ERASMUS UNIVERSITY ROTTERDAM
Erasmus School of Economics

Master Thesis Financial Economics

A Comparison of Alternative UCITS and Hedge Funds Performance

Name student: Agnieszka Dabrowska
Student ID number: 477851

Supervisor: Dr. Mary Pieterse-Bloem
Second assessor: Dr. Sjoerd van den Hauwe

Date final version: 12th August 2018

Abstract

This study analyses and compares the performance results of alternative UCITS and offshore hedge funds to gain insight into their characteristics and to determine whether the alternative UCITS funds can be the suitable substitute for those investors seeking to invest their money into offshore hedge fund-like strategies. Based on the single-index model the alternative UCITS funds show moderate exposure towards the matched offshore hedge funds excess returns. According to the seven-factor model both funds' groups show exposure towards the equity market factors; however, the alternative UCITS funds load on different risk profiles then the offshore hedge funds indicating they follow different strategies.

Table of Contents

List of Tables

1. Introduction

UCITS (Undertakings for Collective Investment in Transferable Securities) funds are mutual funds that emerged in the 1980s and which are easily available globally to retail investors. Considering their retail investor audience, UCITS funds are subject to strong regulatory scrutiny and oversight with embedded investment restrictions. Since the UCITS brand was first created it has evolved substantially, with already five different directives introduced by the EU policymakers over the past three decades. What is more, a sixth version of the UCITS directive is rumored to be under construction.

In the past, particularly in continental Europe, many retail or even institutional investors were not able to invest in funds following hedge fund-like strategies due to regulatory obstacles (Busack et al. 2014). Nowadays investors can choose from a wide range of UCITS funds that offer strategies previously available only to hedge funds' investors. According to the LuxHedge report from January 2018 UCITS brand manages around 9.71 trillion Euro belonging to investors in Europe and in Latin America and Asia-Pacific (APAC). Out of this sum, alternative UCITS funds account for over 450 billion Euro with more than 240 new alternative UCITS funds launched in 2017 alone.

The 3rd UCITS directive introduced back in 2003 expanded the range and type of instruments that the UCITS funds can implement. From that moment on UCITS funds (so-called 'alternative UCITS') can use the derivative instruments in their investment processes. The alternative UCITS funds truly took off after the financial crisis of 2007-2008 when investors start questioning the risk and protection level of the conventional hedge funds. Investors seek more transparent, regulated and liquid alternative investment products. Furthermore, at that time the fund managers look for new distribution channels to increase their investor base and recover their assets level lost due to investor redemptions. All these circumstances increased significantly the popularity of alternative UCITS funds among the fund managers and investors. However, is the alternative UCITS funds' structure suitable for the investors seeking to invest in hedge fund-like strategies? Nowadays, this question is of utmost importance for those European investors who are tightly constrained from investing in offshore hedge funds due to for instance high entry investment requirements, unfavorable tax treatments or quantitative restrictions. Considering the degree of freedom with regards to the use of derivatives the alternative UCITS funds may

accommodate the alternative strategies. However, on the other hand, short-selling restrictions, additional costs, diversification requirements or higher liquidity related with the alternative UCITS funds can prove not suitable for creation of alternative, hedge fund-like, strategies. Additionally, there are also concerns about the alternative UCITS, being a tightly regulated solution targeting retail investors, should in fact follow the offshore hedge fund strategies.

Considering the above the main research questions of this study are whether alternative UCITS funds can, in fact, substitute offshore hedge funds strategies and are alternative UCITS funds generating higher or same returns than the less regulated hedge funds? The comparison of both funds types performance results can give some insight into whether alternative UCITS funds are the right solutions for investors wishing to put their money into hedge fund-like strategies.

Despite huge growth of alternative UCITS funds in the years post the financial crisis there is still little empirical research available on the alternative UCITS funds. Few studies have been made on the comparison of the alternative UCITS funds and hedge funds (Darolles (2011), Tuschmid (2011, 2013) and Busack et al. (2014)). Additionally, Dewaele et al. (2011) and Busack et al. (2017) provide studies on the alternative UCITS funds' performance. This study contributes to the previous literature in two ways. First, it covers the most recent, up to the end of 2017, performance data of the alternative UCITS and hedge funds allowing for most up to date analysis of the status of both groups' performances. Second, the study accounts for survivorship bias by including both the live and dead alternative UCITS and hedge funds in the analysis, instead of focusing only on the alternative UCITS and hedge funds indexes. Previous studies consider both live and dead funds within their alternative UCITS funds' sample only; however, they use the hedge funds indexes which are subject to survivorship biases as very often data vendors and index creators keep only operating funds in their databases.

This study uses two regression models to compare the performance results and strategies followed by the alternative UCITS and offshore hedge funds. The first regression model is the single-index model which compares the excess alternative UCITS funds strategies returns with the matched excess returns on hedge funds strategies. The second regression is a seven-factor model, developed initially by Fund and Hsieh (2004). The multi-factor model's structure separates the funds' returns into alpha and different beta factors, which allows identifying the fund-specific component (alpha) from the common factor performance which bears the systemic risks (beta). Within the seven-factor model, the authors add 3 new factors (called: 'trend-following factors')

that aid in understanding the hedge funds' returns through capturing the non-linear payoff structure of the dynamic trend-following strategies. Fung and Hsieh (1997) extract the common return component from the trend-following funds which they later structure into a portfolio of 'lookback straddles'[1] (Fung and Hsieh, 2001). The trend followers exploit the market opportunities and bet on big moves. This approach is similar to option buyers who make money typically when the markets are volatile. The lookback option portfolios show high correlation and similar return characteristics with those of trend-following funds. The authors eventually create 3 trend-following factors: portfolios of lookback straddles on currencies, bonds and commodities.

During the analyzed period from 2010 to 2017 the alternative UCITS funds underperform the offshore hedge funds in terms of the annualized raw returns; however, they show lower volatility. Based on the single-index model the alternative UCITS funds show moderate exposure towards the matched offshore hedge funds excess returns and underperform in terms of the adjusted-risk performance. In terms of the seven-factor model both alternative UCITS funds and offshore hedge fund show positive and significant exposure to equity risk factors. However, the alternative UCITS display lower exposure towards the market risk factors than the offshore hedge funds. These results are in line with the previous study by Tuchschmid (2011 & 2013) and Busack et al. (2014). Moreover, in case of the risk-adjusted performance, both funds' types exhibit large underperformance with almost no significant results especially in case of alternative UCITS funds which indicate that there is no added value beyond the systemic bets. Finally, the alternative UCITS funds load differently on the risk factors comparing with the matched hedge funds which indicate that they follow different strategies.

