Geography, liquidity and fund performance: New evidence from UCITS hedge funds *

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Abstract

This paper contributes to the literature on the effect of liquidity and geography on performance by documenting the effect of geographically disparate hedge fund regulation on fund performance. Based on regulatory constraints, such as share restrictions and risk limits, which differ by country, we economically motivate and test a range of hypotheses regarding differences in performance and risk between UCITS compliant (Absolute Return UCITS (ARUs)) and other hedge funds. The UCITS fund universe is economically important with assets of over $8 trillion. We uncover a strong performance-liquidity tradeoff. Although ARUs underperform other hedge funds on average, this performance difference disappears when we compare subsets of the two groups that have the same liquidity or share restrictions. Hedge funds exhibit lower volatility and tail risk than ARUs on average which is consistent with obstacles to the transportation of hedge fund risk management techniques to ARUs. We find that geography and domicile have a significant effect on fund performance and risk. Finally, we find that there are limits to the ability of investors to exploit the superior liquidity of ARUs through portfolio rebalancing since they exhibit lower performance persistence.

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1. Introduction

The effect of liquidity and geography on performance is an important research topic that has been extensively studied in the financial economics literature.[1] There is evidence of liquidity premia in a range of asset classes and geographical factors playing a role in explaining fund and analyst performance. Despite calls by the G20 in 2009 for coordinated international financial regulation following the recent 2007-2008 financial crisis, financial regulation around the world has been geographically disparate. Regulatory responses in the area of alternative investment funds, in the form of the Dodd-Frank Act in the US and the AIFMD[2] in the EU, for example, also show significant geographic differences regarding liquidity requirements, remuneration rules and risk limits. These differences are likely to have welfare impacts in the form performance and risk difference between alternative investment funds, which are held by pension funds, sovereign wealth funds and other investors. UCITS[3] is one particular type of EU investment fund regulation that has global implications and leads to testable restrictions regarding the effect of liquidity and geography on fund performance. We use UCITS restrictions on hedge funds as a natural test bed to motivate and test a range of hypothesis related to hedge fund performance.

The UCITS funds universe is economically important. UCITS funds' AuM (Assets under Management) are around $8trillion which is comparable to that of the US mutual fund industry of $11.6 trillion.[4] UCITS funds account for more than half of fund assets worldwide outside of the US and 70-80 percent of funds publicly sold in Asia are UCITS funds.[5] Many investors and managers in the US, the largest financial market in the world may not have heard yet about UCITS, but it turns out that it is relevant even for non-European investors and managers. UCITS funds can be established by fund management companies inside or outside the EU and can be marketed to investors inside and outside the EU (including Switzerland, Singapore, Chile, South Africa, Taiwan and Hong Kong, for example).

From the supply side the UCITS directive matters since it allows alternative investment fund managers, including those based in the US, to create UCITS compliant hedge funds

[1] See, Coval and Moskowitz (2001), Hau (2001), Malloy (2005), Ivkovic and Weisbenner (2005), Teo (2008), Aragon, Liang and Park (2013), for example, for recent studies on the role of geography and Aragon (2007) and Teo (2011) for recent work on the role of liquidity on asset price performance.
[2] The objective of the AIFMD is to create a comprehensive and secure framework for the supervision and prudential oversight of alternative investment fund managers (AIFM) in the EU.
[3] UCITS (Undertakings for Investment in Transferable Securities) refers to the European harmonized regulated fund product which can be sold on a cross border basis within the European Union ("EU") based on its authorization in one EU member state. Appendix A provides further details about UCITS.
[4] See ICI(2012) factbook and http://www.efama.org.
[5] See 'UCITS Guide for Alternative Managers', Carne Group, 30 June 2012.

domiciled in the EU in order to access the UCITS investor base. Paulson & Co, perhaps one of the most famous hedge fund in the US, launched a UCITS version of its flagship offshore hedge fund with Deutsche Bank in 2010.[6] In 2012 NCB Capital launched the first Sharia-compliant UCITS fund domiciled that invests in Saudi Arabia and the Gulf Co-operation Council region.[7]

From the demand size, the UCITS market is important since it allows UCITS compliant funds to access a fast investor base in Europe and beyond. UCITS funds can be marketed in countries such as Hong Kong, Singapore, Taiwan, Chile and Switzerland, for example.[8]

However, the UCITS directive imposes restrictions on alternative investment fund (AIF) managers that, in some respects, are more stringent than those imposed by US regulation on AIF managers regulated by the SEC. This implies that UCITS compliant hedge funds may exhibit performance and risk that differs from that of other hedge funds. We gather data on UCITS-compliant hedge funds, also known as absolute return UCITS, and compare them to a large global hedge fund database.[9] We abbreviate UCITS compliant hedge funds as absolute return UCITS (ARUs) to distinguish them from other non-UCITS hedge funds (HFs).[10] Although the size of the ARU universe stands at $159 billion or about 10 percent of the $1,610 billion global hedge fund assets, the number of ARU funds has growth 700 percent since 2003.

We document four major findings. First, we uncover a strong performance-liquidity tradeoff. Although UCITS-compliant hedge funds underperform other hedge funds on average, when we compare liquidity (i.e. share restriction) matched subsets of the two groups of funds we find that the performance of the two groups converges. Our results show that hedge funds generally exhibit lower volatility and tail risk than UCITS-compliant funds which is consistent with hurdles to the transportation of hedge fund techniques to the UCITS universe. Third we find that geography and domicile has welcome implications and affects fund performance and risk. Finally we find that there are limits to the ability of investors to exploit the superior liquidity of ARUs since they exhibit lower performance persistence than certain HFs.

Our findings raise questions about the resulting welfare implications and the acceptable liquidity-performance trade-off. Moreover, UCITS and ARUs are likely to attract researchers'

[6] 'Investment management: Europe's changing face' by Sam Jones, Financial Times, 10 May 2012.
[7] 'First Saudi Ucits fund to open in Dublin', by Sophia Grene, Financial Times, 2 December 2012.
[8] The latest amendment of the UCITS framework, referred to as UCITS V, allows mainstream fund managers to supply regulated forms of hedge fund-type products to their traditional customer base, while also permitting hedge funds to reach out to the same customers.
[9] ARUs are funds that follow a hedge fund type strategy aiming to generate absolute return or absolute performance. They are, in other words, simply UCITS that take advantage of certain investment techniques allowed by the UCITS regulations which enable them to pursue strategies that were previously more common in the alternative investment sector – in particular, the hedge fund sector.
[10] UCITS compliant hedge fund strategies are sometimes referred to as or Newcits or 'absolute' UCITS in the media.

attention in the future for two further reasons. On the positive side, UCITS funds are exempted from the AIFM directive which comes into effect in 2013 and imposes new compliance rules on EU and non-EU AIF managers, such as New York based hedge fund management companies. On the negative side, there are attempts by the EU to impose remuneration caps on managers of UCITS funds including UCITS hedge funds.

According to a recent Financial Times Article, '*US fund groups have rapidly expanded into Ucits funds in recent years as a way of accessing both the European and Asian markets. More than 1,000 such funds, with assets of €765bn, are now domiciled in Ireland alone, …,However "the US managers that have set up Ucits funds are extremely exercised" about proposals from the European Parliament's economic and monetary affairs committee to limit asset managers' bonuses to 100 per cent of their salary'.* [11]

Alternative investment fund managers are increasingly deciding to implement alternative strategies through traditional investment vehicles such as mutual funds in order to access assets from retail and institutional investors that, for various reasons (such as investment mandates, for example), cannot invest through less regulated structures. Packaging hedge fund strategies in a traditional format is not straightforward, however, and it raises a lot of challenges for the managers as well as for the brand of the regulatory format.[12] An important question is to know whether structuring hedge fund strategies through mutual funds will compromise these strategies and provide the same level of returns, considering the constraints under mutual fund regulations such as investment restrictions, liquidity requirements, operational requirements and risk management.

ARUs differ from other hedge funds in several ways which leads to testable hypotheses about differences in their performance and risk. First, the requirement of a (i) separate risk management function in UCITS funds as well as (ii) leverage limits and (iii) VaR (Value-at-Risk) limits leads to our first hypothesis that the risk of ARUs is lower than that of HFs. Measuring risk is a complex issue and therefore we apply a range of different risk metrics to capture tail-risk in addition to volatility (Patton (2009)). Second, UCITS funds face restrictions regarding the use of derivatives. This leads to two further hypotheses. Our second hypothesis is that restrictions in the use of derivatives reduce option-like payoff profiles and non-normal returns in ARU return distributions. Our third hypothesis is that reduced flexibility in the use of derivatives makes ARU returns less counter-cyclical than those of HFs. A fourth hypothesis is that the investment

[11] 'EU pay cap a concern for US funds', by Steve Johnson, *Financial Times*, March 24, 2013.
[12] Hedge funds have an absolute return objective, i.e. achieving returns uncorrelated with the market (Ineichen (2002)). The absolute return objective implies that risk reduction techniques such as long-short strategies and derivatives positions are used to reduce benchmark exposures.

objective is crucial and that the extent to which UCITS restrictions affect risk and performance depends on the investment objective of the fund. We therefore carry out our hypotheses tests for all funds as well as by investment objective. Our fifth hypothesis is related to the fact that different countries have implemented the UCITS directive in different ways, which implies that geography and in particular domicile matters for ARUs. Regulatory requirements that apply to UCITS imply that ARUs impose less binding share restrictions than HFs. Liquidity is linked to fund performance in at least two important ways. First, liquidity, in terms of less binding redemption restrictions for ARUs investors, may allow them to exploit performance persistence. The ARU universe provides an interesting setting to test whether performance persists and whether it can be exploited in practice. On the other hand, Teo (2011) provides evidence that capital outflows can be costly if HFs are exposed to liquidity risk. This suggests that liquidity may be harmful in certain circumstances. Thus, it is interesting to study the role of share restrictions and liquidity risk for ARUs. Our sixth hypothesis tests whether in practice ARU investors could exploit performance persistence, if any, more easily than HF investors.

Related Literature. Our paper is related to three streams of the literature. First, our work is related to the literature on geography and asset prices. Coval and Moskowitz (2001) report evidence that investors possess significant informational advantages in evaluating nearby investments. Malloy (2005) finds that geographically proximate analysts are more accurate than other analysts. Teo (2008) analyzes the relationship between the risk-adjusted performance of hedge funds and their proximity to investments using data on Asian-focused hedge funds. Aragon, Liang and Park (2013) exploit regulatory differences between onshore and US-domiciled ("onshore") funds to test predictions about organizational design, investment strategy, capital flows, and fund performance.

Second our work is related to numerous studies on the effect of liquidity on asset prices and fund performance. Amihud, Mendelson and Pedersen (2005) review theories of how liquidity affects the returns of capital assets, and empirical studies which find the effects of liquidity on asset prices to be statistically significant and economically important. The literature on cross-sectional performance differences among hedge funds shows that funds with stricter share restrictions (e.g., Aragon (2007)), less binding capacity constraints (e.g., Teo (2010)) and greater managerial incentives (e.g. Agarwal, Daniel, and Naik (2009), Aggarwal and Jorion (2010)), on average, outperform their peers on a risk-adjusted basis. On the relationship between liquidity and hedge fund performance, Aragon (2007) argues that share restrictions allow hedge funds to manage illiquid assets and earn an illiquidity premium. Teo (2011) examines hedge funds that

grant favorable redemption terms to investors. He finds that hedge funds that are exposed to liquidity risk, but not shielded by strict share restrictions, underperform during times of financial distress due to costly capital outflows. Getmansky, Lo and Makarov (2004) explore several sources of hedge fund return serial correlation and show that the most likely explanation is illiquidity exposure.

Third, our paper is related to recent work on 'hedged mutual funds' in the US as well as studies on UCITS-compliant hedge funds or ARUs. Agarwal, Boyson and Naik (2009) study 'hedged mutual funds' which they define as mutual funds regulated by the SEC but employing hedge fund like strategies. They study 49 hedged mutual funds and find that despite using similar trading strategies, hedged mutual funds underperform hedge funds, but outperform traditional mutual funds. In contrast to hedged mutual funds studied by Agarwal, Boyson and Naik (2009), the ARUs that we study in our paper do currently not have restrictions on incentive structures. Our research is also related to that of Koski and Ponti (1999) and Almazan *et al*. (2004) who investigate the differences in performance of mutual funds that use derivatives and mutual funds that do not.

In one of the more recent studies of UCITS funds, Darolles (2011) examines alternative UCITS funds. Similar to Agarwal, Boyson and Naik (2009) he finds that hedge fund experience counts when managing ARUs. Darolles (2011) studies 450 alternative UCITS funds in the Morningstar data from June 2004 to May 2011 and compares them to 2782 hedge funds. Our work is more comprehensive in scope since we test a significantly wider range of hypotheses and on a data set that is also larger in terms of number of funds and sample period. Our database covers the period 2003 to 2012 and consists of more than 780 ARUs and 23,000 hedge funds.[13] In contrast to Darolles (2011) we examine a wider range of investment objectives, performance and risk metrics, and cross-sectional fund features.[14]

In another study on ARUs, Stefanini *et al*. (2010), find that, on average, ARUs underperform by 3.50%. Stefanini *et al*. (2010) employ a tracking error approach to compare performance of offshore traditional hedge fund and the corresponding onshore UCITS version. Other studies examine UCITS using smaller databases. Tuchschmid *et al*. (2010) examine 191 Alternative UCITS funds using the Alix UCITS Alternative Index database. Pascalau (2011) uses a sample of 66 USD share class UCITS from the BarclayHedge database. Tuchschmid *et al*.

