.60	4.13	0.21	0.18
2010	539	419	315	24.82%	-0.80	3.92	-0.03	-0.11					-0.80	3.92	-0.03	-0.11
2011	680	308	256	16.88%	0.32	3.49	0.09	-0.05					0.32	3.49	0.09	-0.05
2012	786	268	224	16.42%	0.11	3.81	0.18	-0.26					0.11	3.81	0.18	-0.26
Average				**14.19%**	**-0.41**	**3.85**	**0.07**	**-0.07**	**-0.60**	**4.03**	**0.10**	**0.04**	**-0.28**	**3.72**	**0.05**	**-0.15**

Table VII: Cloneable and Non-Cloneable Funds - Out-of-Sample Performance of Individual Matches, Quintiles

Summary statistics of out-of-sample individual matching of hedge funds and clones formed on the basis of LASSO Adj. R^2 are reported. Attrition rate, mean tracking error and tracking error volatility are reported for each one year predicting window. Skewness reports the mean skewness of individual hedge fund and clone net returns for one year predicting window. Panel A reports the matches with LASSO Adj. R^2 on the top quintile. Panel B reports the matches with LASSO Adj. R^2 on the bottom quintile.

Panel A: Out-of-Sample Matches, "Cloneable" Funds (Top R^2 Quintile)

Year	Number of ETFs Used	Number of Hedge Funds		Attrition Rate	Tracking Error		Skewness		Tracking Error		Skewness		Tracking Error		Skewness	
		Start	End		Mean	Volatility	Hedge Funds	Clones	Mean	Volatility	Hedge Funds	Clones	Mean	Volatility	Hedge Funds	Clones
1999	19	47	44	6.38%	-0.95	4.70	0.36	0.18	-0.95	4.70	0.36	0.18				
2000	19	62	60	3.23%	-0.82	5.57	0.51	0.47	-0.82	5.57	0.51	0.47				
2001	29	82	78	4.88%	-0.50	4.99	-0.04	-0.28	-0.50	4.99	-0.04	-0.28				
2002	30	108	102	5.56%	-0.16	4.31	-0.09	0.18	-0.16	4.31	-0.09	0.18				
2003	75	138	125	9.42%	-0.89	3.03	0.32	0.04	-0.89	3.03	0.32	0.04				
2004	97	187	168	10.16%	0.49	2.59	-0.06	-0.61	0.49	2.59	-0.06	-0.61				
2005	107	225	209	7.11%	0.15	2.11	-0.16	-0.24					0.15	2.11	-0.16	-0.24
2006	119	278	249	10.43%	0.14	2.03	-0.09	-0.34					0.14	2.03	-0.09	-0.34
2007	153	334	303	9.28%	-0.07	2.70	-0.20	-0.21					-0.07	2.70	-0.20	-0.21
2008	201	378	311	17.73%	0.23	4.42	-0.49	-0.52					0.23	4.42	-0.49	-0.52
2009	332	384	330	14.06%	-0.41	3.81	-0.06	-0.19					-0.41	3.81	-0.06	-0.19
2010	539	335	297	11.34%	0.53	2.90	-0.15	-0.28					0.53	2.90	-0.15	-0.28
2011	680	246	202	17.89%	0.33	4.09	0.01	-0.16					0.33	4.09	0.01	-0.16
2012	786	216	191	11.57%	0.29	2.64	-0.59	-1.05					0.29	2.64	-0.59	-1.05
Average				**9.93%**	**-0.12**	**3.56**	**-0.05**	**-0.22**	**-0.47**	**4.20**	**0.16**	**0.00**	**0.15**	**3.09**	**-0.21**	**-0.37**

Panel B: Out-of-Sample Matches, "Non-Cloneable" Funds (Bottom R^2 Quintile)

