Reviewing the Hedge Funds Literature I: Hedge Funds and Hedge Fund's Managerial Characteristics

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Abstract

This paper summarizes the literature on hedge funds (HFs) developed over the last two decades, particularly that which relates to managerial characteristics (a companion piece covers the risk management characteristics of HFs). It classifies, the current HF literature, suggesting which critical problems have been "solved" and which problems have not been yet adequately addressed. It also discusses the effects of past financial regulation and the prospects for the effect of new financial regulation on the HF industry and its performance and risk management practices, and suggests new avenues for research. Furthermore, it highlights the importance of managerial characteristics for HF performance, and the successes and the shortfalls to date in developing more sophisticated HF-related risk management tools.

JEL Classification Code:

Keywords: Hedge funds; Hedge funds characteristics, Hedge funds managers; Managerial characteristics.

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1. Introduction

"Hedge Funds" (HFs) raise capital via private placements and from a limited number of qualified investors. According to information published in the "The City UK" (TCU) report [2], at the end of 2011, there were more than 9,800 HFs reported worldwide with an asset value under management of $1.9 trillion. This value was still below the $2.15 trillion maximum reached at the end of 2007. New York and London are the two largest HF centres holding around 42 and 18 percent, respectively, of the total world's HF assets. In Europe, London is the largest HF centre, holding $395bn, roughly 70 percent of the total European HF assets. In the European Union (EU) there are about 1,500 HFs with two-thirds of these funds located in London.

Unlike banks, mutual funds and other financial institutions, HFs are pooled private investment vehicles that have largely escaped financial regulations. For instance, they are not required to disclose specific information to financial markets, regulators or databases about their performance, asset holdings and risk management procedures. This contributes to their reputation for being the least transparent major participants in the financial markets. With the 2007 financial crisis, they came, however, under closer scrutiny from regulators. Within the EU institutions and some EU's member countries, such as France, Germany, and the UK, public discussions were initiated in order to comply with a set of new regulations for the finance system. In 2011 a new legislative law, named the "alternative investment fund manager directive" (AIFMD), was proposed by the EU and fully implemented by all member states in 2013. It introduces a new set of risk management procedures and risk management monitoring measures and imposes some constraints on the HF leverage and remuneration of senior staff members[3]. More recently, in December 2013, the European commission adopted a Delegated Regulation [4] which supplements the AIFMD act. It defines some regulatory technical standards so as to determine whether an Alternative Investment Fund Manager (AIFM) is an AIFM open-ended AIF(s) and/or closed-ended AIF(s).

The specificities of HFs and of their managerial characteristics combined with the ongoing discussions, particularly in the U.S. and the EU, for imposing more restrictive regulation on the financial markets, with obvious implications on the HF industry, provided us with a unique opportunity to review the last two decades of academic literature on HF.

[2] TheCityUK (March 2012), "Financial Market Series: HFs".

[3] EU, Proposal for a Directive of the European Parliament and of the Council on Alternative Investment Fund Managers and amending directives 2003/41/EC and 2009/65/EC, 15053/1/10 (27 October 2010) at Chapter III and Chapter IV.

[4] Delegated regulation (EU) No. 694/2014 supplementing Directive 2011/61/EU.

The contribution of this paper is four-fold: (i) summarizes the literature on HF (ii) provides an alternative classification for the HF literature which makes it easier to identify both the most relevant contributions and the gaps in the literature; (iii) suggests which critical problems have been "solved" and which significant problems have not been yet adequately addressed; (iv) suggests new avenues for research and for new regulation related to HF and discusses the managerial characteristics of HFs addressed in the literature which may affect HF performance (a companion paper addresses the literature on HF risk management characteristics).

This paper is organized as follows. In the next section, we identify some key HF characteristics and discuss the effect of these characteristics on the HF performance. In section 3 we review HF papers which consider the effect of managerial characteristics on HF performance. In section 4 we conclude.

2. Hedge fund's characteristics

2.1. Managerial compensation and fee structure

Typically the HF fee structure is divided into an asset based (or flat-rate) management fee and a performance-based (option-like) incentive fee, with the latter dependent on the "high water mark" (HWM)[5] and the "hurdle rate" (HR) provisions.[6] As the HF's manager (HFM) only shares the upside profit, so such an incentive fee contract (IFC) can be seen as a call option written by the investor on the HF's asset with a strike price determined by the HR, HWM provision and the net asset value at which each investor invests in the fund. The investments in the HF are associated with different net asset values (i.e. the net asset value of the HF at the time of each investment), consequently, the option-like performance fee has a strike price that varies with the time and is specific to each investor, and the overall IFC of the HFM is similar to a portfolio of call options each with, potentially, different strike prices.

Several authors have examined the effect of "incentive fees" (IF) on HF's performance and arrived at contradicting conclusions. For instance, Ackermann et al. (1999), Liang (1999), and Edwards and Caglayan (2001) study the association between IF and risk-adjusted performance and report a statistically significant positive association between them. Their results suggest that IF is an effective tool to align the interest of both managers and investors.

[5] HWM provision ensures that the HFM does not get his incentive fee unless the fund's net asset value exceeds its previous maximum net asset value. For example, the fund asset value in 2010 is $500M and the investment value falls to $300k. In 2011 the funds make a 100% return and the asset value is now $600M. The investors would only have to pay performance fees on that gain between the $500M and $600M, not the full 100% gain.

[6] HR provision is the minimum return necessary to overcome in order the HFM to receive an IF. This rate is usually tied to a benchmark such as LIBOR or one-year Treasury bill rate. For example, suppose the HFM sets a HR of 5% and the fund returns is 15% on a year, so the IF relate the 10% return above the HR and not to the 15% return.

Anson (2001) uses the Black-Scholes option pricing model to determine a suitable value for the option-like IFC and concludes that this option has a significant value and the performance-based incentive fee along with the requirement for HFM having their own money invested in the fund are the best ways to alignment the interests of both managers and investors. Koh et al. (2003) and Kouwenberg and Ziemba (2007) report, however, results which show a statistically significant negative coefficient for the association between IFC and HF's performance (HFP).

The literature above examines the impact of managerial incentives, proxied by the performance incentive fee, on the HFP. Other authors study the relationship between the HWM and the HFP. For instance, the Agarwal et al. (2009) work is based on the assumption that the IF percentage rate does not explain performance. They use instead the delta[7] of the call option underlying the IFC along with the HR and the HWM provision and conclude that the HFs with better performances have higher option deltas and include an HWM. Liang and Schwarz (2011) investigate whether the managerial pay-performance compensation structure is able to reduce agency costs. They examine the effects of the HFM's decisions to close funds to new investors to prevent diseconomies of scale and report evidence that managers do not close funds unless there is a significant diseconomy of scale. Agarwal and Ray (2011) study the determinants and consequences of fee changes and whether the structure of fee changes (i.e. management fee percentage rate, IF, and HWM provision) are related to each other and to the fund's past performance and expectations for the future performance, using a dataset comprising information on the HF fee structure, for the period between April 2008 and November 2010. Their results suggest that the IF tend to increase over time and that this tendency is more frequent in younger and smaller HF than in older and larger HF. It appears that investors view the increase in the fee as a signal of managerial ability and reward those funds with a higher investment.