[13] The number of hedge funds in our database is close to that reported by the UBS' proprietary AIS database consisting of about 20,000 hedge funds and 45,000 share classes , while the PerTrac 2010 hedge fund database study finds that the hedge fund industry contains about 23,600 funds.

[14] Darolles (2011) examines the relationship between current performance as well as past performance, fund age, and a year dummy. The risk-adjustment by Darolles (2011) does not take into account non-linearities captured by the Fung and Hsieh (2004) model.

(2010) and Pascalau (2011) both use the Fung and Hsieh (2004) model to calculate risk adjusted return performance.

Our paper sheds light on the convergence of mainstream and alternative investment management as well as drivers of performance and risk for different types of UCITS funds. This study is timely since UCITS funds, and in particular the so-called retailization of complex products and the use of total return swaps, recently attracted the attention of regulators in 2012.[15]

The paper is structured as follows. Section 2 reviews the regulatory restrictions imposed on UCITS funds and motivates the resulting testable hypotheses. Section 3 describes the HF and ARU data and methodology. Section 4 summarizes the empirical results on differences in performance and risk between HFs and ARUs. Section 6 reports results on performance persistence to answer whether investors could in practice exploit the superior liquidity of ARUs. Section 7 concludes.

2. UCITS Restrictions and Testable Hypotheses

There is some misunderstanding in the literature on UCITS funds since they are sometimes viewed as a 'regulated version of hedge funds' or a 'deregulated version' of classic mutual funds. In fact both mutual funds and hedge funds are regulated. Therefore, it is more accurate to view the UCITS fund structure as imposing additional constrains on hedge funds while allowing more flexibility for mutual funds.[16]

The UCITS directive was implemented by the EU in 1985 with the aim of facilitating cross-border marketing of investment funds and maintaining a high level of investor protection. The directive was aimed at regulating the organization and oversight of UCITS funds and imposed constraints concerning diversification, liquidity, and use of leverage. The rules are implemented slightly differently country by country.

The characteristics of UCITS funds lead to several testable implications. First, UCITS funds are subject to leverage and VaR restrictions and also require a separate risk management function. From a theoretical point of view, investment and risk restrictions may prevent managers from risk shifting, that is strategically changing portfolio volatility, to maximize the

[15] See, for example, ESMA's guidelines on ETFs and other UCITS issues, available at http://www.esma.europa.eu/system/files/2012-44_0.pdf .

[16] Note that the hedge fund manager is typically regulated (and to a lesser extent the offshore hedge fund), but both the UCITS fund and the UCITS management company are regulated.

value of their implicit incentive contracts and fees (Buraschi, Kosowski and Sritrakul (2012)). This can be expected to reduce the ex post risk of ARUs. We therefore test the hypothesis (Hypothesis 1a) whether the volatility of ARUs is lower than that of HFs for the same investment objective. EU countries have some leeway in the implementation of the risk management requirements on value at risk (VaR) of the UCITS directive (Tuchschmid *et al*. (2010)). Countries differentiate two approaches to acceptable VaR levels for UCITS in the form of (i) relative VaR and (ii) absolute VaR. Relative VaR is based on a suitable reference index and under this approach, the VaR of a UCITS fund may not exceed twice the level of VaR of the reference index. The absolute VaR approach is used if a reference index does not exist. In this case, the VaR of the UCITS fund may not exceed a specific absolute percentage of the net asset value.[17] The regulatory requirements imply testable restrictions. Therefore we extend our first hypothesis and examine whether the relationship between the risk of HFs and ARUs is dependent on the country of origin of the fund (*Hypothesis 1b*).[18]

Second, restrictions regarding the investment opportunity set may imply that ARUs cannot use derivatives to the same extent as HFs. Since there is evidence that derivatives and dynamic trading strategies can lead to non-normal return profiles we test the hypothesis whether ARUs have less non-normal returns (*Hypothesis 2a*) and lower tail risk, defined as maximum drawdown as well as CVaR than HFs (*Hypothesis 2b*). The instruments used by hedge funds depend on their investment objective and therefore we condition each of our tests on the type of investment objective followed by the funds. The distribution properties of ARUs and HFs are also likely to be affected by the liquidity of the underlying assets. Concentrated portfolios of illiquid assets, for example, may lead for example lead to higher autocorrelation in returns. The Ucits directives contains a range of rules concerning concentration and counterparty risk. These rules, in contrast to VaR requirements discussed above, are in general the same in regulatory implementations across EU countries. The exposure to any security or money market instruments by the same issuer, for example, may not exceed 10% of NAV, and in combination with derivatives it may not exceed 20% of NAV (Tuchschmid et al. (2010)). Another example of such regulatory constrains is the in the form of special rules that apply to securities or money market instruments which are issued or guaranteed by a member state of the EU where the maximum exposure is 35% of NAV. As *Hypothesis 2c*, we test the hypothesis that ARUs returns exhibit lower autocorrelation than HFs as a result of restrictions on the ability to hold concentrated

[17] According to Tuchschmid et al. (2010), most jurisdictions have ruled that the 99% monthly VaR may not exceed 20% of NAV.

[18] In the appendix to this paper we provide further detail on UCITS restrictions and how they vary by country.

portfolios of potentially illiquid securities.

Third, restrictions on the use of derivatives can also limit the ability to hedge against market downturns and this leads us to test the hypothesis whether the returns of ARUs are less counter-cyclical than that of HFs (*Hypothesis 3*). We use exposures to commons risk factors, such as market beta, to measure how cyclical hedge fund returns are.

Fourth we examine whether cross-sectional fund characteristics are related to ARUs performance. We add to the existing literature by focusing on the impact of investment objectives, trading instruments, and share restrictions. Agarwal, Daniel and Naik (2009) and Darolles (2011) find that experience is positively related to performance. As the above summary shows that not only do ARU investment restrictions differ from those faced by HFs but ARU investment restrictions also differ by country.

We examine how share restrictions in terms of notice, lockup and redemption periods explain cross-section of ARUs performance. Since Teo (2011) shows that HFs granting favourable redemption possibilities for investors, but taking liquidity risk is harmless for investors, it is interesting to examine whether this is an issues for ARUs. Indeed, Tuchschmid *et al*. (2010) summarize issues related to liquidity risk and valuation in following way: *'Ucits funds are required to consider liquidity risk [...] when investing in any financial instrument. In practice, this means that they are advised to consider factors such as the bid-ask spread and the quality of the secondary market. They are specifically required to be able to allow 20% of NAV to be redeemed at any point. Ucits funds are required to value their investments at least twice a month. Illiquid instrument are allowed to be held (up to 10% of NAV) as long as the fund is able to meet foreseeable redemption requests. Liquidity should be offered to clients at least twice a month.'*

Hypothesis 4a is related to the effect of liquidity or share restrictions and tests whether less liquid funds (as captured by notice and redemption period) have higher performance. *Hypothesis 4b* examines the effect of differences in remuneration and tests whether funds with higher incentive fees generate higher performance even after accounting for UCITS and liquidity differences.

Hypothesis 5 is based on the fact that we have information on the domicile of the fund which leads to additional testable restrictions regarding the performance of different funds. We therefore test whether fund domiciles within Europe as well as globally has an effect on fund performance and risk.

As we note above, one of several major differences between ARUs and HFs relates to fund liquidity. Apart of the effect on fund performance these differences in liquidity also raise the question of whether investors can exploit the superior liquidity in practice, by, for example

regularly rebalancing their portfolio of funds. In particular as part of *Hypothesis 6a* we examine whether there is evidence of differences in performance persistence. We test the hypothesis that HFs exhibit more pronounced performance persistence than ARUs since the later have more cyclical returns than the former. The performance persistence of HFs may also be driven by the fact that HFs with more stringent share restrictions can pick up a liquidity premium and generate consistent alpha and therefore performance persistence. Finally as part of *Hypothesis 6b* we examine whether evidence of performance persistence changes for HF and ARU once liquidity is taken into account.

3. Data and Methodology

3.1 Absolute Return UCITS (ARU) and Hedge Fund database

In this section, we describe the aggregate ARU and HF databases. We combine five major hedge fund databases (BarclayHedge, EurekaHedge, and Hedge Fund Research (HFR), Morningstar and TASS Lipper) to form an aggregate data set.[19] The sample period is from January 2003 to June 2012 and contains live and defunct funds with at least 12 non-missing monthly returns. We find that our consolidated database contains 786 ARUs with total AuM of around $159 billion.[20] This compares to 23,204 hedge funds in our sample with a total AuM of around $1610 billion. Our sample is very comprehensive in terms of ARU and hedge fund coverage. A leading absolute return UCITS index provider, named ALIX, reports that they follow 794 funds as of February 2013. In a February 2013 report Preqin states that 701 ARUs are in existence.[21] A recent Pertrac study found that alternative UCITS Assets under Management (AuM) peaked at €178.82 billion in May 2011.

It is not a trivial task to merge several commercial hedge fund databases and to identify unique hedge funds based on information on multiple share classes. The main reason is that commercial data vendors only provide an identifier for unique share classes, but they do not

[19] The TASS hedge fund database does not include information whether a fund is a ARU or HF. Our careful merging of the databases indicates that the TASS database contain very few ARUs. Morningstar divides its databases into a hedge fund and a mutual fund database. ARUs fund can be found within the mutual fund database.
[20] 682 of the 786 ARUs are active and only104 are defunct. Of the 23,204 HFs, 11,092 are active and 12,112 are inactive.
[21] Preqin is a leading source of data and intelligence on the alternatives industry.

provide identifiers for unique hedge funds. Using the Joenväärä, Kosowski, and Tolonen (2012) merging approach, we identify unique ARUs and HFs. Given that ARUs have their origin in the European Union we do not limit our focus to USD share classes, but also include funds that have only non-USD share classes. In those cases, we convert their returns and AuM information into USD before including them in the analysis. Our consolidated database contains monthly net-of-fees returns, AuM, and other characteristics, such as manager compensation (management fee, performance-based fee, and high-watermark provision), share restrictions (lockup period, advance notification period, and redemption frequency), domicile, currency code, style category, and inception. Following JKT (2012), we classify funds into 12 main categories: CTA, Emerging Markets, Event Driven, Global Macro, Long Only, Long/Short Equity, Market Neutral, Multi-Strategy, Relative Value, Sector and Short Bias.

Table 1 presents the aggregate AuM, number of funds, attrition rates for the HF and ARU universe at the end of December of each year. The table shows that growth has been extremely fast for the ARU universe during the sample period from January 2003 to June 2012.[22] Both aggregate AuM and number of funds have increased significantly. There are 690 ARUs, with aggregate AuM of USD 159bn at December 2011. Our consolidated database contains a significantly higher number of active HFs. There are 11,042 HFs with aggregate AuM of USD 1.6 trillion.

[Insert Table 1 here]

Table 1 shows that on average, HFs attrition rates are significantly higher compared to ARUs, but at the end of the sample the ARU's attrition rate is almost as high as that of HFs. During the period from 2003 to 2009, the ARUs attrition rate is negligible. We believe that there are two main reasons why the attrition rate is so low. First, during this period, many management companies started to offer alternative ARU funds, and therefore there are relatively few closed (or defunct) ARU funds in the database. Second, and more importantly, during the period from 2003 to 2008 the BarclayHedge, EurekaHedge, HFR and Morningstar databases have not yet started to gather information on whether a fund is UCITS compliant. This implies that if a fund moved to the graveyard module of database during that period, it has been done without an indicator

[22] We calculate aggregate hedge fund AuM figures using December observations given that month's AuM figures are considered to be more accurate for hedge funds. See, Edelmann, Fung and Hsieh (2012) for details.

variable pointing out that the fund is UCITS compliant. Later in the sample, commercial databases started to provide UCITS indicator information for active funds, but not for those funds that entered the graveyard database earlier on. In other words, commercial databases only provide comprehensive data for ARUs that survived. Therefore, the average ARU return could be biased upwards at the beginning of the sample.[23] Our results can therefore be viewed as a conservative estimate of the underperformance of ARUs on average. It is, therefore, important to examine subsamples of the data given the potential survivorship bias in the ARUs database.

3.2 Summary statistics of fund characteristics

Table 2 presents the fund size and age as well as compensation structure and share restriction variables for HFs and ARUs. Overall, we find that on average HFs' fees and share restrictions are higher compared to ARUs.