This study applies the following structure: Section II gives background information on both alternative UCITS and hedge funds. Section III is the literature review which provides a brief overview of prior research related to alternative UCITS and hedge funds performance. The next Section IV is methodology which explains the data, models and variables applied. Section V contains the results of the empirical evidence and the last Section VI concludes the study.

[1] A lookback straddle is made of lookback put and call options. The lookback option is a put (call) option that gives the owner of the option the retroactive right to sell (buy) the assets at their maximum (minimum) within the respective lookback period.

2. Background information on alternative UCITS funds and hedge funds

2.1. UCITS funds

The European Union's (EU) Directive on Undertakings for Collective Investment in Transferable Securities (UCITS) is a framework that started in 1985. Its main aim is the creation of a single European market allowing for the distribution of investment funds which can be sold within the European Economic Area (EEA) on a cross-border basis based on their authorization in a particular EU member state. These EU-regulated investment vehicles also have a high level of appreciation in a large number of non-EEA countries. The UCITS framework addresses some of the main investors' concerns following the 2007-2008 financial crisis, namely regulation, liquidity, custody of assets, risk management and transparency. What is more, it contains various provisions on the use of derivatives, leverage, and diversification with the purpose of keeping a high level of investor protection (Dewaele et al., 2011).

When it comes to UCITS funds structure each UCITS fund can create for different types of investors different share classes. Each UCITS fund can launch an unlimited number of share classes. The main reason for creating different classes is due to various fee levels (performance fees, management fees, up-from redemption and sales charges), different currencies, accumulating and distributing share classes as well as the unhedged and hedged share classes.

2.1.1. History and regulation

The initial UCITS directive from 1985 was a result of almost nine years of various political debates. It came as a kind of revolution creating the first harmonized European structure for retail open-ended funds enabling the retail funds' industry to take off. However, the initial version of UCITS directive came with quite some limitations on investment strategies. Anderberg and Bolton (2006) indicate that some of these restrictions were sensible, for instance, the restriction regarding investing in precious metals; however, others were not, for example, limited exposure to cash holdings and money market instruments (MMI), which finally excluded the UCITS cash funds. Based on the first UCITS directive the investments in transferable securities (mainly shares and bonds) needed to be the primary investment objective. There were already proposals made in the 1990's to alter this situation; however, the so-called UCITS II directive was eventually abandoned due to lack of political support.

In 2001 the update of the UCITS Directive was passed, collectively known as UCITS III. It allowed for smoother cross-border selling of UCITS funds and gave asset managers a broader scope of eligible investment instruments. Besides investments in transferable securities, UCITS funds can also invest in money market instruments, bank deposits, other funds, and derivatives. However, the new directive asked also for an independent risk management to increase the investor protection.

The next amendment to the UCITS directive, UCITS IV, came in 2009. The main changes brought by UCITS IV focused on efficiency improvements of the cross-border marketing process by changing the existing registration process with the regulator-to-regulator notification procedure, authorization of master-feeder structure and provision of a framework for the cross-border UCITS funds' mergers. One of the key change was also an introduction of a management company passport that allows fund managers to market their UCITS funds in different EU member states without a need to apply for additional registrations. The final crucial change was the introduction of a 2-3-page document, the key investor information document (KIID), which replaced the simplified prospectus introduced by UCITS III and which purpose was to provide the investor with the crucial information about the fund in simple English. As summarized by Fermaud (2014) the following information needs to be included in the KIID: the fund name, fund's management company details, an assessment of the fund's risk profile, information on the fund's investment policy, practical information about selling and purchasing shares in the fund, costs and fees borne by the fund.

The next amendment to UCITS directive, named UCITS V, was adopted and came into force in 2014, while EU member states received 18 months transition period until 2016 to implement the changes. The main aim of this new directive is to increase investor protection. It imposes a requirement on self-managed UCITS and UCITS management companies to introduce a remuneration policy to make sure that the compensation arrangements of the staff that could potentially materially impact the UCITS risk profile will not cause the UCITS to take unacceptable levels of risk. The directive also imposed a series of measures towards the depositaries. Including the requirement to appoint a depositary to UCITS, the definition of entities that can act as a depositary and their obligations. The depositary liability obligation has also been amended imposing on UCITS depositaries to return the assets that they hold in custody in case of the loss

of assets. It could only avoid this liability if it can prove that the loss of the assets was due to 'external event beyond its reasonable control'.

In 2012 the European Commission circulated a consultation document on UCITS seeking market feedback on, among other topics, UCITS investment policy including the eligible assets and the use of derivatives. It also addressed the question of depositary passport, money market funds and long-term investment products. This initiative sometimes referred to as UCITS VI, can create a foundation for the further amendments to UCITS framework. At the moment of preparation of this study, there was no further information from the EU Commissions with regards to the results of this consultation or further actions.

2.1.2. UCITS framework

Eligible investment instruments

The Committee of European Securities Regulation, following a mandate received from the EU Commission, issued a guideline listing the investment instruments possible under the UCITS directive. UCITS can invest in the transferable securities including bonds and other types of debt instruments, shares and securities equivalent to shares as well as other negotiable securities that can acquire the transferable securities through subscription or exchange. UCITS are allowed also to invest in financial derivative instruments marketed over-the-counter (OTC Derivatives) or on a regulated market. As pointed out by Tuchschmid et al. (2013) although the short selling is not permitted UCITS funds can achieve synthetically short positions through derivatives like options, swaps or futures. However, these short positions must be sufficiently covered either by the underlying asset or asset that is correlated to the underlying assets. Further UCITS can also invest in bank deposits, shares and units of other UCITS or other Undertakings of Collective Investments (UCIs) and money market instruments. Tuchschmid et al. (2013) point out that in most jurisdictions investments in commodities and their certificates are not allowed for UCITS funds while investments in real-estate holdings, private equity and hedge funds are prohibited in all jurisdictions. However, some non-eligible assets such as commodities or hedge funds can be accessed by UCITS funds via their indices representatives. It is finally worth noticing that there is an exemption to the UCITS directive allowing UCITS funds to hold a maximum of 10% of the total portfolio in non-eligible assets, called 'trash ratio'.