The above literature treats HF compensation fees as fixed payments, once they are made. Schwarz (2007) provides, however, a detailed cross-sectional analysis of fee variation and studies the effect on HFP and cash flow showing that management fees and IF are positively correlated with the lock up period which means that managers charging higher fees tend to have longer lock-up periods in their funds. However, investors do not view these fee levels as a signal of better future performance.

As mentioned earlier, HFMs hold a portfolio of call options on the HF value. The value of this portfolio of call options increases with the increase of the volatility of the HF value and

[7] The delta of the call option embedded in the IFC represents the "dollar increase" in the HFM's compensation for a "one dollar" increase in HF net asset value.

the HFMs exercise these options if, at the maturity of the options, the value of the assets under management exceeds the strike price of the (IF) call options[8]. Fung and Hsieh (1997) find that when the IFC is out of the money, i.e. the current HF value is below the strike price of the underlying call options, contractual constraints, and reputational concerns may prevent managers from increasing risk. It appears that, once a good reputation is built, HFM tend to preserve it by following less risky management strategies.

Brown et al. (2001) examine the association between the risk taken by HFM and reputational or career-management related concerns and conclude that poor relative performance and low-risk premium increases the probability of HF termination and that the subsequent related reputation cost offsets the effect of IFC on risk taking. This pattern is more evident, however, for out-of-the-money (call options) IFC. Kouwenberg and Ziemba (2007) examine the effect of the characteristics of the IFC on the RM behaviour of the HFM and show that HFs with IFC have higher downside risk than HFs without IFC, and that risk-taking behaviour is significantly reduced when HFM invest their own money in a proportion higher than 30% of the total value of the fund.

<Insert Table 1>

2.2. Managerial flexibility

The lockup period is a window of time where investors are not permitted to redeem or sell shares. This period in addition to both redemption and notice periods are considered to be unique characteristics of HF which impose constraints on cash outflows avoiding liquidity problems. It is generally argued that imposing such constraints on investors enhances the possibility of generating higher returns by pursuing, for instance, long-term arbitrage strategies. Aragon (2007) finds that HF with lockup period constraints have higher excess returns than HF without lockup periods, and show that there is a negative relationship between share restrictions[9] and the liquidity of the fund's portfolio. Liang (1999), Koh et al. (2003) and Agarwal et al. (2009) report a positive relationship between HF returns and the length of the lockup period. Liang and Schwarz (2011) also show that the higher the investors' cash outflow restrictions, defined as the sum of the lockup period, redemption notice period and redemption period in months, the lower is the likelihood of the fund closure and the higher is the loss in performance over time.

<Insert Table 2>

[8] A relevant research question, however, is whether an increase in the HF volatility does carry a proportional extra management costs.
[9] Share restrictions: include Lockup and redemption periods.

2.3. Size and age

Liang (1999) and Koh et al. (2003) study the effect of HF size, proxied by the HF assets value under management, on HFP and both arrive at the conclusion that the larger the size of the HF the better is the performance. It appears that HFs of larger size benefit from economies of scale and are more likely to attract new investors. Getmansky (2004) find, however, that there is a concave negative relationship between HFP and the size of the assets under management. This finding suggests that there is an optimal asset value size to maximize return. The optimal asset size depends, however, on several variables, whose effect on performance can offset each other, such as past returns, fund flows, market impact and competition in the industry (i.e. for instance, HFs in illiquid categories are subject to high market impact and have limited investment opportunities and are therefore more likely to exhibit a different optimal size compared with those in more liquid HF categories). Herzberg and Mozes (2003), Teo (2009) and Hedges (2009) provide evidence supporting the results of Getmansky (2004).

Agarwal et al. (2009) examine the effect of HF size and fund flows on returns and show that there is a negative association between the size of the HFs and the evolution of the cash flows over time, which suggests that there is a decreasing return to HF size. Moerth (2007) uses multi-factor regression models to examine the relationship between HF size, evolution of HF flows over time and HFP, considering the following regression variables: return, standard deviation, Sharpe ratio and alpha per asset class, and a data sample that comprises 4,699 HFs collected from the period between January 1994 and April 2005. His results show that on average larger HFs do not take advantage of the economies of scale but, on the contrary, there is a significant negative relationship between HF size and performance. He also studies whether HF allocates new capital efficiently as the inflows increase and shows that periods with high asset inflows are typically followed by periods where returns are below average. However, Kazemi and Schneeweis (2003) and Gregoriou and Rouah (2003), using the stochastic discount factor approach and regression analysis for the period from 1994 till 1999, find no evidence of the effect of fund sizes on HF returns.

Liang (1999) finds a negative relationship between HF performance and the age of the HFM and concludes that HFM of "young funds" (YF) [10] work harder to build up a reputation and consequently their funds achieve higher return performance. Howell (2001) defines YF as "funds with less than three years" and examines the association between the HF age (of young funds and seasoned funds[11]) and HF performance. His results provide evidence that YF has

[10] Young funds are referred to funds with less than 5 years.

[11] Seasoned funds are funds that have been in the business for at least 5 years.

higher returns than seasoned funds. Koh et al. (2003) devotes his attention to the Asian HF industry and find no evidence that YF outperforms seasoned funds.

<Insert Table 3>

2.4. Diversification

The quest for creating the optimal mixture of HFs in a portfolio (i.e. to create funds of HFs) has grown enormously in the last decades, as an alternative way to generating a higher absolute return and optimising hedging strategies. We identify three main branches of the literature on funds of HF. One branch mainly studies the effect on performance of increasing the number of HFs in a portfolio of HFs. Two good contributions to this literature were given by Lhabitant and Learned (2002) and Amin and Kat (2002). The former article tests the effect of diversification on randomly chosen and equally-weighted HF portfolios, using a sample of 6,985 HFs from the time period of 1990 to 2001, and conclude that the greatest benefits of portfolio diversification are achieved when the portfolio of HF does not include more than ten HFs, the latter examines the performance of a randomly selected basket of HFs whose size range from 1 to 20 funds and conclude that portfolios with less than 15 HFs have a more efficient risk-return profile.[12]

The second branch of literature studies the effect on the performance of combining portfolios of HFs with other traditional investments (e.g. stocks and bonds). Amin and Kat (2002) examine the effect on HF performance of including HFs into a traditional portfolio of stocks and bonds. Amin and Kat (2003) investigate the risk-return trade-off for individual funds and portfolio of funds when mixed with the S&P 500 stock index. Both of the studies provide evidence that HFs do not provide superior risk-return trade-off than traditional investments, but also that mixing HFs with stocks, bonds, and/or indices (such as S&P 500) can generate higher and more efficient payoff profiles enhancing the risk-return relationship. The above studies also suggest that above a certain number of HFs, adding an extra HF to the portfolio affects the skewness and kurtosis in such a way that reduces the benefits of diversification. The best results are obtained when HF added represent only 10-20% of fund assets. Davies et al. (2009) adopt the "polynomial goal programming" (PGP) optimization method in order to allocate capital across different HF strategies while incorporating investor preferences for higher return moments such as co-skewness and co-kurtosis, instead of normal skewness and kurtosis, and find that incorporating stocks and bonds into a portfolio of HFs leads to lower kurtosis and higher skewness compared to stand-alone HFs.