Panel A in Table 2 show that an average ARU (with a median size of $298.1 million) is larger than its average HF peer ($165.6 million). At first glance, this finding may appear counter intuitive. However, UCITS regulation imposes minimum capital requirements, while HFs' minimum size is not regulated in general. Moreover, compliance and other fixed costs associated with running a UCITS funds are likely to be higher than those of a HF which explains why there are many small HFs which may not be economically viable if they were UCITS compliant. We define the fund's age using the fund inception date reported to data vendors. We find that HFs are slightly older than ARUs, since HFs' average age is 4.4 years, but ARUs average age is only 3.0 years.

Given that the UCITS format is dominated by mutual funds, ARUs can be expected to charge fees that are lower than those of HFs and closer to those of mutual funds. Panel B in Table 2 shows that HFs' average management fee is 1.55%, which is slightly higher than that of ARUs (1.37%). HFs also charge higher performance-based fees and impose more often high-water mark provisions. Indeed, HFs' average performance based fee is 17.98% compared to ARUs' 12.47%. Performance differences between HFs and ARUs can therefore potentially be at least partly explained by the fact that ARUs charge lower performance-based fees. Both theoretical models and empirical evidence suggest that compensation structure variables are associated with managerial incentives and potentially higher gross returns. On the other hand, by construction

[23] Given the fact that UCITS hedge funds are a relatively recent development it is possible that in the early part of our sample, some funds that are now classified as UCITS hedge funds may have been non-UCITS hedge funds initially.

higher fees should also imply lower net (after-fee) returns for investors.

[Insert Table 2 here]

Panel B in Table 2 shows that HFs impose significantly tighter share restrictions compared to ARUs. By regulation ARUs need to provide at least bi-weekly liquidity to investors. Many HFs are domiciled in the US, however, and US regulation may have an impact on hedge funds' willingness to impose long lockup periods.[24] According to Panel B, 25% of HFs impose a lockup period. In addition, HFs typically allow investors monthly or quarterly redemptions with 30 days advance notice. In contrast, the majority of ARUs provide daily redemptions and *no* lockups. Thus, there are significant differences in redemption terms between HFs and ARUs.

3.3. Methodology

We evaluate performance differences between HFs and ARUs using a set of measures. To investigate whether HFs and ARU add value to the investors, we estimate the alpha or abnormal return using the commonly used Fung and Hsieh (2004) model. Specifically, we regress the net-of-fee monthly returns (in excess of risk-free rate) of a hedge fund portfolio *i* $(r_{i,t})$ against benchmark factor returns

$$r_{i,t} = \alpha_i + \sum_{k=1}^{8} \beta_{i,k} f_{k,t} + \varepsilon_{i,t}, \quad (1)$$

where these *k* factors are defined as the excess return of the S&P 500 index (*SP*), the return of the Russell 2000 index minus the return of the S&P 500 index (*SCLC*), the excess return of ten-year Treasuries (*CGS10*), the return of Moody's BAA corporate bonds minus ten-year Treasuries (*CREDSPR*), the excess returns of look-back straddles on bonds (*PTFSBD*), currencies (*PTFSFX*), and commodities (*PTFSCOM*) as well as MSCI Emerging Market index (MSEMKF). We obtain the data for three stock factors from Data Stream and for the two bond factors from the

[24] Aragon, Liang and Park (2012) and Liang and Park (2008) provide a detailed discussion about US regulation's impact on the hedge fund firm's lockup decision.

Federal Reserve Board's H.15 reports. The three primitive trend following factors are downloaded from the David Hsieh's webpage.[25]

Given that hedge fund returns tend to exhibit serial correlation (e.g., Getmansky, Lo and Makarov (2004)), we adjust alpha and beta coefficients standard errors for autocorrelation using the Newey and West (1987) approach.

To measure systematic risk exposure differences between ARUs and HFs, we follow the recent literature initiated by Bali, Brown and Caglayan (2012) and Titman and Tiu (2011). First, we decompose funds' total risk into systematic and residual risk following closely Bali, Brown and Caglayan (2012). As Equation (1) shows, the total return on fund *i* is the sum of its systematic and idiosyncratic components. Hence, the total variance of fund *i* returns can be broken down into two terms:

$$\sigma_i^2 = \sum_{k=1}^{8} \beta_{i,k}^2 \sigma_{f,k}^2 + \sigma_\varepsilon^2 , \tag{2}$$

where the first component, $\sum_{k=1}^{8} \beta_{i,k}^2 \sigma_{f,k}^2$, refers to systematic risk and the second one, σ_ε^2, denotes the idiosyncratic risk. As a second systemic risk measure[26], we calculate the R^2 with respect to systematic risk factors, where R^2 is defined as

$$R_i^2 = 1 - \frac{\sigma_\varepsilon^2}{\sigma_i^2} . \tag{3}$$

Given that it is difficult to identify benchmark factors for funds that invest in global markets across different assets, we evaluate the performance of HFs and ARUs using several alternative measures. In unreported robustness test, we include the Pastor and Stambaugh (2001) liquidity risk factor as well as the Lustig, Roussanov, and Verdelhan (2011) currency risk factor. Our main results remain unchanged after taking into account the impact of liquidity risk and currency exposure in explaining differences in HF and ARU performance.

4. Average ARU and HF performance

In this section, we first examine differences in statistical return properties and risk-adjusted performance between ARUs and HFs using the individual fund level measures. Second,

[25] We thank David Hsieh making the trend-following factors available in his webpage.
[26] Titman and Tiu (2011)'s model suggests that skilled managers choose to hedge away systemic risks and therefore they should have a lower R^2 with respect to systematic risk factors.

we investigate how average HF and ARU performance differs using equal- and value weight portfolios.

4.1 Individual Fund Level Performance

We examine differences in HFs and ARUs return and risk characteristics using the individual fund level measures. To test *Hypothesis 1* described in Section 2, we estimate standard performance and risk measures for each individual fund having at least 24 monthly return observations over the sample period from January 2005 to June 2012. We then take the cross-sectional median within each fund category reported in Tables 3 and 4.[27] We perform univariate mean difference tests between HFs and ARUs to investigate whether return and risk characteristics of HFs and ARUs differ statistically.

Table 3 shows that HFs outperform ARUs in terms of standard performance and risk measures across investment strategies. Indeed, the cross-sectional means and Sharpe ratios are consistently higher for HFs compared to those obtained for ARUs. Lower average standard deviations for HFs suggest that HFs' higher risk level do not explain their superior performance. Our results therefore reject the hypothesis that ARUs have lower risk than HFs. It is plausible that restrictions on the use of derivatives and other impediments to the implementation of hedge fund-like strategies may lead to ARUs lower performance and higher volatility.

According to Table 3, a larger proportion of HFs than ARU funds exhibit normal distributions and autocorrelated returns. Panel A in Table 3 shows results for all of the funds, while Panel B presents the results across investment objectives. The main conclusion of results remain consistent across investment objectives. This suggests that performance differences between ARU and hedge funds are not investment objective specific and points to more fundamental differences between the two groups.

[Insert Table 3 here]

Based on the Jarque-Bera normality test, we find that 45% of hedge funds exhibit normally distributed returns, while a considerable higher proportion of ARUs tend to follow normal distribution, namely 64%. The finding is mainly driven by the difference in kurtosis and not skewness. HFs median kurtosis is 1.39, but it is only 0.64 for ARUs. The difference is also statistically significant. Our results reject *Hypothesis 2a* that ARUs have less non-normal returns.

[27] We find similar results using the cross-sectional averages. To save space, we only report medians.

Panel B of Table 3 reports results across investment objectives. We can observe that conclusions about the superior average performance of HFs remain consistent across investment objectives. However, in terms of proportion of funds having Gaussian return distribution, Long Only HFs and ARUs exhibit a interesting convergence in terms of risk and performance. This may be due to the fact that in this investment style impediments to the implementation of hedge fund like strategies play a smaller role since hedge funds in this group are less likely to use derivatives and other dynamic trading strategies.[28] In addition, empirical tail risk measured using the Conditional Value-at-Risk (CVaR) are higher for ARUs than HFs. Since ARUs do not exhibit more negative skewness than HFs, it is likely that ARUs' higher tail risk estimates are driven by their higher volatility and lower kurtosis. Univariate mean difference tests also show that differences are statistically significant. This finding rejects *Hypothesis 2b* that ARUs have lower maximum drawdowns. [29]The higher drawdown exhibited by ARUs is consistent with higher exposures to risk factors as we document below.

The last column of Table 3 shows that HFs tend to exhibit more serial correlation in their return than ARUs. We find using the Ljung-Box test that 22% of HFs have autocorrelated returns, while only 13 of ARUs exhibit significant autocorrelation. This is consistent to the fact that ARUs need to provide at least bi-weekly redemptions to investors, while HFs can impose longer redemption, notice and lockup periods and, therefore, they may harvest a premium by investing in less illiquid assets.

Panel B in Table 3 shows that results are consistent across investment strategies. It is interesting to note that the largest proportion of HFs that exhibit autocorrelation can be found in the Event Driven investment objective. There are only eight ARUs that follow the Event Driven strategy. The high autocorrelation of returns for this style is likely to reflect the tendency of Event Driven funds (such as Merger Arbitrage or Distressed Debt funds) to hold less liquid securities. This implies that it is more difficult (and less common) to transport the Event Driven strategy approach to the UCITS space due.

[28] One important caveat related to the currently available data sets is that we do not know whether an ARU in the data started as a mutual fund or a hedge fund. This information is likely to affect the fund's strategy but does not seem to be provided by data vendors.

[29] Finally, we measure HFs and ARUs tail risk using the expected shortfall and maximum drawdown. We estimate empirical expected shortfall from the historical return data at the 10% level for individual funds, since their return series are usually short. We estimate maximum drawdown using the geometric cumulative returns.

Next, we turn to the individual HFs' and ARUs' Fung and Hsieh (2004) alphas and systematic risk measures. The risk-adjusted results based on alphas confirm our conclusions that on average HFs significantly outperform ARUs.

Table 4 presents the cross-sectional average Fung and Hsieh (2004) alphas and their associated *t*-statistics as well as estimates of systematic risk and idiosyncratic risk. The *t*-statistic of alpha can be expected to be less sensitive to leverage, which, due to regulatory risk constraints, can be lower for ARUs than for HFs. Table 3 shows that the cross-sectional median alphas and their *t*-statistics are significantly higher for HFs compared to ARUs, while systematic risk measures are higher for ARUs than HFs. This evidence suggests that regular hedge funds seem to outperform ARUs in terms of risk-adjusted performance.

[Insert Table 4 here]

Panel A in Table show that HFs' median annualized Fung and Hsieh (2004) alpha is 1.41% with a *t*-statistic of 0.27, whereas ARUs' alpha is -4.22% with a *t*-statistic of -0.82. Using the univariate mean difference test, we find that the difference is statistically significant suggesting that ARUs provide lower risk-adjusted returns than ARUs.

To understand the sources of these differences, we estimate systematic risk and idiosyncratic risk measures for HFs and ARUs. We find that both medians of systematic risk measures are statistically higher for ARUs, whereas HFs tend to take more idiosyncratic risk. Indeed, median systematic volatility is over 50% higher for ARUs compared to HFs, while HFs idiosyncratic volatility is only 10% higher for HFs than ARUs. However, the idiosyncratic risk mean difference is statistically significant. We also measure systematic risk using the R^2 with respect to the Fung and Hsieh (2004) model. Our findings suggest that R^2 are significantly higher for ARUs than HFs. Hence, ARU returns are less counter-cyclical than HFs returns which is consistent with our *Hypothesis 3*. Another important insight from these results is that the Fung and Hsieh (2004) model seems to work very well for ARUs, since the median R^2 is 74%.

Panel B in Table 4 presents results across investment objectives. Our conclusion that HFs deliver higher alphas and are exposed less to systematic risk holds across all the investment objectives. For some of the investment objectives, HFs have less to idiosyncratic risk than ARUs. This finding is not very surprising, since on average, HFs and ARUs only exhibit marginally different idiosyncratic risk differences.

4.2. Average performance of ARUs and HFs

To evaluate the average performance of ARUs and HFs, we construct the equal-weight (EW) and value-weight (VW) portfolios over the sample period from January 2005 to June 2012.

[Insert Figure 1 here]

The preliminary average performance results presented in Figure 1 suggests that the EW of HFs outperform ARUs on average, but this marks interesting time-variation in the relationship. Panel A in Figure 1 shows that cumulative returns are higher for ARUs during the early period, while HFs outperformance is more pronounced toward the end of the sample. Panel B shows that ARUs' maximum drawdown is larger during the recent Financial Crisis which is consistent with the higher beta exposure of ARUs to risk factors such as the market index (Table 4). When we examine risk-adjusted performance in Panel C of Figure1, we find that HFs' rolling 24 month Sharpe ratios are consistently higher than those obtained by ARUs.

[Insert Table 5 here]

To more formally investigate the performance differences between HFs and ARUs, Table 5 presents risk-adjusted performance measures as well as systematic risk loadings and tail risk measures for EW and VW portfolios of ARUs and HFs. In terms of risk-adjusted performance, we find consistently for both EW and VW portfolios that ARUs underperform HFs. [30] Indeed, Table 5 shows that average EW and VW Fung and Hsieh (2004) alphas and associated *t*-statistics are significantly higher for HFs compared to those obtained for ARUs. For EW and VW portfolios, we find a statistically significant alpha spread between HFs and ARUs.