Liquidity

In contrast to hedge funds that typically have monthly or quarterly redemption frequency and can impose a lock-up period on investors for a long period of time, the UCITS funds must be liquid which means that they must allow to investors redemptions at least on a bi-monthly basis. Plus, the redemption proceeds must be paid within 10 business days following the dealing day. Majority of the UCITS funds offer daily liquidity with the remaining offering bi-monthly and weekly liquidity. Considering these requirements, the underlying investments of UCITS funds also must be liquid which is obtained by following the diversification and eligible assets conditions. According to Tuchschmid et al. (2013) if a UCITS fund uses a large degree of derivatives the regulation requires a daily liquidity; that is why most of today's UCITS funds offer to the clients this level of liquidity. However, because many UCITS funds require a five-day notice period this gives the clients a weekly liquidity. Despite this notice period, these redemption frequencies are still far higher compared to hedge funds.

The fund can limit the redemptions to 10% of the Net Asset Value (NAV) of the fund on a dealing day and carry over the balance to the next dealing day. This means that if the UCITS funds' liquidity is bi-monthly then the maximum redemption limit per month can be 20% of the NAV. This option to defer part of the redemption request to the following dealing day gives the fund managers possibility to liquidate the positions in an orderly fashion in case of large redemptions and without having to borrow money to meet these requests.

The rigorous liquidity requirements applied to UCITS funds were advantageous during the 2007-2008 financial crisis; however, they are also related to costs. Beaudoin and Olivier (2010) indicate UCITS funds are prohibited from investing in illiquid securities, long-term strategies or distressed securities. Focusing mostly on the liquid portion of the market offers fewer opportunities. Investor aiming for the liquid onshore funds will have to accept the difference comparing with the offshore funds' performance (Fieldhouse, 2010).

Risk Management

UCITS funds have a very complete risk-control framework. There are strict borrowing and investment regulations to ensure the limitation or/and spreading of investment risk. Each UCITS fund must prepare a Risk Management Process (RMP) and have it approved by the home regulator. For instance, in Ireland, this document defines the types of derivatives that are used by the fund,

the risk associated with them and how this risk is controlled and managed. The purpose of the RMP is also for the UCITS fund to measure and monitor the risk and contribution of the underlying investments to the overall portfolios' risk profile. A separate risk-management team must be created within each fund management company offering UCITS funds. In addition to that, according to the UCITS directive, the UCITS funds must consider the management of all crucial risks, including concentration risk, liquidity, leverage, operational and counterparty risk. UCITS funds can be categorized into non-sophisticated and sophisticated funds depending on the use of derivatives. Although the difference between these two types is not very precise it is important operationally because sophisticated funds must implement comprehensive RMP (Tuchschmid et al. 2013).

The UCITS directive on risk management regulation relates to the VaR measure. VaR estimates the maximum loss a portfolio can experience during a certain period at a certain confidence level. There are two acceptable for UCITS VaR levels: relative and absolute VaR. Relative VaR applies to UCITS funds that have a suitable reference index. In such situation, the VaR of the index works as a benchmark for the respective UCITS fund's VaR level. VaR of the UCITS fund cannot exceed twice the value of the VaR of the benchmark index. The absolute VaR approach applies when there is no suitable reference index for the UCITS fund. In such cases, the 99% VaR cannot exceed 20% of the NAV.

Transparency

Transparency is crucial within the UCITS regulations aiming at greater investor protection. UCITS funds must provide various publications to facilitate adequate information for investment decisions. Each UCITS fund must publish a simplified prospectus that provides information on the UCITS' objective, its historical performance, and assessment of the risk profile. Further UCITS fund must provide semi-annual and annual (the latter must be audited) financial statements. On top of that, the UCITS IV directive implemented the so-called KIID (Key Investor Information Document) that also must be published by each UCITS fund. It provides the investor with all essential information on the fund in simple English.

Leverage

As already indicated direct short selling is not allowed for UCITS funds nor is borrowing unless it works as a bridge for settlement mismatches between fund transactions and investors with the

maximum of 10% of the NAV. Leverage in UCITS funds (also called global exposure) is allowed only through derivative instruments. Limits on leverage levels can be measured in two ways: the commitment approach or the Value at Risk (VaR) and stress test. The commitment approach can be used by those UCITS funds that do not use complex derivatives nor use the derivatives extensively. It allows a limit of a maximum 200% leverage of NAV. More sophisticated UCITS funds that apply strategies using large volumes or complex derivatives measure the leverage through the VaR. The absolute VaR, according to which the 99% (confidence interval) monthly VaR cannot exceed 20% of NAV or it cannot exceed twice the level of reference portfolio (Tuchschmid et al., 2013). While the relative VaR is twice the level of VaR of the derivative-free benchmark. Additionally, implementing some further conditions on the use of a particular VaR measure, such as back-testing regime or stress testing, can impose further limits on leverage.

Fees

Considering the regulatory obligations and other different rules, such as risk management, regular reporting requirements and fees charged by platform providers, the UCITS funds must cope with higher average fees. The operational requirements costs including fund accounting, transfer agency and custody can be similar comparing with offshore funds, especially at larger asset levels. However, due to the increased frequency of operation such as cash transfers or portfolio valuations the costs can be higher per annum at lower assets levels. Furthermore, the cross-border/statutory costs are also significant tax and legal burdens for UCITS funds. These are not applicable to offshore funds as they are typically sold via private placements. The UCITS funds' management fees typically range between 0.75% and 2.00% of net asset value while the performance fees are between 10% and 20% of performance or benchmark's outperformance. Additional up-front redemption and sales charges are also possible.

Despite the above factors, investors and managers must consider whether greater regulatory oversight and greater liquidity justify higher fees imposed on UCITS investors. Fund managers understand that investors are very sensitive to fees' level and may try to align costs of the UCITS funds with the offshore funds. This is typically achieved by forgoing some management fees by the fund managers or putting limits on the overall costs. While in the past UCITS funds were expensive, scaring away more fee-sensitive investors, nowadays this is changing as fund managers are aware of the need to keep or attract new European investors.