Year	Number of ETFs Used	Number of Hedge Funds		Attrition Rate	Tracking Error		Skewness		Tracking Error		Skewness		Tracking Error		Skewness	
		Start	End		Mean	Volatility	Hedge Funds	Clones	Mean	Volatility	Hedge Funds	Clones	Mean	Volatility	Hedge Funds	Clones
1999	19	47	42	10.64%	0.29	5.08	-0.09	0.03	0.29	5.08	-0.09	0.03				
2000	19	62	61	1.61%	-0.54	4.63	0.33	-0.14	-0.54	4.63	0.33	-0.14				
2001	29	82	75	8.54%	-0.59	3.37	-0.01	0.11	-0.59	3.37	-0.01	0.11				
2002	30	108	99	8.33%	-0.53	3.44	-0.09	0.05	-0.53	3.44	-0.09	0.05				
2003	75	138	125	9.42%	-1.45	3.20	0.33	0.00	-1.45	3.20	0.33	0.00				
2004	97	187	168	10.16%	-0.35	3.61	0.17	0.10	-0.35	3.61	0.17	0.10				
2005	107	225	199	11.56%	-0.15	2.95	0.02	-0.11					-0.15	2.95	0.02	-0.11
2006	119	278	234	15.83%	-0.23	2.89	0.21	-0.29					-0.23	2.89	0.21	-0.29
2007	153	334	277	17.07%	-0.43	2.93	0.01	-0.07					-0.43	2.93	0.01	-0.07
2008	201	378	265	29.89%	-0.43	5.70	-0.29	-0.45					-0.43	5.70	-0.29	-0.45
2009	332	384	305	20.57%	-0.55	4.00	0.22	0.17					-0.55	4.00	0.22	0.17
2010	539	336	246	26.79%	-0.82	3.88	-0.03	-0.09					-0.82	3.88	-0.03	-0.09
2011	680	246	202	17.89%	0.34	3.48	0.11	-0.08					0.34	3.48	0.11	-0.08
2012	786	215	179	16.74%	0.09	4.03	0.21	-0.23					0.09	4.03	0.21	-0.23
Average				**14.65%**	**-0.38**	**3.80**	**0.08**	**-0.07**	**-0.53**	**3.89**	**0.11**	**0.03**	**-0.27**	**3.73**	**0.06**	**-0.14**

Table VIII: Comparisons of Hedge Fund Portfolios and Clones Portfolios

Comparisons of hedge funds portfolios and clones portfolios 1999-2012 are reported. Portfolios are formulated as of December 31, 1998, and rebalanced annually. Annual returns and cumulative risk-adjusted performances are reported. End value is as of December 31, 2012. Skewness reports the mean skewness of out-of-sample portfolio net returns for one year predicting window. Significance at the 10%, 5%, and 1% levels are designated by *, **, and ***, respectively.

Year	Number of ETFs Used	Adj. R^2	Annual Return		Annual Return		Annual Return	
			Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones
1999	19	0.408	26.24	11.26	26.24	11.26		
2000	19	0.411	8.16	0.91	8.16	0.91		
2001	29	0.405	7.94	-3.14	7.94	-3.14		
2002	30	0.385	3.63	-0.07	3.63	-0.07		
2003	75	0.451	25.23	7.36	25.23	7.36		
2004	97	0.474	10.72	13.40	10.72	13.40		
2005	107	0.528	8.46	8.66			8.46	8.66
2006	119	0.520	14.18	14.85			14.18	14.85
2007	153	0.513	12.44	10.33			12.44	10.33
2008	201	0.559	-17.40	-19.02			-17.40	-19.02
2009	332	0.633	24.14	15.21			24.14	15.21
2010	539	0.593	10.20	9.07			10.20	9.07
2011	680	0.629	-6.63	-3.59			-6.63	-3.59
2012	786	0.570	5.07	8.24			5.07	8.24
End Value			3.27	1.93	2.12	1.32	1.54	1.46
Monthly Return			0.73***	0.42**	1.07***	0.40**	0.48*	0.43*
(t-stat)			(4.18)	(2.53)	(4.46)	(2.37)	(1.95)	(1.65)
alpha			0.22**	-0.04	0.50***	0.01	0.10	0.00
(t-stat)			(2.47)	(-0.55)	(5.06)	(0.16)	(0.93)	(0.02)
Sharpe Ratio			0.24	0.11	0.41	0.11	0.14	0.11
Info Ratio			0.20	-0.05	0.51	0.02	0.10	0.00
Skewness			-0.18	-1.03	0.89	-0.44	-0.56	-1.03
Attrition Rate			11.52%		6.65%		15.17%	
Mean Adj. R2			0.506		0.422		0.568	

Table IX: Cloneable and Non-Cloneable Funds - Portfolio Comparisons, Quartiles, 1999-2012

Annual returns and cumulative risk-adjusted performances of portfolios 1999-2012 formed on the basis of LASSO Adj. R^2. Portfolios of hedge funds and clones are formed as December 31, 1998, and rebalanced annually for funds in the top and bottom quartile of LASSO Adj. R^2. End value is as of December 31, 2012. Skewness reports the mean skewness of out-of-sample portfolio net returns for one year predicting window. Significance at the 10%, 5%, and 1% levels are designated by *, **, and ***, respectively.