[12] Efficient risk-return profile is referred as a profile which is able to yield the highest return with the lowest risk possible.

The third branch of literature focuses on how to construct an optimal portfolio of HFs considering both the risk and the return characteristics. The mean-variance approach is a widely used approach. Amenc and Martellini (2002), Terhaar et al. (2003) and Alexander and Dimitriu (2004) consider such an approach. The mean-variance methodology is based on the assumption that returns follow a normal distribution. When this assumption does not hold the above methodology does not yield appropriate results. Hence, alternative approaches have been developed. One is called the expected utility framework, which is used, for instance, by Barès et al. (2002) who investigate the relation between the HF allocation problem and the uncertainty of the HF survival. More specifically, they use a generic algorithm to study the effect of survival probabilities and investment constraints on the optimal capital allocation and the certainty equivalent of HF's portfolios. Davies et al. (2009) develop a technique to allocate capital across different HF strategies and traditional asset classes which incorporate investors' preference for higher moments into a PGP function solved for multiple competing HF allocation objective functions within a 4-moment framework (mean-variance-skewness-kurtosis). They highlight the importance of constructing 'like for like' representative portfolios that reflect the investment opportunities available to different-sized funds and show the importance of the equity market neutral funds as volatility and kurtosis reducers and of the global macro funds as portfolio skewness enhancers.

Hagelin and Pramborg (2003), Popova et al. (2006), Jurczenko and Maillet (2006) also use a similar analysis to study HF portfolio optimization. Giamouridis and Vrontos (2007) are the first to use dynamic specification for the covariance parameters and to evaluate the consequences at the portfolio allocation level. They examine time-varying variance and covariance/correlations of HF returns by concentrating on the potential impact of HF portfolio construction and find that the "regime switching dynamic correlation model" (RSCM) ranks first in term of reducing portfolio risk, improving the out-of-sample risk-adjusted realized returns, and achieving the lowest "C-VaR" among the alternative covariance models, whereas the full factor multivariate GARCH model ranks second. Adam et al. (2008) use risk measurements to construct optimal portfolios under risk constraints. They assess risk, focusing on moment-based, distortion, and spectral risk measures, and provide comparative analyses of efficient portfolios. Their optimal portfolios selection with respect to the choice of risk measures show that the use of risk measures which are focused on identifying the likelihood of large losses lead to slightly more diversified portfolios. Krokhmal et al. (2002), Favre and Galeano (2002), and Agarwal and Naik (2004) construct optimal portfolios using alternative risk measures.

Rockafellar et al. (2006) propose generalized measures of deviation instead of standard deviation to cope with the uncertainty in attaining rates of return beyond the risk-free rate in

the framework of portfolio optimization theory. The conditional value-at-risk measure is an example of such measures used, which may reflect different risk attitudes from different classes of investors. This approach covers discrete distributions along with continuous distributions which can be applied to portfolios involving derivatives.

<Insert Table 4>

2.5. Trading strategies

2.5.1. Use of derivatives

To our best knowledge Chen (2011) is the first paper to use empirical information to examine the effect of financial derivatives use on risk taking and HF performance. It uses a sample of over 5,000 HFs from the period of 1994 to 2006 and identifies the determinants of derivatives use. It also finds that the use of derivatives is more likely in funds with higher incentive fees, fewer redemption restrictions and where managers have invested their own money and auditing is more effective. Finally, it tests whether investors differentiate the derivatives users from the derivative non-users and finds that the use of derivatives has little influence on the relationship between flow and performance.

2.5.2. Leverage

Ang et al. (2011) is the first study examining the determinants of HFs leverage[13]. They use a sample of funds of HFs from the time period of December 2004 to October 2009 and report that the HF leverage is modest and countercyclical (i.e. it decreased prior to the 2007 financial crisis and increased afterwards). For instance, during 2008 HFs reported the lowest leverage whereas the investment bank sector reported the highest leverage. Before 2008, both industries had, however, similar leverage exposure, which means that the deleveraging of the HF sector was due to the asset withdrawals over 2007 and not due to a change in HF industry leverage policy. They also conclude that HF leverage is more predictable if one rely on economy-wide factors rather than on HF's characteristics. For instance, a decrease in funding costs and an increase in market value, as well as a decrease in the volatility of the HF returns, are all good indicators of an increase in the future of the HF leverage.

McGuire and Tsatsaronis (2008), among others, provide an indirect method to estimate the average amount of the HF leverage, using an extension of regression-based style analysis with

[13] Prior work on HF leverage used many different methods of collecting or computing the HFs' leverage but without using actual leverage data as in Ang et al (2011) paper. For example, some papers used static leverage ratios taken directly from fund databases. For example the work of Schneeweis et al. (2005) who empirically investigate the relationship between HFs leverage and their risk-return relationship using leverage at a point in time database. They find, on a strategy level, a systemic relationship between leverage and standard deviation, whereas on a fund level, they report little evidence of a systematic relationship between the use of leverage and the level of risk-adjusted performance. Some other articles rely on direct estimates for HF leverage such as Banque de France (2007) and Lo (2008).

time-varying betas and based on publicly available data on HF returns. This study considers non-linear exposures, through the use of synthetic option returns, as possible risk factors, and requires a careful specification of the model factors to avoid omitted variable bias. Duffie et al. (2009) and Dai and Sundaresan (2010) develop theoretical models to determine the optimal leverage considering the finding costs, insolvency risk and management fees.

<Insert Table 5>

2.6. Performance persistency

Unlike traditional investment vehicles, investments in HFs impose restrictions on cash outflow such as long lock up and notice periods. Hence, before investing investors study carefully the expected long-term performance fund. The persistence in performance relates to the ability of the HFM to add value and generate absolute returns over time. Brown et al. (1999) conduct one of the early studies on HF performance and do not find evidence of annual return persistence for the sample time period between 1989 and 1995. Agarwal and Naik (2000), Edwards and Caglayan (2001), Kat and Menexe (2002), Barès et al. (2003), Koh et al. (2003) and Baquero et al. (2005) find evidence that contradicts the above results. Their results show the existence of a strong persistency in a good performance over short-term periods (i.e. monthly and quarterly) which decrease when one consider for longer time periods.