Since it is important to test whether the alpha difference is statistically significant while addressing the issue of time variation, Figure 2 reports the rolling 36 month alpha spreads for both EW and VW portfolios as well as the standard error bands. During the early period when the ARU sample may suffer from the survivorship bias, we find that there are no significant alpha differences. However, both EW and VW alpha spread differences start to be more statistically

[30] We test whether the Sharpe ratios of HFs and ARUs are statistically distinguishable from each other using the approach proposed by Ledoit and Wolf (2008). Their approach extends the work of Jobson and Korkie (1993) by taking into account the time-series properties and nonlinearities in fund returns. We estimate standard errors for the difference of two Sharpe ratios by applying the Newey and West (1987) approach.

significant during the more recent period. As we saw in Table 1, in recent years data vendors have gathered information about liquidated ARUs.

[Insert Figure 2 here]

It is important to note that EW and VW Sharpe ratios are significantly higher for HFs than for ARUs. This suggests that benchmark mark error that may be associated with alpha measurements is not driving this finding. Sharpe ratio difference can be explained both higher HFs mean returns and lower volatility. Since we adjust standard errors in Sharpe ratio difference tests using the Ledoit and Wolf (2008) approach and both tail risk measures – expected shortfall and maximum drawdown – are lower for HFs, we believe that more pronounce autocorrelation and non-linearities in HFs returns do not drive the finding that HFs outperform ARUs.

Finally, we find that systematic risk exposure is higher for ARUs than HFs, since their market beta coefficients and R^2 of the Fung and Hsieh (2004) eight-factor model are higher across model specifications. We find that equity market betas and bond market betas, in particular, are significantly higher for ARUs. Hence, systematic risk factor exposure differences are mainly driven by those three factors.

5. Domicile, Share Restrictions and Performance

In this section, we examine how fund domicile and share restrictions impact on fund performance. Since the majority of ARUs are domiciled in Europe, we first investigate whether the average performance of ARUs and HFs converges when we limit our comparison of the two groups on funds domiciled in Europe. Second, we compare the performance of 'liquid' and 'illiquid' European HFs to ARUs to find out whether liquidity, as captured by share restrictions, is an important driver of performance differences between ARUs and European HFs. Finally, we conduct multivariate regressions to investigate whether fund size and age as well as proxies of managerial incentives explain the differences in HFs and ARUs performance.

5.1 Domicile and Performance

We start by investigating HF and ARU performance based on fund domicile. The prior literature (see Aragon, Liang, and Park (2011), for example) documents that onshore hedge funds registered in the USA deliver higher performance than offshore hedge funds. We extend the existing work by examining average hedge fund performance around the world. The domicile regions of funds are divided into five groups: Asia and Pacific, Caribbean, Europe, North America and Rest of world. Given that relatively few of the ARUs are domiciled outside of Europe, we exclude other domicile regions from the analysis.

Table 6 presents the average performance results across fund domiciles for HFs and ARUs. Overall, we find that Europe domiciled funds deliver lower risk-adjusted compared to funds domiciled in other regions. Sharpe ratios and Fung and Hsieh alphas (2004) are lower for European domiciled funds suggesting that they underperform funds domiciled in other regions. The risk-adjusted performance is the highest for USA and Rest of World domiciled funds. The differences cannot be explained by the benchmark model choice, because systematic risk exposures do not differ significantly across fund domiciles. We also find similar results using the benchmark-free Sharpe ratio. One potential explanation for the findding is the differences in fund characteristics across fund domicile. Table 6 reports that Europe domiciled funds are relative large and do not impose as stringent share restrictions as US domiciled HFs, which tend to outperform. We examine this issue below using the multivariate regressions.

[Insert Table 6 here]

Importantly, we find that European HFs' and ARUs' Fung and Hsieh (2004) alpha and Sharpe ratio differences are statistically indistinguishable from each other.[31] Indeed, Sharpe ratios are both of them roughly equal with magnitude of 0.20 per annum. However, the Fung and Hsieh (2004) alpha is slightly higher for European HFs, but still negative, -1.63% per annum. Hence, it seems that when we limit our comparison of ARUs and HFs to Europe domiciled funds, their performance converges.

In unreported robustness tests, we also find that performance does not different between main ARUs domicile countries. Indeed, Ireland and Luxembourg domiciled funds deliver very similar performance measures. Our finding does not support the hypothesis that regulatory differences between countries affect performance in a systematic way. Although UCITS

[31] In Sharpe ratio difference tests, we take autocorrelation and non-normalities into account using the Ledoid and Wolfe (2008) approach.

restrictions vary across countries, it is important to bear in mind that the restrictions by country for UCITS are not be set in stone and may vary over time. Therefore we do not reject hypothesis 5 about performance differences based on domicile when comparing Europe to other jurisdictions but we do reject it for ARUs domiciled in the different European countries. This may be due to the fact that there is regulatory competition in Europe whereby one European country may adapt regulation to respond to regulatory moves regarding UCITS funds in another country.[32]

5.2 Share Restrictions and Performance

The above performance comparison may not be fair however since ARUs and HFs have very different liquidity terms or share restrictions. To avoid comparing apples and oranges, we examine liquidity-performance trade-off between European Hedge funds and Absolute Return UCITS. Both theoretical asset pricing models and empirical evidence suggest that illiquid assets deliver higher average returns. Aragon (2007) shows that hedge funds with strict share restrictions are able to earn an illiquidity premium. Teo (2010) finds that hedge funds that provide liquidity for investors, but hold illiquid assets, deliver poor performance during the liquidity shocks. Hence, it is interesting to examine whether the liquidity-based story can explain performance difference between ARUs and HFs.

UCITS regulations stipulate that Absolute Return UCITS need to offer at least bi-weekly redemptions to investors, while European domiciled hedge funds can impose longer redemption and notice periods. We divide European HFs into 5 groups based on the restriction period defined as the sum of redemption and notice, and then we tests whether 'liquid' and 'illiquid' European HFs differ from ARUs in terms of performance.

Figure 3 highlights the liquidity-performance trade-off between 'liquid' (i.e. low share restriction) and 'illiquid' (i.e. stringent share restriction) European HFs and ARUs. Indeed, liquid HFs do not seem to outperform ARUs, while illiquid HFs outperform both groups of liquid funds. Panel A in Figure 3 plots the cumulative returns than are significantly highest for illiquid hedge funds. According to Panel B, maximum drawdown is not significantly higher for illiquid HFs during the Financial Crisis. Indeed, ARUs face the worst drawdown among the three groups. As expected, Panel C shows that the 24-month rolling Sharpe ratio is the highest for illiquid HFs, while Sharpe ratios are very similar across the two groups of funds with similar redemption terms.

[32] 'UK 'late to game' with fund drive' by Chris Flood, Financial Times, 7 April, 2013.

[Insert Figure 3 here]

Table 7 shows that European HFs exhibit a monotonic liquidity-performance relationship so as that HFs that provide the strictest redemption terms deliver the highest performance, whereas the funds that offer investors the possibility of redeeming at least on a bi-weekly basis deliver the lowest performance. Indeed, ARUs risk-adjusted average performance converges when we draw inference from liquidity matched portfolios. Fung and Hsieh (2004) alphas as well as Sharpe ratios are statistically indistinguishable for ARUs and HFs (providing at least bi-weekly liquidity). However, we find totally different results for illiquid European HFs, since both the Fung and Hsieh (2004) alphas and Sharpe ratios are significantly higher for them than ARUs.

[Insert Table 7 here]

The finding does not seem to be driven by tail risk exposure of illiquid asset, since the expected shortfall and maximum drawdown are not considerably higher for illiquid HFs compared to more liquid funds. More importantly, Figure 4 plots the rolling 36 month Fung and Hsieh (2004) alpha spreads between liquid European HFs and ARUs as well as illiquid European HFs and ARUs. Panel A shows that liquid HFs do not consistently outperform ARUs during the sample period. However, from the Panel B, we can observe that illiquid HFs outperform ARUs statistically significantly during almost the whole sample period. Overall, our findings support the view that HFs and ARUs performance seem to converge especially if we take investor level liquidity terms into account. HFs that impose longer restriction periods seem to deliver superior performance.

5.3 Multivariate Regressions and Performance Differences

We next turn to multivariate regressions to investigate cross-sectional determinants in explaining performance difference between HFs and ARUs. We conduct the multivariate analysis over the period from December 2005 to June 2012. We first estimate monthly Fung and Hsieh (2004) alphas for each of the individual funds having at least 24 return observations. We then run the Fama and MacBeth (1973) regressions, in which alphas are explained by UCITS indicator variable and a set of fund characteristics that prior literature have found to explain fund performance differences. Formally, the Fama-McBeth (1973) procedure can be expressed as

$$Alpha_{i,t} = \lambda_0 + \lambda_1 ARU\_Indicator + \lambda_2' Y_{i,t} + u \quad (4)$$

where $Alpha_{i,t}$ refers to the Fung and Hsieh (2004) alpha of a hedge fund *i* at the time *t*, λ_1 is the slope coefficients for *ARU_Indicator* that is one if the fund *i* is Absolute Return UCITS compliant and otherwise zero, and λ_2 is a vector representing the slope coefficients for time-invariant characteristics containing management and incentive fees, high-water mark provision and share restrictions in the form of lockup, notice, and redemption periods as well as time-variant characteristics, which control for the role of fund size, flow and age that are found to be important by Teo (2010), Teo (2011) and Aggarwal and Jorion (2010).We control for strategy fixed effects, and adjust standard errors for autocorrelation and heteroskedasticity following Newey and West (1987).

[Insert Table 8 here]

Table 8 presents the results of multivariate analysis. In the first model specifications, we use all the funds. The last two model specifications are conducted first using all the European domiciled hedge funds and then restriction period matched European domiciled funds. Overall results in Table 8 show that HFs outperform ARUs even after taking into account the impact of fund characteristics that previous literature have found to explain cross-sectional differences in hedge fund performance. However, we find that the performance of European domiciled HFs and ARUs converges so as that restriction period matched sample does not show significant performance difference. To sum up, our multivariate results suggest that HFs deliver higher performance than ARUs, but when we take domicile effect and liquidity-performance trade-off into account their performance seems to converge.

6. Performance Persistence

Hedge funds typically restrict capital withdrawals by imposing lockup, advance notice, and redemption periods. All these restrictions indicate that investors are not able to withdraw capital from hedge funds in a timely fashion. On the other hand, by regulation, ARUs must provide at least bi-weekly liquidity to investors. This implies that real world HF investors may not be able to exploit short-term performance persistence, if any, while ARU investors can rebalance their portfolios given the low redemption restrictions. It is also important to note that a

significant proportion of HFs provide similar portfolio rebalancing possibilities than ARUs. Hence, it is interesting to examine whether redemption restrictions hinder investors to exploit short-term performance persistence. In doing so, we form six of the out-of-sample investment strategies that provide different level of redemption possibilities to investors across fund domiciles.

We examine performance persistence of HFs and ARUs using standard methodology. In the spirit of Carhart (1997), we sort funds into quintile portfolios based on their past Fung and Hsieh (2004) eight-factor alpha *t*-statistics that are estimated over the prior two years data. Given superior statistical properties of the alpha *t*-statistic, the performance persistence is expected to be stronger than in case we sort on fund alpha.[33] We use two different portfolio rebalancing periods: (i) annual and (ii) monthly. Across rebalancing horizons, we calculate returns for each of the quintile portfolios.[34] Thereafter, we estimate the Fung and Hsieh (2004) spread between the top and the bottom quintile portfolios.

[Insert Table 9 here]

Table 9 presents performance persistence tests for annual rebalancing horizons. The panels on the left-hand-side of the table show performance of the out-of-sample strategies than contain either all of the funds or funds limiting significant investors' redemption possibilities, whereas right-hand-side panels presents results for strategies that provide investors at least bi-weekly redemption possibilities. We find that HFs performance persists at annual horizons, while URUs cannot deliver any long-term performance persistence. Our findings also suggest that HFs providing at least bi-weekly liquidity provide significant performance persistence during the sample period, but HFs that impose above one month notice and redemption periods as well as a lockup period cannot deliver significant performance persistence on an annual basis. Results may be due to recent Financial Crisis, since during it CTA and Macro Strategies did not suffer as much as strategies investing in illiquid assets and thereby imposing tight share restrictions. Again, we find that European HFs underperform their HF peers, since we find that European HFs' performance do not persists at annual horizons.

[33] Funds with a short history of monthly net returns will tend to generate alphas that are outliers. The alpha *t*-statistic provides a correction for outliers by normalizing the fund alpha by the estimated precision of the fund alpha (e.g. Kosowski Timmermann, Wermers and White (2006), Kosowski, Naik and Teo (2007)).
[34] The portfolios are equally-weighted monthly, so the weights are readjusted whenever a fund disappears.