Year	"Cloneable" Funds, Top R^2 Quartile			"Non-Cloneable" Funds, Btm R^2 Quartile		
	Adj. R^2	Annual Return		Adj. R^2	Annual Return	
		Hedge Funds	Clones		Hedge Funds	Clones
1999	0.757	36.88	19.97	0.087	13.56	2.83
2000	0.713	5.49	-3.88	0.123	9.15	4.25
2001	0.697	0.26	-8.18	0.126	14.41	3.04
2002	0.692	-3.98	-5.82	0.109	8.42	3.08
2003	0.762	33.69	20.93	0.156	18.24	0.61
2004	0.799	12.99	19.67	0.153	6.66	3.97
2005	0.815	9.25	11.32	0.215	7.00	6.26
2006	0.816	18.63	19.59	0.203	10.68	8.76
2007	0.824	16.89	15.16	0.196	11.76	6.64
2008	0.850	-26.66	-25.68	0.243	-4.10	-8.20
2009	0.925	38.31	29.74	0.237	7.69	0.55
2010	0.887	11.42	17.31	0.233	9.78	1.69
2011	0.913	-10.16	-7.79	0.263	-4.43	-0.06
2012	0.859	9.50	13.23	0.236	0.61	3.20
End Value		3.54	2.61		2.80	1.42
Monthly Return		0.82***	0.65**		0.63***	0.21***
(t-stat)		(3.02)	(2.18)		(5.06)	(3.76)
α		0.15	-0.01		0.25**	-0.06
(t-stat)		(1.43)	(-0.12)		(2.54)	(-1.27)
Sharpe Ratio		0.18	0.12		0.27	0.03
Info Ratio		0.12	-0.01		0.21	-0.11
Skewness		-0.41	-0.60		0.20	-1.84
Attrition Rate		9.90%			14.19%	
Mean Adj. R^2		0.808			0.184	

Table X: Cloneable and Non-Cloneable Funds - Portfolio Comparisons, Quartiles, 1999-2004 and 2005-2012

Annual returns and cumulative risk-adjusted performances of portfolios 1999-2012 formed on the basis of LASSO Adj. R^2. Portfolios of hedge funds and clones are formed as December 31, 1998, and rebalanced annually for funds in the top and bottom quartile of LASSO Adj. R^2. End value is as of December 31, 2012. Skewness reports the mean skewness of out-of-sample portfolio net returns for one year predicting window. Panel A reports the comparisons of performances 1999-2004. Panel B reports the comparisons of performances 2005-2012. Significance at the 10%, 5%, and 1% levels are designated by *, **, and ***, respectively.

Panel A: Year 1999 to 2004

Year	"Cloneable" Funds, Top R^2 Quartile			"Non-Cloneable" Funds, Btm R^2 Quartile		
	Adj. R^2	Annual Return		Adj. R^2	Annual Return	
		Hedge Funds	Clones		Hedge Funds	Clones
1999	0.757	36.88	19.97	0.087	13.56	2.83
2000	0.713	5.49	-3.88	0.123	9.15	4.25
2001	0.697	0.26	-8.18	0.126	14.41	3.04
2002	0.692	-3.98	-5.82	0.109	8.42	3.08
2003	0.762	33.69	20.93	0.156	18.24	0.61
2004	0.799	12.99	19.67	0.153	6.66	3.97
End Value		2.10	1.44		1.94	1.19
Monthly Return		1.08***	0.56		0.94***	0.24***
(t-stat)		(3.05)	(1.56)		(4.42)	(7.08)
α		0.47***	0.03		0.43***	-0.03
(t-stat)		(3.92)	(0.24)		(3.01)	(-0.87)
Sharpe Ratio		0.28	0.10		0.38	0.00
Info Ratio		0.43	0.03		0.34	-0.10
Skewness		0.35	-0.28		0.13	0.41
Attrition Rate		6.39%			8.37%	
Mean Adj. R^2		0.737			0.125	