Boyson and Cooper (2004) developed a regression model which identifies quarterly performance persistence during the tenure of the HFM. Their results show that over quarterly time periods the best young manager outperforms the annual return of the worse old managers by 9 percent. Capocci (2009) also analyses performance persistence in HF returns and finds that there is a consistent and systematic way to create pure alpha, using risk-return trade-off measures (through the Sharpe score), a pure volatility measure (through the standard deviation) and the beta exposure. He finds that HFs offering stable returns with limited volatility and/or with a limited exposure to the equity market consistently and significantly outperform equity and bond markets for both bullish and bearish markets. Abdou and Nasereddin (2011) study performance persistence of some strategies for different economic periods using the support vector mechanism (SVM), the neural network (NN) and the ordinary least square (OLS) methodologies. They find that the SVM has better prediction accuracy than the NN and OLS, and the HF returns performance related to different strategies are not persistent over the long-term. Indeed, only the returns of emerging market strategy were persistent during the recession[14].

[14] Emerging Market Strategy is part of Equity Long/Short HF style. They invest in all types of securities in emerging countries, including equities, bonds and sovereign debt.

Tudor and Cao (2012) examine the ability of HFs and funds of HFs to generate a consistent absolute return over time, using Bayesian multinomial probit and regular multinomial logit regressions. They find that HFs which use Options Arbitrage, Fixed Income, Global Macro, Emerging Markets strategies, or are Event Driven, have a significantly better chance of producing absolute returns, but there is no evidence of performance persistence in absolute return when the HF's strategies and characteristics are taken into account. Cumming et al. (2012) show that financial regulation can enhance or mitigate returns performance persistence. They use a sample of HFs from 48 countries for 1994 to 2008 and identify three main types of regulations affecting returns performance persistence: (i) minimum capital restrictions, which restrict lower quality funds and hence increase the likelihood of performance persistence, (ii) restrictions on the location of key service providers, which restrict human capital choices and hence tend to mitigate performance persistence, and (iii) distribution channels, which make the HF performance more opaque, decreasing the likelihood of performance persistence.

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3. Managerial characteristics

3.1. Career concern and talent

Over the last two decades, an extensive empirical literature has been developed which helps to better understand the risk-return properties of HFs. Nevertheless, with very few exceptions, the study of the association between the managerial characteristics and performance of HFs has been neglected. Boyson (2005) examines the effect of career concerns on HF's managerial behaviour and the association between changes in managerial behaviour and the HF performance. More specifically, she analyses the effect of the years of experience and the age of the HFM on the HFM's risk-taking behaviour. Her results show that additional years of experience leads to less risk-taking behaviour and lower return performance. Boyson identifies several possible reasons for this negative relationship: (i) older HFM with larger HF earns get higher fees and this lead them to take less risk, (ii) older HFM usually have significant personal assets in their funds and this lead them to be more cautious, (iii) older HFM know that higher risk-taking increases the probability of default which, if it occurs, penalizes more older HFM than younger HFM.

More recently, Aggarwal and Jorion (2010) apply the framework of Boyson (2005) to analyse the effect of the HFM age on HF returns performance. Their data sample focuses, however, on emerging HF only. They use recently established HF as a proxy for emerging funds and emerging managers and evaluate separately HFM of recently established funds, who have

previously run a fund listed in the database, and HFM who have not previously run an HF listed in the database. Their results show that HFM of emerging HFs have stronger financial incentives for better performance than HFM of established funds and emerging HFs are more open to new investors than older HFs. They also report that emerging HF are able to generate higher abnormal returns performance in the first two years and that for each additional year of age after the first two years the return performance decreases by 42 basis points on average.

Li et al. (2011) provide an empirical analysis of the impact of HFM characteristics on HF performance, based on more than 4,000 HFs for the period between 1994 and 2003. They use "intelligence" and "education" as proxies for "talent" and "career concern", respectively. They also include other variables such as the composite SAT score for the manager's undergraduate institution, the number of years of working experience, the number of years of working experience at a specific HF and the age of the HFM. They show that HFMs from higher SAT undergraduate institutions tend to take less risk and have higher raw[15] and risk-adjusted returns and more inflows.

3.2. Timing ability

In previous sections, we reviewed the HF literature which focuses on the ability of the HFM to generate absolute returns. In this section, we focus on the HF literature which studies the timing ability of the HFM (i.e. the HFM's ability to invest in the right securities at the right time). The main approach that has been proposed to evaluate the timing ability is the "return-based measure". The most popular market timing models derived from this measure are those of Treynor and Mazuy (1966) and Merton (1981). Fung et al. (2002) use the traditional capital asset pricing model (CAPM) and the Henriksson and Merton (1981) model.

Aragon (2003) extends the timing model of Merton (1981) and conclude that HFM do not show any general market investment timing ability. Most of the HF literature shows, however, that HFM are able to optimize the timing of their investments at least under some circumstances. For instance, Aragon (2003) shows that HFM have positive (negative) market timing investment ability when they hold liquid (illiquid) portfolios. Chen (2004) uses the concept of focus markets (i.e. markets where HFs trade most actively) and finds evidence of successful market timing at both the individual and style[16] levels. Chen and Liang (2007) test for timing ability in both market level (bear or bull markets) and market volatility on the US equity HF market, and report economically and statistically significant evidence of timing ability at both individual and aggregate fund levels. Moreover, they state that timing ability

[15] Raw returns are the returns directly extracted from the database without any modification.

[16] In order to compare return performance, risk and other HF's characteristics, HFs are categorized according to investment strategies ("styles") - e.g. Long/Short, Relative value, Event driven, and Tactical trading.

appears especially strong during bear markets or when the market is more volatile, indicating that funds provide investors with protection against unfavourable market conditions. Cai and Liang (2012) use a dynamic linear regression model and find significant timing skill related to market return, liquidity, and volatility. Cao et al. (2013) investigate the HF managerial ability to take advantage of the market liquidity and conclude the existence of persistence timing skill over time.

<Insert Table 7>

4. Conclusion

This paper summarizes the literature on HF developed over the last two decades, particularly that which relates to managerial characteristics (a companion paper considers risk management characteristics). We classify the current HF literature, and suggest new avenues for research considering the recent developments. We highlight the importance of the managerial characteristics on the risk-taking and HF performance, and the successes and the shortfalls to date in developing more sophisticated HF-related risk management tools and financial regulation. We discuss past development patterns in the literature and some critical problems which have been "solved" or have not been yet adequately addressed.

The tables in the Appendix are helpful to identify both the gaps in the HF literature and the most relevant contributions in different research areas.