[Insert Table 10 here]

Given that ARUs and some of the HFs provide investors possibilities to redeem their capital on a timely fashion, we conduct performance persistence tests with monthly rebalancing.[35] Table 10 presents the monthly performance persistence tests. The results presented in right-hand-side could not be obtained in-practice since share restrictions hinder monthly rebalancing, while the results in panels on the left-hand-side are obtained using the funds providing at least bi-weekly liquidity. Table 10 shows significant performance persistence for HFs, but even with the monthly portfolio rebalancing we cannot find any performance persistence for ARUs. In contrast, HFs that provide at least bi-weekly liquidity provide significant performance persistence. European domiciled HFs also deliver significant performance persistence at monthly horizons even after taking into account rebalancing possibilities realistically.

To summarize, we find that HFs' performance persists, but ARUs cannot deliver significant performance persistence even at monthly horizons.

7. Conclusion

This paper contributes on the literature on the effect of liquidity and geography on welfare and asset price performance by documenting the effect of geographically disparate hedge fund regulation on fund performance. Based on regulatory constraints, such as share restrictions and risk limits, which differ by country, we economically motivate and test a range of hypotheses regarding differences in performance and risk between Absolute Return UCITS (ARUs) and hedge funds. We uncover a strong performance-liquidity tradeoff. Although ARUs underperform other hedge funds on average, when we compare liquidity (i.e. share restriction) matched groups of ARUs and hedge funds we find that the performance of the two groups converges. Our results show that hedge funds generally exhibit lower volatility and tail risk than ARUs which is consistent with hurdles to the transportation of hedge fund risk management techniques to ARUs. We find that geography and domicile matter for fund performance and risk. Finally we find that there are limits to the ability of investors to exploit the superior liquidity of ARUs since they exhibit lower performance persistence than certain HFs. As explained in the introduction it is likely that this research topic will attract researchers' attention in the future since there are

[35] We use one-month lagged *t*-statistic of alpha in forming the out-of-sample strategies so as real-time investor could rebalance her portfolio in-practice.

currently plans in the EU to impose remuneration restrictions on UCITS funds. In the data that we analyzed there are no such regulatory restrictions and funds are free to choose their fee and compensation structures. Since we find that performance increases with incentive fees it is plausible that if UCITS-compliant funds were forced by regulators to implement bonus caps that this would drive a further wedge between the average ARUs and HF performance and have welfare implications for investors such as pension funds that invest in alternative investment funds. We leave this analysis to future work.

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Appendix

Appendix A: UCITS Regulation

UCITS (Undertakings for Collective Investment in Transferable Securities) refers to a set of European Union Directives establishing a harmonized legal framework for the creation, management and marketing of collective investment schemes in the EU (and EEA) Member States. Below we briefly review how UCITS fund rules have evolved over time and summarize the requirements under the latest version of UCITS, that is UCITS IV.

Appendix A.1: Evoluation of UCITS Regulation

UCITS I (1985)

The aim of the original UCITS Directive 85/611/EEC, adopted in 1985, was to allow for open-ended funds investing in transferable securities to be subject to the same regulation in every Member State. Under UCITS I, derivatives could only be used for hedging and efficient portfolio management, that is with the aim of reducing risk or cost, or to replicate a position that could otherwise be achieved through investing in the underlying asset.

UCTIS II (early 1990s)

In the early 1990s attempts were made to amend the 1985 Directive and more successfully harmonize laws throughout Europe, since several obstacles become apparent in following UCITS I. Individual marketing rules in each Member State created obstacles to cross-border marketing of UCITS. The limited definition of permitted investments for UCITS also weakened the marketing possibilities of a UCITS. Attempts to reform UCITS in the 1990s faltered and it was not until the introduction in 2001 of Directive 2001/108/EC (generally known as the "Product Directive") and Directive 2001/107/EC (generally known as the "Management Directive") that substantive change was eventually introduced.[36]

UCITS III (2002):

The UCITS III revision gave asset managers a broader scope of eligible. At the same time, the requirements on investor protection were increased and called for an independent risk management function (to limit/monitor leverage, counterparty risk, concentration limits, etc.).

[36] The Product Directive and the Management Directive are generally collectively referred to as "UCITS III".

UCITS III expanded the range of available investments to include derivatives for investment purposes, other UCITS and cash. This dramatically increased investor choice, allowing for cash funds, funds of fund, mixed asset funds and absolute return UCITS or UCITS hedge funds. This has allowed a number of hedge fund strategies to be accommodated within the UCITS format such as equity long/short, relative value, etc. Some strategies, however, remain difficult to implement within the UCITS framework because the underlying asset class is not permissible (for example, individual commodities or bank loans) or because of the lack of liquidity (for example, distressed debt).

UCITS IV (2009-11)

The UCITS IV directive introduced the management company passport and allows a UCITS to be managed by a management company authorised and supervised in a Member State other than its home Member State. UCITS IV has increased the governance ("organisational") requirements of UCITS Management Companies and funds and has brought these requirements more in line with MIFID.[37] UCITS or its management company needs to establish independent compliance and audit functions in addition to the independent risk management which was already required under UCITS III but which has been expanded to formalise the management of a variety of risks.

UCITS V (2013 -)

Following a consultation period, the EU published a proposal for the UCITS IV directive in 2012. There are three key elements in this proposal:

(1) A new depositary regime which includes a clarification of the depositaries' duties, responsibilities and liabilities and a set of the rules under which responsibilities, such as sub-custodian roles) can be delegated.

(2) Rules governing remuneration of fund managers including bonus caps.

(3) A sanctions regime.

The proposal will pass to the European Parliament and Council of Ministers for consideration and adoption. At the time of the publication of the UCITS V proposal the AIFMD did not include any restrictions regarding fund manager remuneration.

[37] The Markets in Financial Instruments Directive 2004/39/EC (known as "MiFID") is a European Union law that aims at creating harmonized regulation for investment services across the 30 member states of the European Economic Area (the 27 Member States of the European Union plus Iceland, Norway and Liechtenstein). See, for example, http://ec.europa.eu/internal_market/securities/isd/index_en.htm#isd.

UCITS VI (Consultation Period)

Although the UCITS V proposal has not been adopted yet, a consultation document for for the UCITS VI directive has been issued. The EU commission asks respondents whether there is a need to review the list of eligible assets under UCITS. Other topics in the consultation paper include efficient portfolio management, OTC derivatives, liquidity management and money market funds.

Appendix A.2: Current UCITS (IV) Regulation Requirements

A.2.1 Eligible Assets:

A UCITS can only invest in eligible assets. The eligible assets that a UCITS can invest in include:

- Transferable securities – essentially, publicly traded equities or bonds, listed on mainstream stock exchanges.
- Deposits and Money Market instruments (MMIs) – Cash deposits with "credit institutions" (i.e. banks) can be held as investment assets, together with MMIs. These might include treasury and local authority bills, certificates of deposit or commercial paper. Thus pure cash funds can be UCITS.
- Certain other funds: open-ended mutual funds where those are other UCITS or non-UCITS funds with UCITS-like traits. This has allowed the development of UCITS funds of funds.
- Financial Derivative Instruments –following UCITS III UCITS are able to use derivatives for investment purposes, using exchange-traded or over-the-counter ("OTC") instruments, with some limitations. The underlying of a derivative must be one of the following types (i) an eligible asset of the type mentioned above, (ii) interest rates, (iii) currencies, (iv) financial indices.
- Short-selling: Physical short selling is not permitted. However, the same economic effect can be achieved and is allowed through the use of derivatives such as Contracts for Difference ("CFDs").
- Ineligible assets – certain assets remains out of scope:
    - Real estate
    - Bank loans
    - Physical metals such as gold (although certain securities based on metals are permitted)
    - Commodities (although derivatives on financial indices such as commodity

indices are eligible)

A.2.2. Diversification Requirements, Risk and Leverage Limits:

Diversification rules:

UCITS must operate on a principle of risk spreading, which means that restrictions apply which limit the spread of investments, leverage and exposure. A UCITS must be properly diversified. The so-called 5/10/40 Rule states that a UCITS cannot invest more than 5% of its assets in securities issued by a single issuer. However, this limit can be increased up to 10% provided that where the 5% limit is exceeded, the exposure to these issuers, when added together, does not exceed 40% of the fund's assets. There are also rules around the proportion of a company that a UCITS may hold in that it might gain significant influence over its management. Rules exist too regarding the amount of a company's debt or non-voting shares that can be held.

Risk Limits:

There are two approaches to risk limits: the commitment approach and the VaR (Value-at-Risk) approach.

The Commitment Approach

This essentially aggregates the underlying notional value of stock and derivatives to determine the degree of gross exposure (called "global exposure" in the Directive). The commitment approach is potentially suitable for Long-only funds, or UCITS funds making a simple or limited use of derivatives. Under the commitment measure, the leverage limit generated by using financial derivatives is limited to 100% of the UCITS' net asset value. With the 10% short term overdraft facility that all funds are permitted, this means the total gross exposure of the fund cannot exceed 210% of the net asset value of the fund.

Value at Risk

The VaR approach is an alternative to the commitment approach and has two versions, the absolute and the relative VaR approach. The VaR approach has advantages over the commitment approach since it captures risk exposures better and is more suitable for funds that make use of derivatives. Gross exposures can be quite high in funds that use derivatives or shorting. The VaR limit, for UCITS purposes, is calculated on a monthly basis using a confidence interval of 99%. The VaR can be either calculated in absolulte or in relative terms. Absolute

return UCITS must limit their 1-month 99% VaR to twice that of the benchmark index. Absolute return funds must stand within the limit of 20%.

A.2.3. Liquidity requirements and custody:

A UCITS must be open-ended i.e. shares or units in the fund may be redeemed on demand by investors. A UCITS must be liquid, that is, its underlying investments must be liquid enough to support redemptions in the fund on at least a fortnightly basis. In practice, most UCITS funds UCITS funds allow daily dealing. Assets must be entrusted to an independent custodian or depositary and held in a ring-fenced account on behalf of investors.

Appendix B: UCITS Regulation and fund domicile by country:

Tuchschmid *et al*. (2010) summarize differences in the implementation of the UCITS directive in different countries:

"*The limited definition of eligible assets, however, hampered investment interest. As a consequence, in the decade following 2000 the European Commission adopted and applied several significant directives referred to as Ucits III. Due to the ambiguity of the Ucits directives, the European Commission granted The Committee of European Securities Regulators (CESR) a mandate to issue guidelines [CESR/07-044b] on what constitutes eligible investment instruments. In general, shares in companies, bonds (government and corporate), and most forms of derivatives on bonds and shares are allowed. In addition, the investment instrument must be easily traded in liquid markets. Most jurisdictions do not allow investments in physical commodities or certificates which represent them. The main exception is the German regulation which does allow holdings in commodities certificates. Hedge fund, private equity and real estate holdings are not allowed. However, the Luxembourg regulation allows Ucits to invest in closed-ended real estate investment trust (REIT) funds and closed-ended hedge funds. Many jurisdictions also allow investment in indices representative of such non-eligible assets as physical commodities or hedge funds. An exemption in the Ucits directive allows Ucits to hold up to 10%, often called the trash ratio, in non-eligible assets, which in practice allows investments in hedge funds and private equity. In general, Ucits funds are allowed to synthetically achieve short positions through derivatives. France and Ireland are the exceptions where limited amounts of short selling are allowed. There are, however, additional rules which require that the short position should be adequately covered, either by the underlying asset or by an asset which is highly correlated to the underlying."*

Table 1: Capital formation of Hedge Funds and Absolute Return UCITS

Table 1 presents the capital formation process of hedge funds and Absolute Return UCITS from January 2003 to June 2012. N is the number of funds in given year. 'AggAum' provides aggregate assets under management for Hedge Funds and Absolute Return UCITS. Attrition rate is the percentage of funds that became inactive during the year.

Year	Hedge Funds			Absolute Return UCITS		
	N	AggAuM	Attrition rate	N	AggAuM	Attrition Rate
2003	9466	836,556		107	5,915	
2004	11190	1,243,365	7.6	141	10,902	0
2005	12623	1,460,366	9.8	182	16,208	0
2006	13779	1,904,221	11.1	247	24,656	0
2007	14286	2,380,921	13.3	320	36,586	0.4
2008	13311	1,589,894	20.3	392	27,367	0.6
2009	12785	1,585,876	15.3	535	63,776	0.5
2010	12406	1,705,818	14.8	684	123,143	5.0
2011	11042	1,610,721	16.4	690	159,795	10.2

Table 2: Descriptive Statistic of Fund Characteristics

This table presents the summary statistics for fund size and age as well as compensation and share restrictions variables of Hedge Funds (HF) and Absolute Return UCITS (ARU). Table presents cross-sectional means and medians within a specific category. Size denotes the fund's size in Millions of US Dollars. Age denotes the fund's age in years based on the fund inception data. Management Fee (%) shows the management fee within a specific category. Incentive Fee (%) shows the incentive fee within a specific category. Incentive Fee (Y=1, N=1) indicates the percentage of funds charging an incentive fee. High-water mark indicates whether a fund imposes a high-water mark provision. Redemption denotes redemption frequency. Notice is the advance notice period. Restriction is the sum of redemption and notice periods. Lockup denotes the length of period when investors are restricted to withdraw their initial investment.