Panel B: Year 2005 to 2012

Year	"Cloneable" Funds, Top R^2 Quartile			"Non-Cloneable" Funds, Btm R^2 Quartile		
	Adj. R^2	Annual Return		Adj. R^2	Annual Return	
		Hedge Funds	Clones		Hedge Funds	Clones
2005	0.815	9.25	11.32	0.215	7.00	6.26
2006	0.816	18.63	19.59	0.203	10.68	8.76
2007	0.824	16.89	15.16	0.196	11.76	6.64
2008	0.850	-26.66	-25.68	0.243	-4.10	-8.20
2009	0.925	38.31	29.74	0.237	7.69	0.55
2010	0.887	11.42	17.31	0.233	9.78	1.69
2011	0.913	-10.16	-7.79	0.263	-4.43	-0.06
2012	0.859	9.50	13.23	0.236	0.61	3.20
End Value		1.68	1.81		1.44	1.19
Monthly Return		0.62	0.72		0.39***	0.19*
(t-stat)		(1.58)	(1.61)		(2.74)	(1.98)
α		0.01	0.08		0.19*	-0.05
(t-stat)		(0.05)	(0.52)		(1.73)	(-0.73)
Sharpe Ratio		0.12	0.13		0.18	0.05
Info Ratio		0.01	0.06		0.20	-0.09
Skewness		-0.62	-0.68		-0.01	-1.50
Attrition Rate		12.53%			18.55%	
Mean Adj. R^2		0.861			0.228	

Table XI: Cloneable and Non-Cloneable Funds - Portfolio Comparisons, Quintiles, 1999-2012

Annual returns and cumulative risk-adjusted performances of portfolios 1999-2012 formed on the basis of LASSO Adj. R^2. Portfolios of hedge funds and clones are formed as December 31, 1998, and rebalanced annually for funds in the top and bottom quintile of LASSO Adj. R^2. End value is as of December 31, 2012. Skewness reports the mean skewness of out-of-sample portfolio net returns for one year predicting window. Significance at the 10%, 5%, and 1% levels are designated by *, **, and ***, respectively.

Year	"Cloneable" Funds, Top R^2 Quintile			"Non-Cloneable" Funds, Btm R^2 Quintile		
	Adj. R^2	Annual Return		Adj. R^2	Annual Return	
		Hedge Funds	Clones		Hedge Funds	Clones
1999	0.783	34.81	20.90	0.073	0.81	2.98
2000	0.736	6.18	-4.20	0.105	12.00	4.77
2001	0.721	0.27	-7.91	0.106	11.35	3.69
2002	0.721	-4.07	-6.78	0.095	8.22	2.24
2003	0.787	35.22	23.09	0.135	18.04	0.49
2004	0.824	13.52	20.19	0.130	6.60	2.99
2005	0.835	9.96	11.70	0.189	6.82	6.01
2006	0.839	17.02	18.89	0.175	10.25	8.04
2007	0.846	17.35	15.88	0.173	11.67	6.45
2008	0.869	-27.19	-25.67	0.214	-4.12	-6.91
2009	0.936	38.85	29.90	0.201	6.42	0.20
2010	0.903	11.22	17.93	0.201	9.48	1.30
2011	0.927	-10.34	-8.38	0.224	-4.56	0.42
2012	0.879	9.46	13.53	0.203	0.68	3.16
End Value		3.52	2.68		2.42	1.41
Monthly Return		0.82***	0.67**		0.54***	0.21***
(t-stat)		(2.93)	(2.19)		(4.53)	(4.20)
α		0.15	0.00		0.16	-0.05
(t-stat)		(1.32)	(-0.06)		(1.62)	(-1.15)
Sharpe Ratio		0.17	0.12		0.23	0.03
Info Ratio		0.11	0.00		0.14	-0.10
Skewness		-0.43	-0.60		-0.24	-1.63
Attrition Rate		9.93%			14.65%	
Mean Adj. R^2		0.829			0.159	

Table XII: Cloneable and Non-Cloneable Funds - Portfolio Comparisons, Quintiles, 1999-2004 and 2005-2012

Annual returns and cumulative risk-adjusted performances of portfolios 1999-2012 formed on the basis of LASSO Adj. R^2. Portfolios of hedge funds and clones are formed as December 31, 1998, and rebalanced annually for funds in the top and bottom quintile of LASSO Adj. R^2. End value is as of December 31, 2012. Skewness reports the mean skewness of out-of-sample portfolio net returns for one year predicting window. Panel A reports the comparisons of performances 1999-2004. Panel B reports the comparisons of performances 2005-2012. Significance at the 10%, 5%, and 1% levels are designated by *, **, and ***, respectively.