One of the limitations related to UCITS investing is the fact that many funds accrue the performance fee on share class level, rather than on the investor level. This means that investors in UCITS fund below their high-water mark will continue to pay the performance fee, even though the fund is at the stage of recovering losses. There are number of methodologies in place for performance fee calculation including the performance of the average number of shares in issue, daily accruals of assets credit and debits or average performance across all shares. Some other methodologies also exist but none of them are perfect and NAVs are in all cases impacted by assets outflows and inflows. Series accounting or equalization principles largely used under offshore funds are not applied to UCITS funds mostly due to their retail nature. Although UCITS funds are trying to implement various solutions regarding performance fee calculation it still causes huge dispute among all the parties within the UCITS industry.

2.1.3. Strategies

UCITS funds can offer hedge fund-like strategies under a regulated framework usually referred to alternative UCITS funds. UCITS funds are is typically more constrained when it comes to the types of investment strategies they can follow comparing with a traditional hedge fund. They can be structured as exchange-traded funds, traditional (long only) strategies (such as money market, funds of funds, bond, equity), structured products (structured, guaranteed funds, index) as well as alternative strategies (including such solutions like: credit, macro, equity, relative value, event driven or multi strategy). Most of the alternative strategies can work well within the UCITS rules; however, sometimes they require some adjustments in such areas as liquidity, diversification rules, eligible asset types or leverage limits.

Hedge fund manager who wants to replicate their existing offshore fund structure into a UCITS fund must conduct an analysis of the existing strategy and compare it to the UCITS rules to determine any potential issues. The strategy might fit within the UCITS framework with minimum adjustments required; however, in some cases, certain aspects of the alternative strategy need to be adjusted. In some instances, fund managers can achieve certain strategies under UCITS by using different techniques, for instance by using derivatives for shorting instead of physical shorting (which is not allowed under UCITS directive). One of such examples is long/short equity strategy which is constrained due to the restrictions on shorting. However, as mentioned by Beaudoin and Olivier (2010) the use of derivatives to gain short exposure involves additional costs

such as active collateral management related with the limitation of the counterparty risk to only 10% of the NAV. Furthermore, they also explain that with the short selling restrictions in place under UCITS framework strategies like fixed income arbitrage are challenging for implementation due to difficulties related to establishing short position through derivatives in non-equity instruments. Dewaele et al. (2005) explain that under UCITS regulation, UCITS funds can reach a maximum short exposure of 30%. This is not sufficient to create a matched-pair strategy in which one security is held short and another is held long. Basically, only 60% of the portfolio (meaning 30% short and 30% long) can be dealt on a matched-pair basis.

Beaudoin and Olivier (2010) explain further that such alternative strategies as emerging markets which involve more concentrated portfolios are affected by the strict diversification requirements imposed on UCITS funds. Leverage requirements under UCITS directive also impact hedge fund strategies which involve highly leveraged positions like for instance fixed income arbitrage. Furthermore, the liquidity requirements cause also obstacles for UCITS funds to enter some of the alternative strategies. The long-term and illiquid nature of distressed and even driven strategies resulted in only a few UCITS funds operating in this area.

However, many of the presented restrictions can be overcome. Markov and Tuchschmid (2011) indicate that an alternative UCITS fund can replicate the performance of an offshore hedge fund using total return swaps (TRS) or contracts for difference (CFD). Though these replicated strategies are not risk-free. They can be harmful to the fund itself as investors can become displeased due to large tracking error between the offshore and the onshore fund. As the authors also observe, even though they are technically allowed, such strategies are outside the scope of transparency authorized by the UCITS directives. They also comment that the appearance of even more mysterious and complex vehicles can be potentially harmful to the UCITS brand and many fund managers are pushing UCITS framework and not keeping to the rules in 100%. What can be even more worrying is that regulator can try to provide regulatory cover for these funds instead of focusing on the original objective of investor protection.

2.1.4. Challenges

Many alternative fund managers are not able or do not want to operate within the UCITS directive. Instead, they chose to comply with the AIFMD (Alternative Investment Fund Managers Directive). AIFMD is considered a post-financial crisis regulation launched in July 2014 impacting private

equity, hedge funds, real estate, infrastructure and nearly any alternative fund manager marketing non-UCITS funds in the EU. One of the important standards set by the AIFMD is the marketing ability in Europe. The directive specify that the investment decisions of the fund managers must be made within the EU. For non-European based managers, this can be challenging as they do not want to move their key personnel from the major US financial centers to EU. Whereas under the UCITS directive they can launch a fund, usually domiciled in Ireland or Luxembourg, which can be then 'passported' to other European jurisdictions. Another important objective built into AIFMD is the investor protection mostly focusing on the information disclosure which includes liquidity profiles and an independent valuation of assets. Based on this directive the alternative investment funds are intended only for professional investors; however, some EU states can make them available also to retail investors under the condition that additional safety measures are put in place at a national level. Another important objective is to remove the systemic risk that the alternative funds can create within the EU economy. To achieve this AIFMD requires that the remuneration policies within the management companies' employees are structured in a way that they do not encourage excessive risk-taking and that the fund manager implements proper risk management systems that also takes liquidity into account. The framework of both AIMF and UCITS directives have been well documented and it is important to notice several similarities between those two, especially when it comes to the previously mentioned remuneration policies or obligations regarding depository banks which are; however, much stricter under UCITS framework. From the moment of introduction of AIFMD there were a lot of comments concerning the future of alternative funds in Europe as well as future of UCITS funds. Fund managers must choose whether they want to market their products under the AIFM directive or whether they want to create new structures which will comply with the UCITS framework.

However, the AIFMD is not the only challenge that the European financial market must face. From the beginning of 2018 fund managers must deal with the Markets in Financial Instruments Directive II (MiFID II) which includes a comprehensive set of changes to the previously introduced in 1997 Markets in Financial Instruments Directive (MiFID). MiFID II replaces the initial MiFID and introduces requirements applicable especially to firms that produce and distribute financial instruments and provide investment services. The main objective of the MiFID framework is investor protection. Going into this direction there is huge emphasis put on the audit, compliance, and risk to ensure that financial instruments are created and developed in a

transparent manner and that they address the characteristics and needs of the target markets. The directive also focusses on the governance related to the manufacture (creation, development and issue) of investment products and their distribution into identified target markets.