Panel A: Fund Size and Age

	Mean		Median	
	HF	ARU	HF	ARU
Size (Millions)	165.6	298.1	39.0	88.9
Age (Years)	4.4	3.3	3.0	2.3

Panel B: Compensation Structure

	Mean		Median	
	HF	ARU	HF	ARU
Management Fee (%)	1.55	1.37	1.5	1.5
Incentive Fee (Yes=1, No=0)	0.93	0.73	1	1
Incentive Fee (%)	17.98	12.47	20	15
High-Water Mark (Yes=1, No=0)	0.79	0.60	1	1

Panel C: Share Restrictions

	Mean		Median	
	HF	ARU	HF	ARU
Redemption (days)	55	3	30	1
Notice (days)	33	2	30	1
Restriction (days)	92	4	60	2
Lockup (years)	0.25	0	0	0
Lockup (Yes=1, No=0)	0.28	0	0	0

Table 3: Cross-sectional Medians of Statistical Measures

Table 3 presents statistical measures for Absolute Return UCITS (ARU) and hedge funds (HF) which fund have at least 24 return observations over the period from January 2003 to June 2012. Panel A reports cross-sectional medians within a specific category as well as mean difference tests for ARUs and HFs. Panel B reports cross-sectional medians across investment objectives. Mean and Std represents the annualized fund's mean return and standard deviation. Sharpe denotes the annualized Sharpe ratio. Skew and Kurt are the funds' skewness and kurtosis. Normal(%) denotes the percentage of funds having a normal distribution based on the Jarque-Bera test statistic. CVaR denotes historical expected shortfall at the 10% level. Autocor(%) denotes the percentage of funds having autocorrelated returns according to Box-Liung test.

Panel A: Cross-sectional Medians and Mean Difference Tests

		N	Mean	Std	Sharpe	Skew	Kurt	Normal(%)	CVaR	Autocor(%)
HF	ALL	18860	3.65	14.18	0.29	-0.25	1.39	0.45	7.01	0.22
ARU		599	1.61	17.23	0.09	-0.28	0.65	0.64	8.92	0.13
Testing Mean Difference:		Mean Diff	-2.70	2.64	-0.34	0.03	-1.83		1.92	
ARU vs. HF		t-stat	-5.60	5.43	-2.36	0.69	-8.44		8.27	

Panel B: Cross-sectional Medians across Investment Objectives

	Main Strategy	N	Mean	Std	Sharpe	Skew	Kurt	Normal(%)	CVaR	Autocor(%)
HF	CTA	1742	3.97	15.32	0.30	0.09	1.00	0.53	7.03	0.12
ARU		40	-0.74	16.90	-0.04	-0.18	0.27	0.78	8.90	0.05
HF	EMERGING MARKETS	2645	6.02	19.13	0.36	-0.30	1.46	0.44	9.27	0.28
ARU		105	5.47	27.30	0.20	-0.38	0.94	0.61	13.88	0.19
HF	EVENT DRIVEN	981	3.55	10.55	0.40	-0.52	2.29	0.32	5.40	0.39
ARU		8	-0.32	13.93	-0.09	-0.37	0.68	0.63	7.44	0.13
HF	GLOBAL MACRO	1012	3.11	13.37	0.25	-0.06	1.27	0.49	6.64	0.14
ARU		38	0.42	13.99	0.03	-0.17	0.33	0.82	7.44	0.00
HF	LONG ONLY	481	4.31	17.89	0.27	-0.41	1.43	0.42	9.23	0.33
ARU		108	2.08	20.70	0.13	-0.50	1.03	0.44	11.63	0.20
HF	LONG/SHORT	5547	3.24	14.42	0.24	-0.25	1.17	0.49	7.28	0.19
ARU		109	2.06	16.99	0.12	-0.26	0.37	0.72	8.80	0.17
HF	MARKET NEUTRAL	1011	2.24	10.42	0.22	-0.23	1.17	0.52	5.21	0.14
ARU		34	-0.48	13.19	-0.04	-0.12	0.19	0.88	6.97	0.09
HF	MULTI-STRATEGY	2472	3.69	14.11	0.31	-0.27	1.45	0.45	6.93	0.21
ARU		45	-0.67	15.37	-0.04	-0.14	0.28	0.71	8.06	0.02
HF	OTHERS	463	3.84	10.69	0.40	-0.24	1.32	0.50	4.89	0.24
ARU		11	1.83	15.67	0.11	-0.15	0.26	0.82	8.49	0.18
HF	RELATIVE VALUE	1959	3.37	10.84	0.34	-0.62	3.40	0.29	5.23	0.32
ARU		85	0.94	14.37	0.08	-0.25	0.87	0.59	7.38	0.07
HF	SECTOR	469	4.39	15.40	0.29	-0.31	1.37	0.48	7.46	0.19
ARU		16	3.90	26.39	0.15	-0.59	1.54	0.44	14.80	0.25
HF	SHORT BIAS	78	0.15	15.72	0.01	0.16	0.99	0.54	6.35	0.21
ARU		0	-	-	-	-	-	-	-	-

Table 4: Cross-sectional Medians of Alphas and Risk Loadings

Table 4 presents alphas and risk loadings for Absolute Return UCITS (ARU) and hedge funds (HF) which have at least 24 return observations over the period from January 2003 to June 2012. Panel A reports cross-sectional medians within a specific category as well as mean difference tests for ARUs and HFs. Panel B reports cross-sectional medians across investment objectives. Alpha is the annualized Fung and Hsieh (2004) alpha within a specific category. Alpha t-stat presents the t-statistic of alpha. SystRisk is defined as the difference of return standard deviation and residual risk. IdioRisk denotes the residual risk that is obtained from the Fung-Hsieh (2004) model. R^2 is the R-squared of the Fung-Hsieh (2004) model.

Panel A: Cross-sectional Medians and Difference Tests

		N	Alpha	Alpha t-stat	SystRisk	IdioRisk	R^2
HF	ALL	18860	1.41	0.27	3.66	9.43	0.47
ARU	ALL	599	-4.22	-0.82	8.08	8.79	0.74
Testing Mean Difference:		Mean Diff	-6.46	-1.29	4.50	-1.86	0.22
ARU vs. HF		t-stat	-12.15	-8.03	21.33	-5.15	24.62

Panel B: Cross-sectional Medians across Investment Objectives

	Main Strategy	N	Alpha	Alpha t-stat	SystRisk	IdioRisk	R^2
HF	CTA	1742	2.86	0.47	2.61	12.15	0.30
ARU		40	-5.42	-0.66	6.55	10.46	0.57
HF	EMERGING MARKETS	2645	2.04	0.31	6.17	11.49	0.58
ARU		105	-2.84	-0.48	16.56	10.15	0.82
HF	EVENT DRIVEN	981	2.42	0.60	2.95	6.95	0.50
ARU		8	-6.52	-1.36	5.37	6.91	0.61
HF	GLOBAL MACRO	1012	1.14	0.21	2.94	9.69	0.38
ARU		38	-5.15	-0.93	6.36	7.98	0.65
HF	LONG ONLY	481	0.05	0.03	7.28	9.04	0.69
ARU		108	-4.50	-1.03	11.96	9.16	0.82
HF	LONG/SHORT	5547	0.69	0.13	4.29	9.47	0.52
ARU		109	-3.62	-0.72	8.62	8.69	0.75
HF	MARKET NEUTRAL	1011	0.74	0.15	1.89	7.90	0.36
ARU		34	-5.48	-1.14	5.91	7.35	0.66
HF	MULTI-STRATEGY	2472	1.68	0.32	3.53	9.19	0.45
ARU		45	-4.88	-1.02	6.43	8.66	0.67
HF	OTHERS	463	1.85	0.33	2.47	7.63	0.42
ARU		11	-4.46	-0.73	6.46	8.38	0.75
HF	RELATIVE VALUE	1959	1.75	0.39	2.60	7.52	0.43
ARU		85	-4.26	-0.93	4.95	8.41	0.58
HF	SECTOR	469	1.76	0.20	4.31	10.75	0.49
ARU		16	-1.95	-0.34	16.22	9.59	0.84
HF	SHORT BIAS	78	0.49	0.13	4.70	8.21	0.60
ARU		0	-	-	-	-	-

Table 5: Average Performance of Absolute Return UCITS and Hedge Funds

Table 5 presents performance measures for the equal-weighted (EW) and value-weighted (VW) portfolios of Absolute Return UCITS (ARU) and Hedge Funds (HF) from January 2005 to June 2012. 'Number of funds in portfolio' refers to the number of funds in a given portfolio (mean, minimum and maximum). *Mean* and *Std* denotes the annualized mean and standard deviation. *Sharpe* refers to the annualized Sharpe ratio. *CVaR* refers to empirical expected shortfall at 5% level. *MaxDD* refers to maximum drawdown. *Alpha* refers to the annualized intercept of the Fung and Hsieh (2004) model. *Alpha t-stat* is the t-statistic of the model's intercept. Risk loadings are estimated using the excess returns of the S&P 500 index (SP), the return spread between the Russell 2000 index and the S&P 500 index (SCLC), the excess return of ten-year Treasuries (CGS10), the spread return between Moody's BAA and ten-year Treasuries (CREDSPR), the excess returns of look-back straddles on bonds (PTFSBD), currencies (PTFSFX), and commodities (PTFSCOM) as well as the excess return of the MSCI Emerging Market Index (MSEMKF). R^2 refers to the R-squared of the model.

Panel A: Average EW Performance of HFs and ARUs

	Number of funds in portfolio						
	Mean	Min	Max	Mean	Std	Sharpe	CVaR	MaxDD
HF	8866	12731	14336	4.52	8.76	0.52	6.48	0.23
ARU	145	418	722	2.95	15.31	0.19	11.40	0.40
Diff				1.57	-6.55	0.32	-4.92	-0.17
p-value						0.02		

	Alpha	Alpha t-stat	SP	SCLC	CGS10	CREDSPR	PTFSBD	PTFSFX	PTFSCOM	MSEMKF	R^2
HF	1.46	1.13	0.06	-0.06	-0.04	0.10	0.00	0.00	0.01	0.26	0.88
ARU	-3.43	-1.53	0.20	-0.12	0.13	0.12	0.00	0.00	0.02	0.44	0.89
Diff	4.89		-0.13	0.06	-0.17	-0.02	0.00	0.00	-0.01	-0.18	0.77
t-value	3.19		-2.97	0.95	-2.17	-0.44	0.03	0.39	-1.54	-7.35	

Panel B: Average VW Performance of HFs and ARUs

	Number of funds in portfolio						
	Mean	Min	Max	Mean	Std	Sharpe	CVaR	MaxDD
HF	6705	9297	10419	4.60	7.22	0.64	4.86	0.18
ARU	57	251	612	3.86	14.37	0.27	10.39	0.38
Diff				0.75	-7.15	0.37	-5.52	-0.20
p-value						0.06		

	Alpha	Alpha t-stat	SP	SCLC	CGS10	CREDSPR	PTFSBD	PTFSFX	PTFSCOM	MSEMKF	R^2
HF	2.46	1.76	0.03	-0.10	-0.06	0.08	0.01	0.00	0.02	0.22	0.80
ARU	-2.08	-0.95	0.14	-0.19	0.08	0.10	0.00	-0.01	0.02	0.44	0.87
Diff	4.54		-0.12	0.09	-0.14	-0.03	0.01	0.00	0.00	-0.21	0.76
t-value	2.72		-2.23	1.28	-1.71	-0.50	0.49	0.38	-0.34	-7.46	

Table 6: Fund Domicile and Average Performance

Table 6 presents performance measures for Absolute Return UCITS (ARU) and Hedge Funds (HF) across fund domiciles over the period from January 2005 to June 2012. We divide hedge funds into 5 groups based on the geographic regions in which funds are domiciled. Table presents standard performance measures that are defined as in Table 5. We also present cross-sectional means for fund size, redemption and notice periods, which are defined in Table 2.