Panel A: Year 1999 to 2004

Year	"Cloneable" Funds, Top R^2 Quintile			"Non-Cloneable" Funds, Btm R^2 Quintile		
	Adj. R^2	Annual Return		Adj. R^2	Annual Return	
		Hedge Funds	Clones		Hedge Funds	Clones
1999	0.783	34.81	20.90	0.073	0.81	2.98
2000	0.736	6.18	-4.20	0.105	12.00	4.77
2001	0.721	0.27	-7.91	0.106	11.35	3.69
2002	0.721	-4.07	-6.78	0.095	8.22	2.24
2003	0.787	35.22	23.09	0.135	18.04	0.49
2004	0.824	13.52	20.19	0.130	6.60	2.99
End Value		2.11	1.47		1.71	1.18
Monthly Return		1.09***	0.59		0.76***	0.23***
(t-stat)		(3.00)	(1.59)		(3.74)	(9.41)
α		0.49***	0.05		0.27*	-0.02
(t-stat)		(3.81)	(0.50)		(1.71)	(-1.06)
Sharpe Ratio		0.27	0.11		0.30	-0.05
Info Ratio		0.44	0.06		0.21	-0.12
Skewness		0.34	-0.23		-0.56	0.10
Attrition Rate		6.60%			8.12%	
Mean Adj. R^2		0.762			0.108	

Panel B: Year 2005 to 2012

Year	"Cloneable" Funds, Top R^2 Quintile			"Non-Cloneable" Funds, Btm R^2 Quintile		
	Adj. R^2	Annual Return		Adj. R^2	Annual Return	
		Hedge Funds	Clones		Hedge Funds	Clones
2005	0.835	9.96	11.70	0.189	6.82	6.01
2006	0.839	17.02	18.89	0.175	10.25	8.04
2007	0.846	17.35	15.88	0.173	11.67	6.45
2008	0.869	-27.19	-25.67	0.214	-4.12	-6.91
2009	0.936	38.85	29.90	0.201	6.42	0.20
2010	0.903	11.22	17.93	0.201	9.48	1.30
2011	0.927	-10.34	-8.38	0.224	-4.56	0.42
2012	0.879	9.46	13.53	0.203	0.68	3.16
End Value		1.67	1.82		1.41	1.19
Monthly Return		0.61	0.73		0.37***	0.19**
(t-stat)		(1.51)	(1.60)		(2.66)	(2.21)
α		-0.02	0.07		0.19*	-0.04
(t-stat)		(-0.12)	(0.46)		(1.67)	(-0.60)
Sharpe Ratio		0.12	0.13		0.16	0.05
Info Ratio		-0.01	0.05		0.20	-0.07
Skewness		-0.63	-0.69		0.00	-1.27
Attrition Rate		12.43%			19.54%	
Mean Adj. R^2		0.879			0.197	

Table XIII: Comparisons of Portfolios Formulated upon Manager Claimed Style, 1999-2012

Comparisons of hedge funds portfolios and clones portfolios 1999-2012 are reported. Portfolios are formulated as of December 31, 1998, based on manager claimed styles, and rebalanced annually. Annual returns and cumulative risk-adjusted performances are reported. End value is as of December 31, 2012. Skewness reports the mean skewness of out-of-sample portfolio net returns for one year predicting window. Significance at the 10%, 5%, and 1% levels are designated by *, **, and ***, respectively.