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Appendix

Table 1 – Describes the Managerial Compensation characteristics of the HFs (Fee structure and Compensation and risk behaviour)

Name	Objective	Modelling/Framework	Findings	Database	Sample	Period
1- Fees Structure						
Ackermann et al. (1999)	Test the relationship between risk-adjusted performance and incentive fee	Sharpe ratio	1- A strong relation between Sharpe ratio and incentive fees. 2- Incentive fees are effective in aligning manager and investor interests and attracting top managers	MAR and HFR	906	1988-1995
Liang (1999)	Study the effect of incentive fees on fund's performance	Cross-sectional analysis using simple regression	1- Incentive fees are highly positively significant with respect to the performance. 2- Management fees are not significantly related to performance	HFR	385	Jan. 1994-Dec. 1996
Anson (2001)	Determine a suitable value for the option-like incentive fee contract	Black-Scholes option pricing model	The performance-based incentive fee along with managerial investment should lead to better alignment of interest between the manager and the investors	NA		
Edward and Caglayan (2001)	Examine the Incentive fee- Performance relationship within two groups of HFs	Cross-sectional analysis using simple regression	1- Incentive fees are positively related to performance. 2- high-incentive funds paying incentive fees of 20% or more earn an annualized excess return of about 3-6% higher than funds that pay lower incentive fees (less than 20%)	MAR/Hedge	1458	Jan. 1990-Aug. 1998
Koh et al. (2003)	Study the effect of incentive fees on fund's performance	Cross-sectional analysis using simple regression	Negative coefficient on the performance fees which indicates no evidence of a relationship between higher returns and higher incentive fees	Asian Hedge and Eureka Hedge	417	Jan. 1999-Mar. 2003
Kouwenberg and Ziemba (2002)	Study the effect of incentive fees on both absolute and risk-adjusted returns	Cross-sectional analysis using simple regression	The negative coefficient on the performance fees which indicates no evidence of a relationship between higher returns and higher incentive fees.	Zurich HF Universe	1242 Funds and 451 FoHF	Jan. 1995-Nov. 2000

Agarwal et al. (2009)	Investigate the effect of managerial incentives proxied by (Delta of HF managers, Hurdle rate, and High-water mark provisions)	Regression analysis	Funds do perform better with better managerial incentives represented by higher delta and the inclusion of high-water mark.	CISDM, HFR, MSCI, and TASS	Total of 7535 Funds	Jan. 1994-Dec. 2002
Liang and Schwarz (2011)	Investigate whether the pay-performance compensation structure of fund managers has any effect on fund managers' decisions to limit investments	Regression analysis	1- Managers do not close funds before the occurrence of significant diseconomies of scale since closure shifts funds from outperforming to average performance. 2- The higher the investor outflow restrictions the lower is the closure likelihood and greater performance loss over time. 3- High pay-performance deltas are not strong enough to prevent overinvestment.	TASS	Varies according to each year	1999-2010
Schwarz (2007)	How hedge fund fee levels influence net performance and flows	Cross-sectional analysis using simple regression	1- Management and incentive fees are correlated with lock-up periods reducing the cross-sectional fee variation. 2- Negative relationship between funds of hedge fund performance and incentive fees. 3- Large funds charge higher fees and are more likely to raise fees level. And Investors do not view fee levels as a signal of future fund performance.	TASS	Varies according to each year	1998-2006
Agarwal and Ray (2011)	Explore the determinates of fee changes and whether these changes are related to each other and to the fund's past and future performance	Cross-sectional analysis using simple regression	1- Managers tend to increase their fees more than decreasing them over time. This fee increase is more observable in younger and smaller fund. 2- Investors view fee increases as a signal of managerial ability and reward these funds with higher inflows.	TASS	3770	Apr. 2008-Nov. 2010

2- Compensation and risk-taking behaviour of HF managers						
Fung and Hsieh (1997)	The role of incentive-fee and the reputation value on managerial risk-taking behaviour within HFs' survivorship framework	Regression Analysis	When the incentive-fee contract is out of the money, contractual constraints, and reputational concerns might alleviate managers' tendency to increase variance and risk	TASS	526 (CTA Funds)	1990-1995
Brown et al. (2001)	Examine the risk of HFs in light of managerial career concerns	Regression Analysis	There is a reputation cost that has a mitigating effect on incentives for taking extreme risk, especially when the incentive-fee contract is out of the money.	TASS	715	1989-1995
Kouwenberg and Ziemba (2007)	Examine how the incentive fee contract's features might affect the manager's risk-taking behaviour within the behavioural framework of prospect theory	Cross-sectional regression model	1- HFs with incentive fees have higher downside risk than funds without these contracts. Therefore, funds with incentive fee contracts are not riskier than other funds.	Zurich HF Universe	1242 Funds and 451 FoHF	Jan. 1995-Nov. 2000
			2- Risk-taking behaviour is significantly reduced when managers invest their own money (more than 30%) into the fund.			

Table 2- The main articles investigating the effects of HF managerial flexibility (Lockup, redemption, and notice periods)

Name	Objective	Modelling/Framework	Findings	Database	Sample	Period
Liang (1999)	Study the relationship between managerial flexibility variables and generating higher returns	Regression analysis	1- the Positive relationship between average returns and lockup periods. 2- The longer the lockup periods the fewer cash holdings and more investments, resulting in higher returns.	HFR	385	Jan. 1994-Dec. 1996
Koh et al. (2003)	Study the relationship between managerial flexibility variables and generating higher returns	Regression analysis	The positive relation between redemption periods and average returns.	Asian Hedge and Eureka Hedge	417	Jan. 1999-Mar. 2003
Agarwal et al. (2009)	Study the relationship between managerial flexibility variables and generating higher returns	Regression analysis	Better future returns are due to greater managerial flexibility in the form of longer redemption and lockup periods.	CISDM, HFR, MSCI, and TASS	Total of 7535 Funds	Jan. 1994-Dec. 2002
Aragon (2007)	Study the relationship between HF returns and restrictions imposed by funds that limit the liquidity of fund investors	Regression analysis	1-Excess returns of funds with lockup restrictions are 4-7% higher than those of no lockup funds. 2- the Negative relationship between share restrictions and the liquidity of the fund's portfolio (Investors' share illiquidity premium).	TASS	3354	Jan. 1994-Dec. 2001