Panel A: Fund Domicile and Risk Measures

		Number of funds in portfolio								Cross-sectional Mean		
	Fund Domicile	Mean	Min	Max	Mean	Std	Sharpe	CVaR	MaxDD	Size	Redemption	Notice
HF	Europe	1883	1194	2154	2.20	11.15	0.20	8.19	0.29	298.1	3.0	1.6
ARU	Europe	396	142	714	3.05	15.50	0.20	11.56	0.40	209.8	29.9	17.1
Diff					-0.84	-4.35	0.00	-3.36	-0.11			
p-value							0.95					

		Number of funds in portfolio								Cross-sectional Mean		
	Fund Domicile	Mean	Min	Max	Mean	Std	Sharpe	CVaR	MaxDD	Size	Redemption	Notice
HF	Asia and Pacific	405	199	820	8.02	13.33	0.60	8.82	0.32	86.0	32.6	13.7
HF	Caribbean	5545	4292	6468	4.47	8.97	0.50	6.53	0.24	208.8	49.0	38.3
HF	Rest of World	1151	968	1218	8.54	11.25	0.76	7.02	0.26	121.6	35.8	22.8
HF	USA	3937	3046	4371	5.85	7.27	0.80	4.66	0.16	107.7	82.1	36.4

Panel B: Fund Domicile, Alphas and Risk Loadings

	Fund Domicile	Alpha	Alpha t-stat	SP	SCLC	CGS10	CREDSPR	PTFSBD	PTFSFX	PTFSCOM	MSEMKF	R^2
HF	Europe	-1.63	-0.71	0.16	-0.14	0.09	0.09	0.01	0.00	0.02	0.30	0.79
ARU	Europe	-3.55	-1.52	0.18	-0.11	0.17	0.13	0.00	-0.01	0.02	0.45	0.89
Diff		1.92		-0.02	-0.03	-0.08	-0.04	0.01	0.00	0.00	-0.15	0.87
t-stat		-1.53		-2.85	1.35	-1.31	-1.52	-0.25	0.34	-1.89	-10.95	

	Fund Domicile	Alpha	Alpha t-stat	SP	SCLC	CGS10	CREDSPR	PTFSBD	PTFSFX	PTFSCOM	MSEMKF	R^2
HF	Asia and Pacific	2.77	0.98	-0.05	-0.17	0.04	0.10	0.01	-0.03	0.03	0.45	0.77
HF	Caribbean	1.09	0.72	0.01	-0.06	0.01	0.14	0.00	0.00	0.01	0.29	0.86
HF	Rest of World	5.63	2.51	-0.01	-0.09	-0.19	-0.03	0.01	0.00	0.01	0.39	0.80
HF	USA	4.47	3.84	0.12	0.04	-0.14	0.09	0.01	0.00	0.01	0.15	0.87

Table 7: Redemption Restrictions Matched European Hedge Funds and Absolute Return UCITS

Table 7 reports evidence of liquidity-performance trade-off between European Hedge funds and UCITS Hedge Funds. UCITS regulation stipulates that ARUs need to offer at least bi-weekly redemptions to investors, while European domiciled hedge funds can impose longer redemption and notice periods. We divide European HFs into 5 groups based on the restriction period defined as the sum of redemption and notice, and then we tests whether 'liquid' and 'illiquid' European Hedge Funds differ from the performance of ARUs. Previous Tables define the performance and risk measures.

Panel: Standard Performance and Risk Measures

		Number of funds in portfolio							
	Restriction (Days)	Mean	Min	Max	Mean	Std	Sharpe	CVaR	MaxDD
ARU	(0, 14]	145	418	722	2.95	15.31	0.19	11.40	0.39
Liquid HF	(0, 14]	321	452	532	1.67	12.30	0.14	8.79	0.29
Liquid HF - ARU					-1.28	-3.01	-0.06	-2.60	-0.10
p-value							0.52		
HF	[15,30)	28	37	45	1.83	9.64	0.19	6.30	0.20
HF	[30,60)	207	346	422	2.11	11.23	0.19	7.83	0.28
HF	[60, 160)	214	428	507	3.27	9.85	0.33	7.42	0.27
Illiquid HFs	[160,∞)	20	56	90	8.69	11.98	0.73	8.31	0.30
Illiquid HFs -UHFs					5.74	-3.33	0.53	-3.09	-0.09
p-value							0.00		

Panel B: Alphas and Risk Loadings

	Restriction (Days)	Alpha	tValue	SP	SCLC	CGS10	Credspr	PTFSBD	PTFSFX	PTFSCOM	MSEMKF	R^2
ARU	(0, 14]	-3.43	-1.53	0.20	-0.12	0.13	0.12	0.00	0.00	0.02	0.44	0.89
Liquid HF	(0, 14]	-2.44	-1.08	0.20	-0.13	0.10	0.08	0.02	-0.01	0.03	0.33	0.80
Liquid HF - ARU		0.98		0.00	0.00	-0.03	-0.04	0.02	0.00	0.01	-0.12	0.72
t-stat		1.02		0.00	-0.15	-0.86	-1.10	2.43	-0.28	1.49	-6.22	
HF	[15,30)	-1.30	-0.57	0.12	-0.11	0.11	0.05	0.02	0.00	0.01	0.26	0.72
HF	[30,60)	-1.72	-0.74	0.16	-0.13	0.05	-0.03	0.01	0.00	0.02	0.32	0.77
HF	[60, 160)	-0.27	-0.14	0.10	-0.18	0.04	0.14	0.00	-0.01	0.01	0.27	0.80
Illiquid HF	[160, ∞)	3.73	1.45	0.10	-0.21	0.04	0.20	-0.02	0.02	0.00	0.32	0.76
Illiquid HF -ARU		7.16	4.41	-0.10	-0.09	-0.09	0.08	-0.02	0.02	-0.03	-0.12	0.52
t-stat		4.41		-1.67	-1.31	-1.14	1.24	-1.41	2.62	-3.15	-3.53	

Table 8: Multivariate Analysis

Table 8 presents multivariate analysis results using period from December 2005 to June 2012. We first estimate monthly Fung and Hsieh (2004) alphas for each of the individual funds having at least 24 return observations. We then run the Fama and MacBeth (1973) regressions, in which alphas are explained by ARU indicator variable and a set of fund characteristics that prior literature have found to explain fund performance differences. The first model specifications, we use all the funds. The last two model specifications are conducted using all the European domiciled hedge funds and share restrictions matched European domiciled funds. We control for role of strategy fixed effects and adjust standard error properly into autocorrelation and heteroskedasticity.

Variable	All funds		European Funds		Share restrictions Matched Funds	
ARU (No=0, Yes=1)	-0.0018	-0.0018	-0.0013	-0.0012	-0.0006	-0.0010
	-3.40	-3.33	-2.00	-1.96	-1.06	-1.46
Lagged Fund Size		-0.0002		-0.0003		-0.0004
		-2.12		-1.60		-1.83
Lagged Fund Age		-0.0007		0.0002		0.0000
		-3.13		0.43		-0.11
Lagged Fund Flow		0.0085		0.0084		0.0016
		5.75		2.26		0.53
Management Fee		0.0195		-0.0511		-0.0215
		0.90		-0.91		-0.34
Incentive Fee		0.0080		0.0069		0.0042
		4.65		1.59		1.01
High-Water Mark		0.0001		0.0003		0.0004
		0.38		0.96		1.07
Lockup period		0.0001		-0.0002		
		0.41		-0.49		
Notice period		0.0037		0.0069		-0.0694
		2.08		1.08		-0.69
Redemption period		-0.0002		0.0008		-0.0804
		-0.35		0.34		-1.63
Intercept	0.0034	0.0024	-0.0002	-0.0004	-0.0032	-0.0019
	2.07	1.48	-0.13	-0.22	-1.89	-0.92
Strategy Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes
Newey-West Standard Errors?	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: Annual Performance Persistence of Absolute Return UCITS and Hedge Funds

Table 9 presents the performance persistence tests based on the annual rebalancing horizons over the period from January 2005 to June 2012. Funds with the highest Alphas *t*-statistics comprise quantile 5, and funds with the lowest comprise quantile 1. *Alpha* and its t-statistic estimated using the Fung-Hsieh (2004) model. *Sharpe* is the annualized Sharpe ratio of the respective portfolio. *MPPM* is the manipulation-proof performance measure based on Goetzmann, Ingersoll, Spiegel, and Welch (2007). *CVaR* is the empirical expected shortfall at 95 percent level.

All HFs

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-0.22	-0.13	0.27	0.44	5.88
2	1.74	0.87	0.47	2.23	5.77
3	1.25	0.58	0.47	2.22	7.29
4	-0.71	-0.42	0.24	-0.29	8.17
Top	2.20	1.84	0.52	2.45	6.24
Top-Bottom	2.42	1.97	0.25	2.01	0.36
test stat	2.18				

ARUs

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-2.89	-1.02	0.22	-1.97	9.84
2	-3.04	-1.18	0.23	-3.66	11.96
3	-4.48	-1.58	0.17	-7.16	14.21
4	-5.62	-1.89	0.06	-6.94	12.96
Top	-1.90	-0.74	0.24	-3.58	12.08
Top-Bottom	0.99	0.28	0.02	-1.61	2.24
test stat	0.53				

All Illiquid HFs (longer than monthly redemptions, lockup restriction)

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-0.01	0.00	0.19	-0.96	8.07
2	0.04	0.03	0.23	-0.53	8.72
3	0.29	0.17	0.27	-0.15	8.44
4	0.55	0.33	0.30	0.33	7.88
Top	2.29	1.64	0.61	2.77	5.32
Top-Bottom	2.29	1.64	0.42	3.73	-2.75
test stat	1.50				

All Liquid HFs (Bi-weekly Redemptions, no lockups)

Portfolio	Alpha	tStat	sharpe	MPPM	CVaR
Bottom	-1.65	-0.73	0.14	-0.79	6.24
2	0.14	0.06	0.31	0.42	7.16
3	1.53	0.76	0.47	2.05	7.42
4	0.10	0.04	0.30	-0.17	9.25
Top	4.11	2.37	0.57	3.14	7.66
Top-Bottom	5.76	3.10	0.43	3.93	1.42
test stat	3.55				

All European HFs

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-2.40	-0.90	0.16	-1.66	8.25
2	-0.84	-0.30	0.28	-0.59	8.76
3	-1.07	-0.38	0.24	-1.04	8.78
4	-3.17	-1.10	0.05	-3.60	9.47
Top	-1.73	-0.76	0.08	-1.78	7.50
Top-Bottom	0.68	0.14	-0.08	-0.12	-0.75
test stat	0.35				

Liquid European HFs (Bi-weekly Redemptions, no lockups)

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-3.50	-1.35	0.05	-2.88	8.57
2	-0.80	-0.28	0.26	-0.77	8.70
3	-2.60	-0.88	0.13	-2.70	8.81
4	-3.87	-1.21	0.02	-4.48	10.15
Top	-2.35	-0.90	0.05	-2.80	8.23
Top-Bottom	1.15	0.45	0.00	0.08	-0.34
test stat	0.58				

Table 10: Monthly Performance Persistence of Absolute Return UCITS and Hedge Funds

Table 9 presents performance persistence tests based on the monthly rebalancing horizons over the period from January 2005 to June 2012. Funds with the highest Alphas *t* statistics comprise quintile 5, and funds with the lowest comprise quintile 1. *Alpha* and its t-statistic estimated using the Fung-Hsieh (2004) model. *Sharpe* is the annualized Sharpe ratio of the respective portfolio. *MPPM* is the manipulation-proof performance measure based on Goetzmann, Ingersoll, Spiegel, and Welch (2007). *CVaR* is the empirical expected shortfall at 95 percent level.

All HFs

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-0.67	-0.36	0.22	-0.13	6.28
2	-0.06	-0.03	0.37	0.98	7.68
3	0.35	0.21	0.37	1.06	7.40
4	1.36	0.88	0.44	1.81	7.02
Top	3.62	2.79	0.76	4.25	5.51
Top-Bottom	4.30	3.15	0.54	4.38	-0.77
test stat	3.28				

ARUs

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-1.50	-0.52	0.32	-0.84	9.72
2	-3.28	-1.18	0.21	-4.33	12.65
3	-6.10	-2.14	0.06	-7.87	13.68
4	-5.32	-1.87	0.09	-6.78	13.09
Top	0.14	0.05	0.38	-1.00	11.27
Top-Bottom	1.65	0.57	0.06	-0.16	1.55
test stat	0.71				

All Illiquid HFs (longer than monthly redemptions, lockup restriction)

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-2.01	-1.38	0.02	-2.92	8.78
2	-0.21	-0.12	0.23	-0.83	9.12
3	1.08	0.68	0.37	1.11	7.86
4	2.39	1.48	0.47	2.15	6.86
Top	3.74	2.80	0.87	4.20	4.34
Top-Bottom	5.76	4.18	0.85	7.12	-4.44
test stat	4.23				

All Liquid HFs (Bi-weekly Redemptions, no lockups)

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-1.43	-0.64	0.19	-0.73	7.52
2	-1.07	-0.48	0.27	-0.22	8.02
3	0.33	0.15	0.39	1.15	7.72
4	2.74	1.49	0.51	2.54	7.55
Top	4.66	2.52	0.64	3.91	7.68
Top-Bottom	6.10	3.16	0.45	4.64	0.16
test stat	3.32				