Year 1999 to 2012

Hedge Fund Style	Fund-Year Obs	Adj. R^2	End Value		Monthly Excess (t-stat)		α (t-stat)		Sharpe Ratio		Info Ratio		Skewness	
			Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones
CTA/Managed Futures	2062	0.363	2.86	1.47	0.49** (2.04)	0.06 (0.39)	0.25 (1.15)	-0.16 (-1.05)	0.16	0.03	0.10	-0.09	0.24	-1.52
Distressed Securities	633	0.489	2.97	2.09	0.50** (2.51)	0.27* (1.69)	0.23** (2.03)	0.07 (1.05)	0.19	0.13	0.15	0.09	0.00	-0.55
Emerging Market Equity	560	0.599	9.36	3.26	1.35*** (2.81)	0.66 (1.62)	0.48* (1.87)	0.06 (0.34)	0.22	0.13	0.15	0.03	-0.51	-0.35
Equity Market Neutral	1031	0.537	2.92	2.11	0.48*** (2.68)	0.29 (1.55)	0.21** (2.29)	0.03 (0.34)	0.21	0.12	0.18	0.03	0.09	-0.67
Long Bias Equity	946	0.646	4.18	2.54	0.75** (2.44)	0.44 (1.52)	0.27** (2.53)	0.05 (0.52)	0.19	0.12	0.21	0.05	-0.36	-0.48
Long/Short Equity	4396	0.580	3.34	1.99	0.58** (2.51)	0.26 (1.21)	0.22** (2.02)	-0.05 (-0.57)	0.19	0.09	0.16	-0.05	0.25	-0.79
Macro	1270	0.473	3.95	1.81	0.66*** (3.84)	0.18 (1.33)	0.38*** (3.06)	-0.05 (-0.6)	0.30	0.10	0.25	-0.50	1.43	-1.18
Multi Style	1570	0.521	2.77	1.81	0.44*** (2.91)	0.18 (1.29)	0.20** (2.22)	-0.04 (-0.63)	0.23	0.10	0.19	-0.06	-0.68	-1.24
Convertible_Arb	446	0.431	2.96	2.41	0.49*** (2.61)	0.36** (2.31)	0.22 (1.5)	0.16 (1.54)	0.20	0.18	0.14	0.13	-2.50	0.40
Fixed_Income	350	0.460	1.15	1.81	0.00 (0.01)	0.18 (1.42)	-0.48 (-1.12)	-0.06 (-0.63)	0.00	0.11	-0.13	-0.05	-8.20	-1.07
Fixed Income_Arb	420	0.396	2.40	2.09	0.35** (2.53)	0.26*** (2.64)	0.11 (0.84)	0.12 (1.42)	0.20	0.20	0.08	0.12	-2.97	-0.04
Merger_Arb	337	0.503	2.97	1.89	0.48*** (3.23)	0.20 (1.63)	0.31*** (3.05)	0.04 (0.57)	0.25	0.13	0.26	0.05	-0.47	-1.53

Table XIV: Comparisons of Portfolios Formulated upon Manager Claimed Style, 1999-2004 and 2005-2012

Comparisons of hedge funds portfolios and clones portfolios are reported. Portfolios are formulated as of December 31, 1998, based on manager claimed styles, and rebalanced annually. Annual returns and cumulative risk-adjusted performances are reported. End value is as of December 31, 2012. Skewness reports the mean skewness of out-of-sample portfolio net returns for one year predicting window. Panel A reports the comparisons of hedge funds and clones 1999-2004. Panel B reports the comparisons of hedge funds and clones 2005-2012. Significance at the 10%, 5%, and 1% levels are designated by *, **, and ***, respectively.

Panel A: Year 1999 to 2004

Hedge Fund Style	Fund-Year Obs	Adj. R^2	End Value		Monthly Excess (t-stat)		α (t-stat)		Sharpe Ratio		Info Ratio		Skewness	
			Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones
CTA/Managed Futures	500	0.286	1.79	1.15	0.62 (1.57)	-0.04 (-0.35)	0.28 (0.98)	-0.10 (-0.90)	0.18	-0.04	0.11	-0.10	0.24	-0.44
Distressed Securities	156	0.416	1.87	1.40	0.67** (1.98)	0.24 (0.98)	0.28 (1.45)	0.05 (0.44)	0.23	0.12	0.15	0.05	0.73	-0.42
Emerging Market Equity	127	0.480	5.11	1.44	2.19*** (3.36)	0.38 (0.67)	1.43*** (3.69)	-0.07 (-0.24)	0.40	0.08	0.38	-0.03	1.00	-0.35
Equity Market Neutral	200	0.495	1.97	1.36	0.73*** (2.61)	0.20 (0.81)	0.49*** (3.59)	0.05 (0.50)	0.31	0.10	0.38	0.06	0.84	-0.51
Long Bias Equity	202	0.589	2.40	1.39	1.04** (2.52)	0.26 (0.70)	0.65*** (4.42)	0.04 (0.37)	0.30	0.08	0.49	0.05	-0.03	-0.48
Long/Short Equity	697	0.522	2.25	1.36	0.94** (2.47)	0.22 (0.70)	0.57*** (3.65)	-0.02 (-0.12)	0.29	0.08	0.38	-0.02	0.95	-0.45
Macro	303	0.373	2.40	1.33	1.01*** (3.44)	0.16 (1.21)	0.66*** (3.62)	0.04 (0.43)	0.41	0.14	0.37	0.05	1.86	-1.08
Multi Style	304	0.422	2.02	1.30	0.75*** (3.70)	0.13 (0.95)	0.52*** (5.21)	0.02 (0.24)	0.44	0.11	0.53	0.03	1.13	-0.51
Convertible_Arb	124	0.317	1.94	1.36	0.69*** (4.67)	0.18** (2.52)	0.58*** (4.85)	0.13*** (2.63)	0.55	0.30	0.54	0.26	0.28	1.36
Fixed_Income	66	0.301	0.91	1.24	-0.15 (-0.21)	0.06 (0.51)	-0.66 (-0.75)	-0.05 (-0.48)	-0.03	0.06	-0.12	-0.05	-6.60	-0.13
Fixed Income_Arb	64	0.284	1.71	1.30	0.51*** (3.36)	0.12* (1.75)	0.41*** (2.97)	0.09 (1.5)	0.40	0.21	0.36	0.16	0.24	0.10
Merger_Arb	90	0.412	1.79	1.38	0.57*** (4.30)	0.20** (2.02)	0.46*** (4.49)	0.15*** (3.52)	0.51	0.24	0.57	0.43	-0.85	0.15