Table 3- Describes the major studies on HF size and age

Name	Objective	Modelling/Framework	Findings	Database	Sample	Period
Liang (1999)	Study the effect of fund size on the fund's performance	Regression analysis	The larger the fund the better the performance due to economies of scale or attracting more money.	HFR	385	Jan. 1994-Dec. 1996
Koh et al. (2003)	Study the effect of fund size on the fund's performance in the Asian market	Regression analysis	The larger the fund the better the performance due to economies of scale or attracting more money.	Asian Hedge and Eureka Hedge	417	Jan. 1999-Mar. 2003
Getmansky (2004)	Study the effect of fund size on the fund's performance	Regression analysis	1- The Concave relationship between performance and assets under management. 2- An optimal asset size can be obtained by balancing out the effects of past returns, fund flows, market impact, competition and favourable category positioning.	TASS	3501	Jan. 1994-Dec. 2002
Agarwal et al. (2009)	Study the effect of fund size and investors' money flows on performance	Regression analysis	Find that worse future performance is reported due to both larger hedge funds and greater cash flows due to decreasing returns to scale.	CISDM, HFR, MSCI, and TASS	Total of 7535 Funds	Jan. 1994-Dec. 2002
Gregoriou and Rouah (2003)	Study the impact of fund size on HF returns	Regression analysis	No evidence for any impact of fund size on HF returns.	Zurich HF Universe, and LaPorte asset Allocation System	204	1994-1999
Moerth (2007)	Analyze the relationship between fund size, fund flows, and performance (HF return, SD, Sharpe ratio, and Alpha)	Cross-sectional analysis using simple regression	1- On average large funds cannot take advantage of their economies of scale. On the contrary, a significant negative relationship between fund size and hedge fund performance is revealed. 2- Periods with high asset inflows in individual funds are typically followed by periods of below average returns.	TASS and CISDM	4699	Jan. 1994-Apr. 2005
Liang (1999)	Investigate the relationship between fund age and performance	Regression analysis	The negative relationship between fund's performance and age because managers of young funds work harder to build up the fund's reputation hence achieving higher returns.	HFR	385	Jan. 1994-Dec. 1996
Koh et al. (2003)	Investigate the relationship between fund age and performance in the Asian market	Regression analysis	No relationship between fund age and performance in the Asian market.	Asian Hedge and Eureka Hedge	417	Jan. 1999-Mar. 2003
Howell (2001)	Study the relationship between the fund age (young and seasoned funds) and their performance	Regression analysis	Superior returns for young funds over their seasoned peers.	NA	NA	NA

Table 4- The main contributions in the HF literature studying the diversification of HF

Name	Objective	Modelling/ Framework	Findings	Database	Sample	Period
Increasing the Number of HFs in a Portfolio						
Lhabitant and Learned (2002)	1- Test the effect of diversification on randomly chosen and equally-weighted HF portfolios	Naïve diversification strategies/ Mean-Variance Framework	1- Validates the usefulness of HF portfolio as an investment vehicle, since they show that increasing the number of HFs in the portfolio will decrease the volatility and downside risk while keeping a steady level of returns	MAR, HFR, TASS, EACM, and Private resources	6985	1990- 2001
	2- Examine the effect of naively increasing the number of HFs in a portfolio	Naïve diversification strategies/ Mean-Variance Framework	2- To get the best benefits from portfolio diversification, the portfolio should be of a small size not including more than 10 HFs			
Amin and Kat (2002)	Examine the performance of a randomly selected basket of HFs ranging in size from 1 to 20 funds	Mean-VaR Framework	To achieve a more efficient risk-return profile one needs to combine a small number of funds (less than 15 funds).	TASS	455 (Artificially created)	1994- 2001
Mixing HFs with a Portfolio of Traditional Investments						
Amin and Kat (2002)	Examine the diversification effect from including hedge funds into a traditional portfolio of stocks and bonds	Mean-VaR Framework	1- HFs inclusion in the portfolio will significantly enhance the mean-variance efficiency. However, the skewness and kurtosis will reduce this diversification benefit	TASS	455 (Artificially created)	1994-2001
			2- To have some impact on the overall portfolio, an allocation should be made to HFs exceeding the typical 1-5% that is normally considered.			
Amin and Kat (2003)	Investigate the risk-return trade-off for individual, portfolio and indices of hedge funds	Continuous time version of Dybvig's (1988) payoff distribution pricing model	1- HFs do not offer any risk-return superiority as a stand-alone investment. However, they produce an efficient payoff profile when mixed with the S &P 500.	MAR	77 HFs, 13 HF indices	May1990- Apr. 2000
			2- The best results are obtained when 10-20% of the portfolio value is invested in HFs			
Hagelin and Pramborg (2003)	Examine the gains from adding hedge funds into portfolios of stocks and bonds allowing for different moments of the return distribution to affect the analysis	Discrete-time investment model	1- Statistically significant gains for most of the strategies investigated from adding HFs to the portfolios of stocks and bonds. 2- HFs enter the risk neutral portfolio as well as the most risk-averse portfolio. 3,- Allocation to HFs are extensive at time	HFR index	NA	Jan. 1990- Oct. 2002

Davies et al. (2009)	Test investors' preferences for higher moments such as skewness and kurtosis to solve for capital allocation problem in the HF	Polynomial Goal Programming (PGP) optimization method	Incorporating stocks and bonds in a portfolio of HFs make it more favourable in terms of less kurtosis and higher skewness compared to another portfolio of only HFs	TASS	348	June1994- May 2001
Optimal HF Portfolio						
Amenc and Martellini (2002)	Allocate the optimal portfolio of HFs through the risk and return characteristics within an improved estimator of the covariance structure of HF index return	The mean-variance approach	1- Strongly indicates that optimal inclusion of HFs in an investor portfolio can potentially generate a dramatic decrease in the portfolio volatility 2- Differences in mean returns are not statistically significant suggesting that improvements in terms of risk control does not necessarily come at the cost of lower expected returns	CSFB/Tremont HF indices	NA	1994- 2000
Terhaar et al. (2003)	Evaluate the portfolio policy allocation of HFs within time and liquidity constraints	The mean-variance approach	The longer the investor's horizon and the lower the need for liquidity, the greater will be the allocation to the illiquid alternative investments	NA	NA	NA
Alexander and Dimitriu (2004)	Developing a portfolio construction model specifically designed for fund of hedge funds incorporating specific controls for operational limitations, data bias, and incompleteness	The mean-variance approach	Fund selection method based on factor models' alpha estimates greatly improves the performance of HF portfolios optimized to have minimum variance.	HFR	282	Jan. 1990- May 2003
Davies et al. (2009)	How to allocate capital across different hedge fund strategies and traditional asset classes while incorporating investors' preference within a 4 moments framework (Mean-Variance-Skewness-Kurtosis)	Polynomial goal programming optimization function (PGP)	1- Emphasizes the importance of constructing 'like for like' representative portfolios that reflect the investment opportunities available to different-sized funds 2- Highlights the importance of equity market neutral funds as volatility and kurtosis reducers and of global macro funds as portfolio skewness enhancers.	TASS	348	Jun.1994- May 2001
Popova et al. (2006)	Examine the effects of semi-variance, conditional third and fourth moments on portfolio allocations to HFs	Higher moment analysis/ Stochastic programming models	Substantial allocation to HFs is justified even with consideration for the highly unusual kurtosis and skewness	CISDM	Top 50 funds in the sample	1994- 2003