The UCITS and alternative investment funds (AIF) managers are not included directly under the MiFID II scope. However; units and shares in the investment funds that they manage are financial instruments and companies that distribute these shares are within the scope of this directive. That is why UCITS and AIF managers are indirectly subject to many MiFID's product governance requirements. Fund managers' intermediaries or distributors cannot sell manager's products unless the manager provides them with the required product information and make sure that the distributors have a good understanding of the product and the product's approval process. Fund managers must also review their products to ensure that they remain consistent with the characteristics, objectives, and needs of the target market groups. Furthermore, the products manufacturers are also obliged to meet MiFID's Product Information requirements which extend the scope of the KIID document introduced by the UCITS directive. That is why fund managers must find a solution to produce and communicate this additional information to the distributors.

2.2. Hedge Funds

Wealthy individuals and institutional investors for many years have been attracted to hedge funds as different investment strategies to their traditional portfolio of assets. For the past few decades, hedge funds have evolved from minor investment vehicles to very sophisticated structures. It is not surprising that they have drawn a considerable attention not only from investors but practitioners and academics. Although the global financial crisis was turbulent for hedge funds and resulted in astonishing headlines many hedge funds were able to recover and they keep growing in power by remaining nowadays an essential part of the financial world.

There is no universally approved meaning of the term 'hedge fund'. However, this expression refers to investment vehicles that use different strategies to invest in a different range of asset classes. According to the Online American Heritage Dictionary, the hedge fund is defined as:

"*A pooled investment fund, usually a private partnership, that seeks to maximize absolute returns using a broad range of strategies, including unconventional and illiquid investments.*"

Brief history

Although first origins of hedge funds go back to 1920s, according to Anson (2006) Alfred W. Jones created the first hedge fund back in 1949 and introduced the name 'hedged fund'. He initiated the new investment model by including technical analysis solutions into forecasting which lead to the creation of first long/short strategy that incorporates both short positions in securities that are overpriced and long positions on securities that are underpriced. Jones contributed also to the incentive fee structure used still today by the hedge funds. However, the hedge funds' market remained still unknown to the investment world until 1966. That year an article appeared in Forbes describing Jones fund's return which at that time was considerably higher than any best performing mutual fund. This lead to a rapid expansion of hedge funds within the next two years until a considerable set back in the years 1969-1970 and 1973-1974, when many hedge funds suffered from capital withdrawals and losses. This was the situation until 1986 when again information in media appeared informing about the success of Julian Robertson's Tiger Fund with a compounded annual return of above 40% (after incentive fee and expenses) during the first six years of its existence. This caused interest in hedge funds and creation of many new hedge funds. Overall hedge funds investments decreased in the aftermath of the financial crisis in 2007-2008; however, afterward, the number of hedge funds has again grown over time.

Regulation

The U.S. restrictions and regulations that refer to hedge funds differ significantly from those related to mutual funds. Unlike hedge funds, mutual funds fall under the Investment Company Act of 1940 which is an extensive and detailed regulatory regime. U.S. hedge funds are exempt from standard reporting and registration requirements since they only accept high net worth and sophisticated institutional investors (Stowell, 2010a). In U.S. hedge funds fall under the regulations of the Commodity Futures Trading Commission. They are also subject to the provisions and rules of the 1922 Commodity Exchange Act that prohibits manipulation and fraud. On top of that according to the Securities Act of 1933, they are obliged to file a registration statement to the SEC (U.S. Securities and Exchange Commission) to obey the private placement rules. Following the global financial crisis, new regulations were put in place in U.S. and EU which introduced additional reporting requirements for hedge funds. In the U.S. the Dodd-Frank Wall Street Reform Act was established in 2010 which requires advisers who manage private funds of

more than 150$ million in assets to register under SEC. Fund managers must also provide updated ADV Forms (document including all details about adviser's ownership structure, business, types of advisory services offered, fee schedule, management background) to SEC together with information regarding their trading positions and AUM (assets under management). In Europe, the AIFM (Alternative Investment Fund Managers) directive requires all EU hedge funds managers to disclose information on a more frequent basis and to register with regulatory authorities. The main purpose of this directive is greater control and monitoring of alternative investment funds.

2.2.1. Hedge Funds framework

Transparency

Hedge funds are not required to make their investment returns and activities publicly available. A hedge fund investor can have access to the fund's reporting including information on the performance returns, detailed discussions of the assumed risks, positions valuation methodology or leveraged exposure. However, this information is typically not available to non-investors. In some circumstances, the hedge fund manager agrees to provide the fund's performance information to investment advisors who monitor the funds' performances and search for new potential investors in hedge funds. Nevertheless, hedge fund managers are very sensitive when it comes to distribution of their fund's information to any parties and closely monitor all the recipients of their data.

Leverage

Leverage is used very often in the hedge funds industry while the use of leverage is very limited within the mutual fund industry. Hedge fund managers apply leverage to increase their returns on a security (consequently also a level of risk) for the same level of initial capital. In most cases there are no regulations regarding the limit of the leverage's level that can be used; however, hedge fund managers usually provide the limit in the prospectus. Additionally, prime brokers also define the level of leverage that can be used by the fund manager depending on the strategy implemented (Capocci, 2013).

Stowell (2010a) discusses in his book a few examples of hedge funds' leverage. The first one is called a margin loan. If a hedge fund obtained $100 million from its investors, it can now borrow an additional $300 million from a financial institution like a bank and purchase securities

worth in total $400 million. It uses as a collateral these $400 million of purchased securities against the $300 million loan. Another type of leverage is created via a repurchase agreement based on which hedge fund sells a security to different party for a defined price and agrees to buy it back on a specified date at a higher price. Additionally, leverage can be also obtained by selling the securities short and purchase other securities as well as through derivatives contracts based on which hedge fund managers can have exposure to an asset without having to use much capital that would normally be required if they want to buy the asset directly.

Fees

Hedge fund managers charge their investors for two types of fees: a fixed management fee and a performance-based fee. The performance fee ranges typically between 10-40% of the fund's annual profit based on how well the hedge fund performed. Performance fees represent the fund manager's profit and create incentives for managers to achieve good results. In practice, the typical amounts of fees are 2% of the management fee and 20% of the performance fee, commonly named as the 2/20 principle.