Table XIV cont.: Comparisons of Portfolios Formulated upon Manager Claimed Style, 1999-2004 and 2005-2012

Panel B: Year 2005 to 2012

Hedge Fund Style	Fund-Year Obs	Adj. R^2	End Value		Monthly Excess (t-stat)		α (t-stat)		Sharpe Ratio		Info Ratio		Skewness	
			Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones	Hedge Funds	Clones
CTA/Managed Futures	1562	0.421	1.60	1.27	0.38 (1.32)	0.14 (0.54)	0.42* (1.76)	-0.11 (-0.53)	0.13	0.05	0.19	-0.06	0.17	-1.39
Distressed Securities	477	0.544	1.59	1.50	0.36 (1.55)	0.30 (1.38)	0.23** (1.99)	0.12** (2.09)	0.16	0.14	0.22	0.23	-1.17	-0.66
Emerging Market Equity	433	0.688	1.83	2.26	0.72 (1.06)	0.86 (1.52)	-0.08 (-0.31)	0.24 (1.33)	0.11	0.16	-0.03	0.15	-1.07	-0.38
Equity Market Neutral	831	0.569	1.48	1.56	0.29 (1.27)	0.35 (1.32)	0.05 (0.47)	0.06 (0.52)	0.13	0.14	0.05	0.06	-0.58	-0.74
Long Bias Equity	744	0.689	1.74	1.83	0.53 (0.08)	0.57 (0.16)	0.08 (0.62)	0.16 (1.36)	0.12	0.14	0.07	0.17	-0.44	-0.50
Long/Short Equity	3699	0.624	1.48	1.46	0.30 (1.09)	0.29 (0.99)	0.02 (0.17)	-0.02 (-0.25)	0.11	0.10	0.02	-0.03	-0.72	-0.99
Macro	967	0.547	1.65	1.36	0.39** (1.98)	0.20 (0.91)	0.23* (1.88)	-0.06 (-0.52)	0.20	0.09	0.21	-0.06	0.56	-1.04
Multi Style	1266	0.596	1.37	1.39	0.21 (0.97)	0.22 (0.98)	0.00 (0.01)	-0.01 (-0.12)	0.10	0.10	0.00	-0.01	-1.36	-1.20
Convertible_Arb	322	0.517	1.52	1.78	0.34 (1.10)	0.49* (1.84)	0.03 (0.16)	0.34*** (2.65)	0.11	0.19	0.02	0.32	-2.16	0.21
Fixed_Income	284	0.580	1.26	1.45	0.11 (0.57)	0.26 (1.33)	-0.14 (-1.08)	-0.01 (-0.07)	0.06	0.14	-0.13	-0.01	-1.43	-1.13
Fixed Income_Arb	356	0.479	1.40	1.61	0.23 (1.08)	0.37** (2.23)	-0.09 (-0.59)	0.20* (1.78)	0.11	0.23	-0.07	0.21	-3.24	-0.15
Merger_Arb	247	0.571	1.66	1.37	0.41* (1.71)	0.21 (0.99)	0.27* (1.85)	0.03 (0.4)	0.18	0.10	0.20	0.05	-0.28	-1.37