	In general, evaluate and identify the optimally constructed portfolio					
Giamouridis and Vrontos (2007)	1- Models comparison in terms of selecting the optimal portfolio of HFs	Dynamic specification for the covariance parameters	1.. Switching dynamic correlation model (RSCM) ranks first in term of reducing portfolio risk, improving the out-of-sample risk-adjusted realized returns, and achieving the lowest CVaR among the alternative covariance models	HFR index	NA	Jan. 1990-Aug. 2005
		Variance and covariance Framework/ RSCM, GARCH	2. The full factor multivariate GARCH model ranks second with significant differences. The implicit factor GARCH, the implicit factor, and sample covariance model rank third, fourth, and fifth, respectively.			
Adam et al. (2008)	The use of risk measurements to construct optimal portfolios under risk constraints	Risk measures within Asset Management Approach	1- Optimal portfolios chosen with respect to the choice of risk measures show that risk measures that emphasize large losses lead to slightly more diversified portfolios	In line with Chabaane et al. (2006)	16	Jan. 1990-July 2001
			2- Risk measures that account primarily for worst case scenarios overweight funds with smaller tails which mitigate the relevance of diversification			
Rockafellar et al. (2006)	Propose generalized measures of deviation instead of standard deviation to cope with the uncertainty in attaining rates of return beyond the risk-free rate	Discrete distributions along with continuous disturbing	1- Conditional value-at-risk measure is an example of such a measure and can reflect the different attitudes of different classes of investors	NA	NA	NA
			2- The utilized approach can be applied to portfolios involving derivatives, as well as to financial models involving a finite number of scenarios.			

Table 5- The literature on HFs' Flexible Trading Strategies (Derivatives and Leverage)

Name	Objective	Modelling/ Framework	Findings	Database	Sample	Period
1-Derivatives						
Chen (2011)	The General aim is to empirically examine the use of derivatives on the risk taking and performance on hedge fund industry			TASS, 13F filings, and TASS notes	4376	1994- 2006
	1- Studies the relationship between derivatives use and various fund characteristics	Regression Analysis	1- Derivatives are more likely to be used by funds imposing higher incentive fees, have less redemption restrictions, have managers' personal money invested, and employ effective auditing.			
	2- Examines the link between derivatives use and HFs risk taking profile	Regression Analysis	2- Using derivatives is motivated by risk-management concerns which imply that derivatives use is associated with lower risk			
			Empirically there is a significant negative relationship between derivatives use and fund risks represented by return volatility, market risk, downside risk, and extreme event risk			
			No significant relationship between fund performance based on net-of-fee return and derivatives users and non-users			
	3- Investigate whether derivative users have different tendency to shift fund risk	Regression Analysis	Derivative users engage less in risk shifting practice than non-derivatives' users funds			
	4- The effect of derivatives' users on hedge funds high failure risk	Hazard model methodology	Strong evidence that derivative use leads to lower systematic risk especially with lower downside/event risk. Therefore, they mitigate the unfavourable influence of severe market conditions on fund operations.			
			Derivatives use reflects fund managers' risk-management efforts due to career concerns and reputation costs.			
	5- Tests whether investors are able to differentiate between derivatives users and non-users	Regression Analysis	5- Derivatives use has little influence on the fund flow-performance relation			

2-Leverage – The literature on the leverage of HFs						
Ang et al. (2011)	Investigate the determinants of hedge funds' leverage using actual leverage ratios	Time series analysis	1- Fund leverage is fairly modest with an average gross leverage (including long and short positions) of (2.1) 2- HF leverage is countercyclical since it decreases prior to the start of the financial crisis in mid-2007, whereas a continuous increase occurred in the finance and investment banks sector 3- Changes in HF leverage tend to be more predictable by economy-wide factors than by fund-specific characteristics	* TASS, CISDM, Barclay, and Private funds	208 funds of hedge funds	Dec.2004- Oct. 2009
Schneeweis et al. (2005)	Empirically investigate the relationship between hedge funds leverage and their risk-return relation	Correlation and Regression Analysis	1- On a strategy level, a systemic relationship between leverage and standard deviation exist. However, it is not a positive relationship which indicates that strategies with lower volatility generally have higher leverage. 2- On a fund level, little evidence is reported of a systematic relationship between the use of leverage and the level of risk-adjusted performance.	CISDM and TASS	NA	Jan.2000- Mar.2003
McGuire and Tsatsaronis (2008)	Provide an indirect method to estimate the average amount of the hedge fund leverage	An extension of regression-based style analysis with time-varying betas	The creation of an approach that estimates the leverage for several HF families, in particular, those whose returns are well captured by the risk factors used in the estimation	HFR	NA	Jan.1996- Jun. 2007

Table 6-The main articles investigating the persistency in the HF performance.

Name	Objective	Modelling/ Framework	Findings	Database	Sample	Period
Brown et al. (1999)	Investigate the annual return persistency for offshore HFs	Year by year cross-sectional regression	No evidence of annual return persistency, no persistent winners or losers with either style adjusted fund returns or raw fund returns	Data provided by A. Bernheim	from 78 Funds in 1989 to 399 Funds in 1995	1989- 1995
Agarwal and Naik (2000)	1- Compare the performance persistence in two-period and multiple period frameworks	Regression-based (parametric) and contingency-based (non-parametric)	1- The level of persistence in multi-periods is considerably smaller than that observed under the two-period framework, with no persistency at the yearly return level in the multi-period framework	HFR	746 (with quarterly return), 716 (with half-yearly return), and 586 (with yearly return)	Jan. 1982 - Dec. 1998
	2- Examine the sensitivity of persistence to the length of return measurement intervals	Regression-based (parametric) and contingency based (non-parametric)	2- Maximum persistence at quarterly horizons (short-term persistence), whereas it decreases when moving to yearly horizons.			
Edward and Caglayan (2001)	Study the persistence in performance among winning and losing funds	Parametric and non-parametric approach	Find evidence of performance persistence over one-year and two-year horizons among both winners and losers	MAR/Hedge	1458	Jan. 1990- Aug. 1998
Bares et al. (2003)	1- Analyze performance persistence over short and long-term horizons	Non-parametric method: Forming two groups of 5 portfolios containing the best and worst managers over (1 to 36) months	1- Significant short-term persistence (1 to 3 months) with vanishing persistence over the long horizon.	FRM	4934	Jan. 1992- Dec. 2000
	2- Analyze the risk-adjusted performance persistence in the long-term (36 months) funds	APT (Arbitrage pricing theory) model	2- A slight over-reaction at the long-term horizon/ long-term investors should be cautious about relying on past performance measures while making a long-term investment in a specific HF.			
Baquero et al. (2005)	Analyze performance persistence taking into account the look-ahead bias	Model liquidation of HFs and analyze how it depends on historical performance after eliminating look-ahead bias	Performance persists over the quarterly horizon and decreases over the yearly horizon.	TASS	1797	1994- 2000
Boyson and Cooper (2004)	1- Test HF performance persistence over short and long horizons	Multi-factor model to control for risk factors	1- No persistence over both short and long horizons.	TASS	1659 (Quarterly), 1503 (Half-yearly), and 982 (Yearly)	Jan. 1994- Dec. 2000