When it comes to charging performance fee an additional safety measure called high-water mark is applied to make sure that investors do not pay for poor performance. If manager suffers losses over a certain period, he must recover those losses above the high-water mark before he starts charging the performance fee. This prevents the manager from taking the performance fee from the same gains twice (Stowell, 2010b).

Risk Management

Hedge funds' investor must be a qualified (accredited) investor who is assumed to be aware of the risks related to the investments and accept these risks. Hedge fund managers typically use comprehensive risk management strategies to protect the investors and the fund, to the extent that they employ independent risk officers who only focuses on managing and assessing risk. Fund managers use different measurement models and techniques to estimate risk according to the fund's liquidity, leverage and investment strategy. On top of that investors often arrange for operational due diligence (including such areas like management and organization on the side of the hedge fund manager, sustainability of the investment strategy and fund's ability to develop) to assess the risk related to fraud or error on the hedge fund side resulting in the loss to the investor.

2.2.2. Strategies

Different characteristics of hedge fund strategies make their classification very challenging. However, it is crucial to understand these strategies to profit from the opportunities they offer. Many strategies aim at market risk minimalization by using derivatives or short selling. Hedge funds investment strategies also offer different investment risk, volatility, and returns.

Morningstar introduced its Hedge Funds Category Classification back in 2005 and was revising it several times. At this moment Morningstar carries 31 hedge-fund categories which are grouped into six main categories (directional debt, directional equity, global/derivatives, relative value, event and multistrategy). A directional strategy involves taking a short and long position in a market. It bets on the direction in which the market is going to move. Within this strategy, the hedge funds either do not fully hedge or do not hedge at all. Although managers of those funds keep some exposure to the market they aim at achieving higher than expected returns for the risk that they take. Aggressive investors who are eager to take the systemic risk for potentially higher return usually invest in funds following the directional strategy. Equity hedge strategies take both short and long positions in equity derivative and equity securities. Directional debt strategy focusses on broad-based prices and changes in fixed income products. Usually manager selects different fixed income products like emerging market or high yield debt to provide the fixed investment solution. Funds within this strategy lean towards a long market exposure. Global derivatives/global macro strategies focus on broad-based prices and changes in global markets. These hedge funds make tactical decisions on optimal global allocation of assets and usually use bonds, equities, derivatives, commodities and currencies in their portfolio. Relative value strategies aim at exploiting mispricing between securities that are closely related. Event driven strategies gain on price movements by keeping positions in companies involved prospectively or currently in such corporate transactions as restructurings, mergers, security issuance, shareholder buybacks and other capital structure adjustments. Finally, multistrategy is a broad asset class containing hedge funds that merge into one single fund multiple techniques. The most popular subgroup within this strategy is a fund of hedge funds (FOF) which invest in different hedge funds to diversify the risk related with investment into a single fund and to provide broader exposure to the industry of hedge funds.

3. Literature overview

One of the first paper that this study is close to is Liang (1999). The author compares the performance of mutual funds and offshore hedge funds for a period from 1992 to 1996. According to the research results, the risk-adjusted performance of hedge funds is higher. The main reason behind these findings Liang attributes to the fact that hedge funds have better dynamic trading strategies, diversity of financial instruments they can invest in and incentive schemes.

Further studies of Koski et al. (1999), Deli et al. (2002) and Almazan et al. (2004) focus on the comparison of performance results between the mutual funds that use or do not use the derivatives. According to the results of Koski et al. (1999) risk and performance levels between funds that apply derivates and those that do not are similar. They also conclude that the risk management flexibility achieved using derivative increases the risk management of exposure. Furthermore, Deli et al. (2002) found that the use of derivatives adds efficiency.

For the U.S. market, Agarwal et al. (2009) investigated the performance of hedged mutual funds which hold many similarities compared to the alternative UCITS funds. The alternative UCITS are UCITS funds that are regulated under the European Securities and Markets Authority (ESMA) and follow hedge fund-like strategies. While hedge mutual funds are regulated by the U.S. Securities and Exchange Commission (SEC) and employ hedge fund-like strategies. The authors compare hedged mutual funds with traditional mutual funds and hedge funds by testing on three hypotheses. According to the skill hypothesis, the hedged mutual fund managers that have previous hedge fund experience outperform those hedge mutual funds that are run by managers without prior hedge funds experience. Next hypothesis focusses on strategy, based on which the authors assume that due to profits from both short and long positions and more diverse strategies hedged mutual funds can outperform traditional mutual funds. Final incentive and regulation hypothesis assume that due to compensation based on performance and lighter regulatory requirements hedge funds will outperform hedge mutual funds. For the analyzed period from 1994 to 2004 Agarwal et al. (2009) obtain results supporting all three hypotheses. Furthermore, the authors also try to find the answer to the question why hedge fund managers with experience want to launch hedged mutual funds if they provide inferior performance. Eventually, they conclude that hedge fund managers aim at raising new assets and having a more diversified client base.

Darolles (2011) tests in his study skill hypothesis developed by Agarwal et al. (2009) on alternative UCITS funds taken from the Morningstar database for the period from 2004 to 2011.

Similarly, to Agarwal et al. (2009) he also finds that alternative UCITS funds that are run by managers having experience with offshore fund strategies perform better than those managed by the non-experienced manager. Furthermore, Derolles (2011) also focuses on the regulation hypothesis and concludes that regulatory requirements have a negative impact on the performance of alternative UCITS funds as they underperform comparing with hedge funds.

Many critics argue that hedge funds' flexibility is in contradiction with the alternative UCITS funds' restrictions. UCITS regulations regarding leverage, diversification, eligible instruments or liquidity can curtail some offshore funds investment strategies causing to assume that the alternative UCITS funds average returns can be slightly lower when compared with the offshore hedge funds. However, some empirical results, especially those related to the period during the financial crisis, show that more conservative alternative UCITS funds delivered risk-adjusted returns like the offshore hedge funds' returns. Tuchschmid et al. (2010) study cross-sectional differences between traditional offshore hedge funds and alternative UCITS indices. For the analyzed period from March 2008 to May 2009 the authors find that alternative UCITS indices deliver competitive performance compared to offshore hedge funds. Additionally, they also observe differences in risk with alternative UCITS showing lower volatility. The main reasons behind it being the limitations on leverage, risk, and higher volatility. Tuchschmid et al. (2010) summarize that given the conservative nature of UCITS products it is of no surprise that they outperformed the hedge fund indices during the global financial crisis.