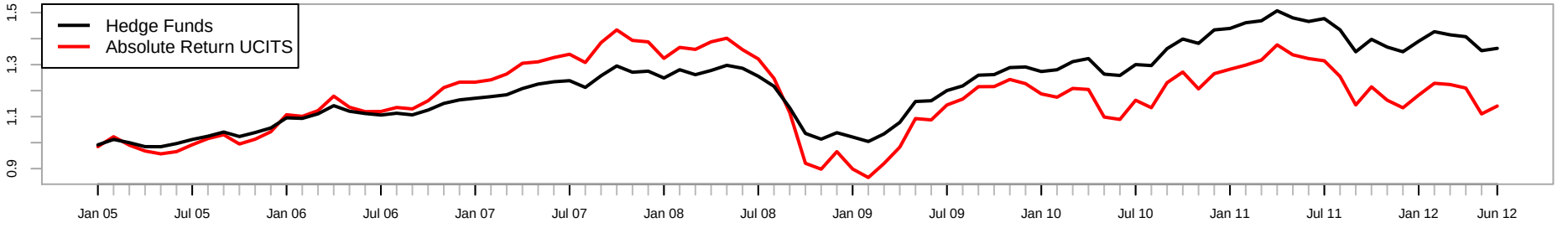
All European HFs

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-3.73	-1.29	0.08	-3.42	9.85
2	-3.38	-1.26	0.08	-3.93	10.20
3	-4.06	-1.34	0.10	-3.55	10.11
4	-0.79	-0.28	0.23	-0.84	8.19
Top	2.26	1.10	0.51	2.52	5.75
Top-Bottom	5.99	2.39	0.43	5.94	-4.10
test stat	3.00				

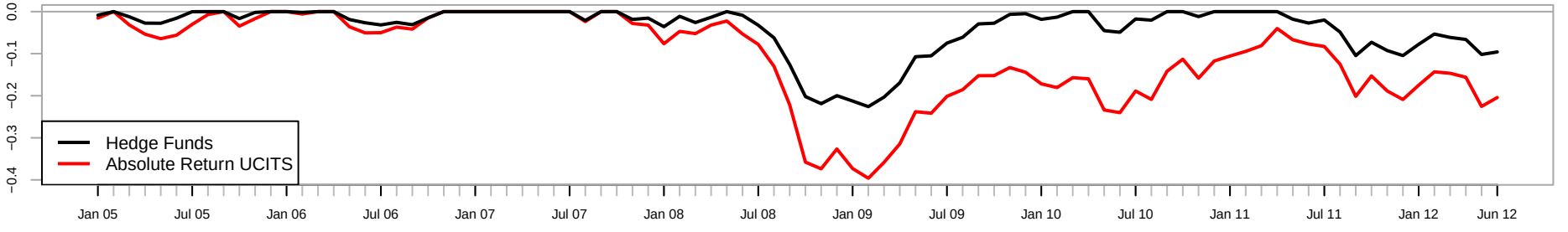
Liquid European HFs (Bi-weekly Redemptions, no lockups)

Portfolio	Alpha	t-stat	Sharpe	MPPM	CVaR
Bottom	-4.27	-1.55	0.03	-4.01	9.82
2	-4.09	-1.45	0.05	-4.69	10.87
3	-4.97	-1.57	0.05	-4.47	10.21
4	-2.16	-0.74	0.15	-2.16	8.85
Top	1.94	0.73	0.41	1.58	6.25
Top-Bottom	6.21	2.28	0.38	5.59	-3.57
test stat	2.77				

Figure 1: Average EW Performance
Panel A: Cumulative Returns 2005−2012



Panel B: Maximum Drawdowns 2005−2012



Panel C: Rolling 24−Month Sharpe Ratio

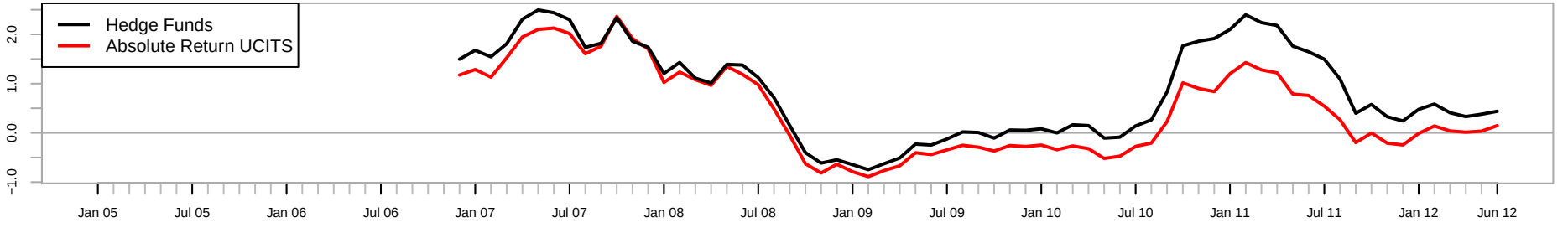
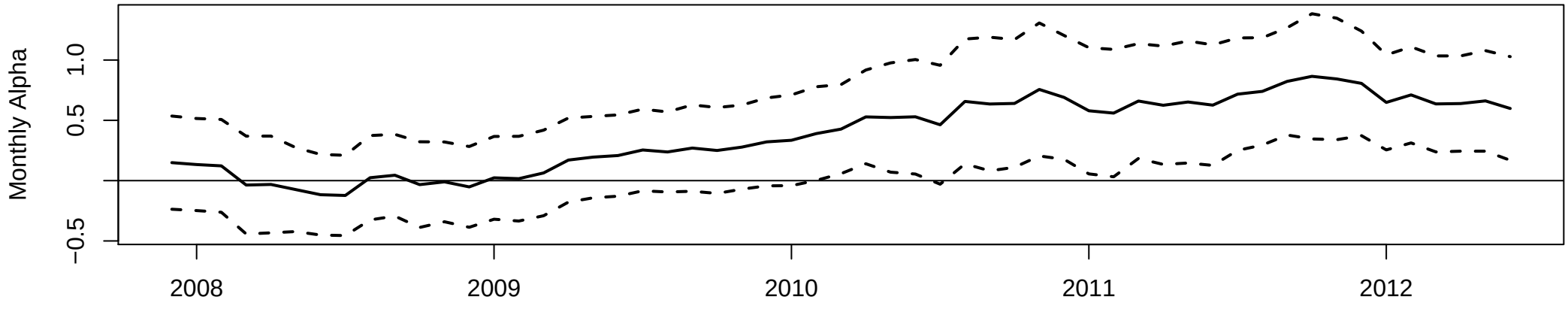


Figure 2: Time−Varying Alpha Spread of Hedge Funds and Absolute Return UCITS

Panel A: Rolling 36−Months EW Alpha Spread between HFs and ARUs



Panel B: Rolling 36−Months VW Alpha Spread between HFs and ARUs

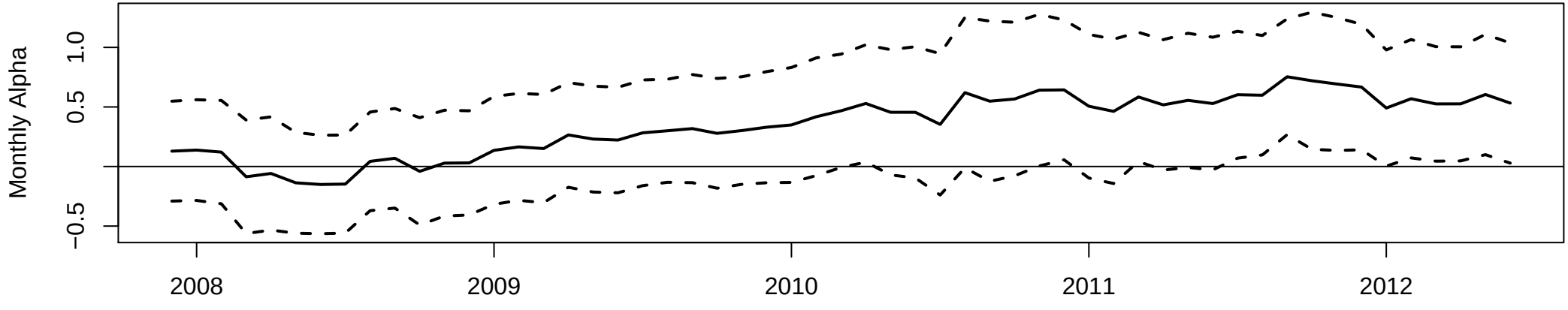
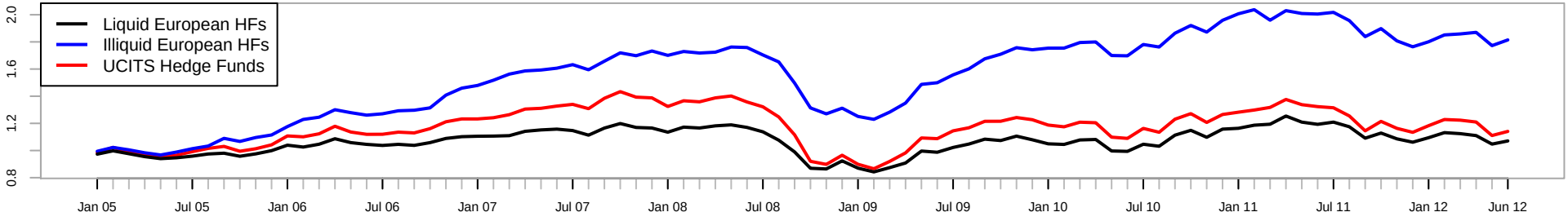
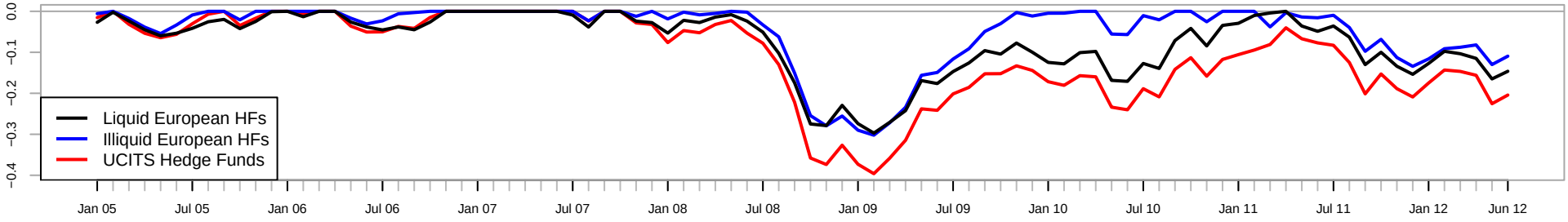


Figure 3: Impact of Liquidity on Performance

Panel A: Cumulative Returns 2005−2012



Panel B: Maximum Drawdowns 2005−2012



Panel C: Rolling 24−Month Sharpe Ratio

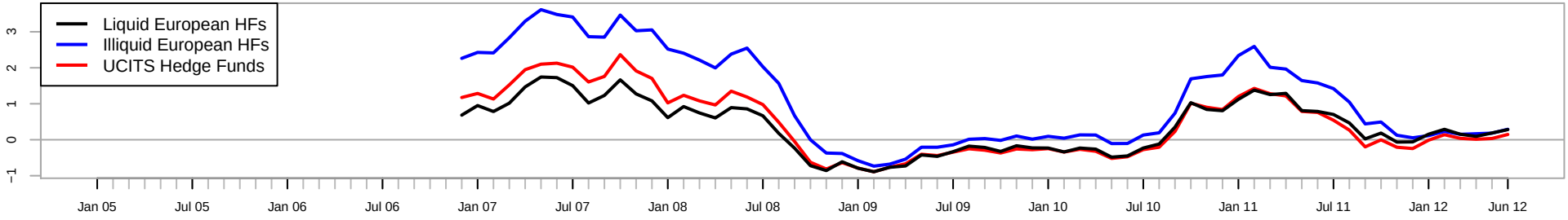
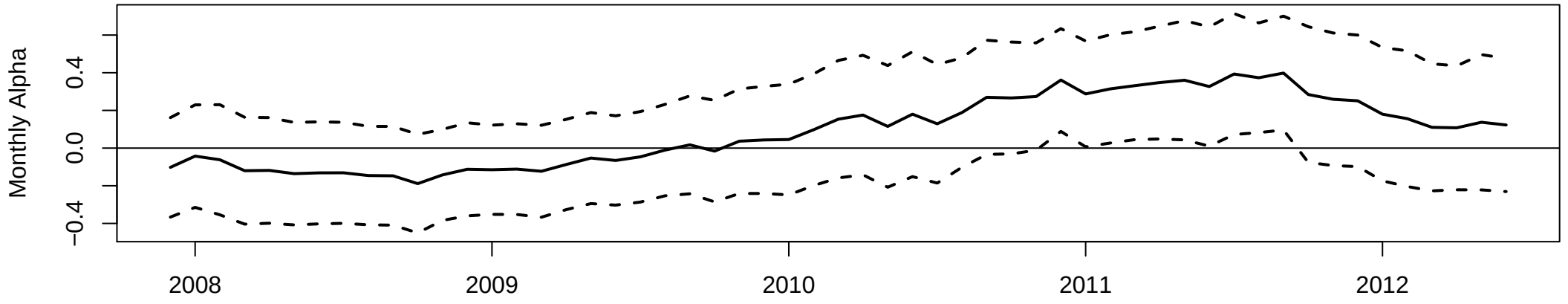


Figure 4: Impact of Liquidity to Time−Varying Alpha Spread

Panel A: Rolling 36−Month Alpha Spread between European Liquid HFs and ARUs



Panel B: Rolling 36−Month Alpha Spread between European Illiquid HFs and ARUs