	2- Designing a test to measure the persistence by HF managers' tenure	Multi-factor model to control for risk factors	2- Over quarterly time horizon, young managers (good ones) outperform old managers (bad ones) by 9% a year.			
Koh et al. (2003)	Study Asian HFs' performance persistence	Simple factor model: A contingency method of winners and losers / Then apply a Multi-factor model	Strong evidence of persistence at monthly and quarterly horizons, with a considerable decrease over a period beyond a quarter.	Asian Hedge and Eureka Hedge	417	Jan. 1999-Mar. 2003
Kat and Menexe (2002)	Study the persistence and predictability of several statistical parameters of individual hedge fund returns	Risk-Return measurement analysis (e.g. Mean, SD) and Regression Analysis	Strong persistence in the standard deviation of the hedge funds but little evidence of persistence in mean returns.	TASS	338	Jan. 1994-May 2001
Capocci (2009)	Analyze HF performance persistency after decomposing HF returns	10-14 Multi-factor models including Option factors model of Agarwal and Naik (2004)	Finds a consistent way to create pure alpha using simple classification tools: risk-return trade-off measures (the Sharpe score), pure volatility measure (the standard deviation) and the beta exposure in order to detect persistency in the returns.	MAR/CISDM, HFR, TASS, and Barclays	3060 Funds and 903 Funds of Hedge Funds	Jan. 1994-Dec. 2002
Abdou and Nasereddin (2011)	1- Investigate the persistence of some strategies during different economic time periods	Divide the sample into three sub-samples then use the Support Vector Mechanism (SVM)	1- HF strategies are not persistent in the determination of returns. Moreover, only the returns of emerging market strategy were persistent during the recession.	CISDM	Varies according to each month	Mar.2000-Dec. 2005
	2- Compare different mechanisms to test the returns prediction accuracy	Support Vector Mechanism (SVM), Neural Network (NN), and Ordinary Least Square (OLS)	2- SVM has better prediction accuracy than NN and OLS.			
Tudor and Cao (2012)	Examine the ability of HFs and funds of funds to generate a consistent absolute return over time	Bayesian multinomial probit and regular multinomial logit model	No evidence for performance persistence in terms of absolute return, after accounting for fund strategies and fund characteristics.	CISDM	2460 Funds and 1106 FoHF	Jan. 1985-Apr. 2009
Cumming et al. (2012)	Test the effect of financial regulation on performance persistence	Multivariate tests (Regression models)	Evidence of three types of regulation influencing performance persistence: (1) minimum capital restrictions, (2) restrictions on the location of key service providers, (3) distribution channels.	CISDM	2073 (3-year alpha) and 4038 (1-year alpha)	Jan. 1994-Dec. 2008

Table 7- The main articles on HF managerial characteristics (Career concern and manager' talents and Managerial timing ability).

Name	Objective	Modelling/ Framework	Major Findings	Database	Sample	Period
1-Career concern and managers' talents						
Boyson (2005)	Studies the effect of career concerns on managerial behaviour and how they might affect the performance of HFs	Regression analysis	An additional year of experience leads to less risk taking behaviour and therefore generating returns around 0.8%.lower	TASS	2275	Jan. 1994-Dec. 2004
Agarwal and Jorion (2010)	Analyze the effect of managerial age on the performance of emerging hedge funds	Regression analysis	Emerging funds and managers, during their first two years of existence, are able to generate an abnormal performance of 2.3% relative to that in later years.	TASS	Varies according to each year	Jan. 1996-Dec. 2006
Li et al. (2011)	An empirical analysis of the impact of manager characteristics on hedge fund performance	Regression analysis	1- Managers from higher SAT undergraduate institutions tend to have higher raw and risk-adjusted returns, more inflows, and take fewer risks. 2- Some weaker evidence states that more established managers tend to have lower returns and take less risk.	TASS	More than 4000	1994-2003
2-Managerial Timing Ability						
Fung et al. (2002)	Examines the market timing ability of global equity HFs	CAPM and (Henriksson and Merton 1981) model	HFs' managers do not demonstrate any market timing ability but do show security-selection ability.	MAR	115 global equity HFs	1994-2000
Aragon (2003)	Derives an equilibrium value of market timers' forecasting ability in funds of hedge funds to get a steady and reliable estimation of the managers' ability to time multiple markets	Extending (Merton 1981) model to multiple risk factors	For both individual and aggregate FoHF, managers do not have the ability to time the market for different investment style.	TASS	299 FoHF	1994-2002
Chen (2004)	Examine the timing ability of HFs covering various investment categories	Extends the Treynor and Mazuy (1966) and Merton (1981) models to multiple market frameworks, Then proposes the concept of focus markets	Evidence of successful market timing at both the individual and style levels.	TASS and HFR	1471 Funds from TASS without fund of hedge funds	Jan. 1994-June 2002
Cai and Liang (2012)	Examine the existence of timing skills among HF managers	Dynamic linear regression model	Find significant timing skills for liquidity timing, market timing, and volatility timing.	TASS	3102 (1590 live, 1512 defunct)	Jan. 1994-Dec. 2008

Cao et al. (2012)	1- Investigate managerial ability to time market liquidity	Extend the Treynor and Mazuy (1966) model	1- Find strong evidence of liquidity timing ability. 2- HF managers increase (decrease) their market exposure when equity market liquidity is high (low). 3- Liquidity timing ability of top managers cannot be attributed only to luck.	TASS	5298	1994-2009
	2- Study the persistency over time of managerial timing skill	Out of sample test	2- Liquidity timing ability persists over time.			
Chen and Liang (2007)	Examine whether market timing hedge funds have the ability to time the US equity market at both market level and volatility level	Based on the classical models of (Jensen 1972) and (Admati and Bhattacharya 1986)	Evidence of strong timing ability especially during bear markets or when the market is more volatile.	CISDM, TASS, and HFR	221 Market Timing Funds	1994-2005

* Notes: TASS: Lipper TASS, HFR: Hedge fund research, FRM: Financial Risk Management hedge fund database, MAR/Hedge: Managed Accounting Reports (Recently known as Zurich HF Universe), LaPorte Asset Allocation system, ZCM: Zurich Capital Markets.