According to Dewaele et al. (2011) already for the period, 2010 to 2011 in 6 out of 10 strategy classes the offshore hedge funds perform better than the alternative UCITS funds. These include fixed income and long/short equity, two most popular strategies within the alternative UCITS funds with the highest value of AUM. Moreover, as shown by Tuchschmid et al. (2013) alternative UCITS funds are less likely to bring extreme returns under the legal and regulatory framework they need to comply with. The authors find differences in the set of investment opportunities of hedge funds and alternative UCITS and point out that hedge funds' dispersion of return is significantly higher and scattered over a larger range than in alternative UCITS. They also find large differences regarding the strategy level. Under some strategies, alternative UCITS funds underperform hedge funds in terms of absolute return, while in others the alternative UCITS perform better. Hedge funds seem to be more diverse group than alternative UCITS funds.

Busack et al. (2014) compare equally weighted alternative UCITS indices to hedge fund indices. According to their findings, the alternative UCITS funds show limited exposure towards the respective matched hedge funds strategies. The authors explain these results based on more rigorous risk limits of alternative UCITS and differences in regulation. Furthermore, according to Busack et al. (2014), the alternative UCITS funds during the full sample period from 2002 to 2012 outperformed the investable hedge funds and achieved similar results to non-investable hedge funds. On top of that, the alternative UCITS funds also show a lower standard deviation and smaller tail risks.

In the latest study by Busack et al. (2017) the authors analyze the performance persistence of alternative UCITS funds. They conclude that performance persistence of alternative UCITS funds is less pronounced compared with hedge funds and that both groups are distinctly different in that the hedge funds display persistence over longer time periods, although both alternative UCITS and hedge funds follow similar strategies. Additionally, fund characteristics, such as management fee, size, and hedge fund experience are also linked to persistence. Alternative UCITS with an equivalent offshore fund has a similar persistence to a traditional hedge fund.

Based on the above literature overview these study hypotheses are as follow:

H1: *Alternative UCITS funds and their strategies are exposed to and driven by the same risk factors as the respective matched offshore hedge fund strategies (single-index model).*

H2: Alternative UCITS funds risk profiles are very similar to the offshore hedge funds risk investment profiles (seven-factor model and coefficients comparison).

H3: Alternative UCITS funds show higher adjusted-risk returns than offshore hedge funds (seven-factor model alpha).

4. Research design

The study analyses and compares the performance of alternative UCITS and hedge funds over the period from January 2010 to December 2017. This part of the study describes the creation of the universe, presents the factor models under consideration and analysis method.

4.1. Data

Data for the alternative UCITS funds is extracted from the two databases: Morningstar and Datastream. Morningstar provides information on the alternative UCITS strategies allowing for selection of the ISINs required for the analysis. Historical monthly price information for the selected funds is downloaded from Datastream. In case of hedge funds as Capocci and Hubner (2004) state in their research three main databases are commonly used in scientific studies; TASS Management (TASS), Hedge Fund Research (HFR) and Managed Account Reports (MAR). Net asset values per share, performance indicators and strategy information for this study are extracted from the Lipper TASS database.

Set of screening criteria is applied to obtain a representative universes samples of both alternative UCITS and hedge funds. First, it is common practice among investment funds to launch different share classes and series under different currencies or different fees applied for different types of investors (Busack, 2014). For the purpose of this study, only one share class per fund is kept. Further, all non-euro denominated share classes or series are converted to euro using the month end exchange rate. The main reason behind it is to analyze the performance from the perspective of a European investor (Busack, 2014). Third, following the approach of Busack (2014) for the performance evaluation of funds, I only retain funds that have at least 5 years of performance history. Further, I exclude duplicates and funds that lack consecutive monthly returns. The net asset values per share and performance returns applied in this study are reported after performance and management fees; however, the study disregard such one-time fees like an entry or exit fees. Finally, a global universe of both types of funds and their respective strategies are grouped into portfolios and their raw monthly returns are calculated based on equally weighted monthly returns of the respective list of funds available within each portfolio group.

Investment funds databases, especially the hedge funds databases can suffer three most well-known biases that can affect the reliability of the analyzed alternative UCITS and hedge funds data. The first one refers to selection bias most common within hedge funds when data vendors select and decide, with the hedge fund's manager consent considering the confidentiality of the hedge funds' data, which funds to include in their database. That is why the data vendors will not cover the entire hedge funds' universe. It is also worth noticing that fund managers have an influence on the funds that are reported as they have an incentive to only report the funds that are doing well. In the case of alternative UCITS funds, this bias has a little effect since UCITS funds

are required to report their performance information on a consistent basis and make them publicly available. In case of hedge funds data, the Lipper Tass database is a source of thousands of both active and graveyard hedge funds data. The second most common bias is survivorship bias. Very often data vendors keep only operating funds in their databases. Hence, the funds that decided not to report the returns or ceased operations are not available. One of the reasons behind it is that they are uninteresting to investors (Fund and Hsieh, 2004). Considering that funds that ceased operations typically have worse performance that can potentially give an upward bias on the aggregate performance. Busack (2014) estimates that for the alternative UCITS funds the attrition rate reached even 7% during the financial crisis period. There is a continuous debate in the literature whether the graveyard funds should be included in studies focusing on investment funds performance. Brown et al. (1999) argue that removing ceased funds biases the results, while others (Agarwal and Naik, 2009) find that funds performance persistence is more pronounced in samples without the survivorship biases. This study accounts for the survivorship biases in a way that it includes both the live and defunct funds. The third bias is the incubation or backfill bias that arises when a fund enters a database after it earns a sequence of good past returns. According to Evans (2010) study, there is a quite small effect of backfill bias on the total fund returns. This study does not account for this bias.

The sample period spans from January 2010 to December 2017. The sample provides monthly returns and additional information on individual alternative UCITS and hedge funds and group them in sections depending on the strategies for proper conduction of the regression analysis and comparison. The 2010-2017-time frame provides in total 8 full years of monthly performance data which is sufficient evidence to carry out a comprehensive and reliable analysis and comparison of alternative UCITS and hedge funds' performance. A shorter data period can hinder the hypothesis, normality and robustness tests leading to biased results (statistical power and economical magnitude of coefficients estimates). The reason for this sample period is because prior and during the financial crisis there was only a moderate number of alternative UCITS funds available. Their amount increases significantly after the introduction of UCITS III directive and doubled between 2008 and 2010. Moreover, this approach is in line with previous studies on alternative UCITS funds which typically considered between 6 to 10 years of data. Finally, the performance data is not influenced by the recent financial crisis of 2007-2008.

All the funds including the alternative UCITS funds downloaded from the Datastream and Morningstar as well as hedge funds downloaded from Lipper TASS database are classified based on the strategies they follow into three main categories Equity Hedge, Relative Value and Global Macro/CTA, respective. This detailed classification and breakdown of all strategies is presented in Table 1. Following Busack (2014) approach this study does not consider Short-Biased funds and Funds of Funds. Additionally, it does not retain Event-Driven strategy considering the small number of funds and Mutli-strategy due to the strategy-based approach.

Table 1. Alternative UCITS and hedge funds classification

This table presents all alternative UCITS and hedge funds strategies obtained from the Morningstar and Lipper Tass databases respectively. All these strategies are classified under 3 main strategies classifications used for the further purpose of this analysis: Equity Hedge, Relative Value and Global Macro/CTA.

Morningstar Category (Alternative UCITS Funds)	Strategy classification	Lipper Tass Category (Hedge Funds)
EAA Fund Alt - Long/Short Equity - Emerging Markets	Equity Hedge	Long/Short Equity Hedge
EAA Fund Alt - Long/Short Equity - Europe		Equity Market Neutral
EAA Fund Alt - Long/Short Equity - Global		
EAA Fund Alt - Long/Short Equity - Other		
EAA Fund Alt - Long/Short Equity - UK		
EAA Fund Alt - Long/Short Equity - US		
EAA Fund Alt - Volatility	Relative Value	Fixed Income Arbitrage
EAA Fund Alt - Debt Arbitrage		Convertible Arbitrage
EAA Fund Alt - Diversified Arbitrage		
EAA Fund Alt - Long/Short Debt		
EAA Fund Alt - Market Neutral - Equity		
EAA Fund Alt - Systematic Futures	Global Macro/CTA	Emerging Markets
EAA Fund Alt - Global Macro		Global Macro
EAA Fund Alt - Currency		
EAA Fund Alt - Event Driven	Not included in the study	Fund of Funds
EAA Fund Alt - Multistrategy		Multistrategy
EAA Fund Alt - Fund of Funds - Equity		Dedicated Short Bias
EAA Fund Alt - Fund of Funds - Multistrategy		Event Driven
EAA Fund Alt - Fund of Funds - Other		

4.2. Methodology

This section of the study provides an overview of the regression models and analysis method applied to empirically test the hypothesis and draw the respective conclusions.

4.2.1. Regression models

Single-index model

Developed initially by William Sharpe back in the 1960s is widely used within the finance industry to measure the assets' returns. For this study the regression is as presented below with the alternative UCITS funds' excess returns regressed on the excess returns of the matched hedge fund portfolio:

$$r_{i,t} - rf_{i,t} = \alpha_i + \beta_i(rPORTFOLIO_{i,t} - rf_{i,t}) + +\varepsilon_{i,} \quad (1)$$

where $r_{i,t} - rf_{i,t}$ stands for the excess return of the alternative UCITS fund. The $rPORTFOLIO_{i,t}$ refers to the matched hedge fund portfolio. The risk-free rate $rf_{i,t}$ applied in this study is the 1-month Euribor rate from Datastream. The regressions are performed separately for each alternative UCITS funds' strategy with the matched hedge fund strategy portfolio and for the total portfolio of alternative UCITS funds and the global hedge fund. The regression results provide information whether the alternative UCITS funds give access to similar risk-return profiles and strategies as offshore hedge funds. According to Busack et al. (2014) the high *R*-squares and high regression coefficients imply that the alternative UCITS funds and hedge funds are close substitutes. Low *R*-squares but high coefficients suggest that alternative UCITS funds have different sources of risk, while the opposite meaning high *R*-squares and low coefficients indicate lower exposure to the hedge fund strategies. Finally, low *R*-squares and low and insignificant coefficients suggest that alternative UCITS funds do not deliver exposure to offshore hedge fund strategies.

The returns are calculated as a discrete month end total returns on the net asset values per share and converted to logarithmic returns as per the following equation:

$$r_{i,t} = \ln \frac{NAV_{i,t}}{NAV_{i,t-1}} \quad (2)$$

where $r_{i,t}$ stands for alternative UCITS fund return and the NAV is the net asset value per share.

Seven-factor model

The seven-factor model was proposed initially by Fund and Hsieh (2004) for performance measurement. Well-structured factor model can reveal crucial information regarding hedge fund portfolio's risk profile. The seven-factor model provides evidence where the average fund places

its bets and whether the fund, in fact, adds value beyond the systemic bets on the model factors (Agarwal et al., 2009). This model includes two equity factors and two bond factors as well as three non-linear trend-following strategies. The study estimates the seven-factor model for alternative UCITS and hedge funds to compare the exposure of their different factors based on the following regression:

$$r_{i,t} - rf_{i,t} = \alpha_i + \beta_{i,1}WMkt_{i,t} + \beta_{i,2}WSMB_{i,t} + \beta_{i,3}CE10Y_{i,t} + \beta_{i,4}CECSPREAD_{i,t} + \beta_{i,5}PTSBD_{i,t} + \beta_{i,6}PTFSFX_{i,t} + \beta_{i,7}PTFSCOM_{i,t} + \varepsilon_{i,} \quad (3)$$

where $r_{i,t}$ stands for the excess return of the risk-free rate $rf_{i,t}$ on alternative UCITS fund return or the excess return on hedge funds return. Similar to Busack et al. (2014) this study uses the Fama and French (2012) factors such as the European market ($WMkt$) and size ($WSMB$) instead of the S&P500 excess returns and the spread between Russel 2000 and S&P 500 index as initially proposed by Fung and Hsieh (2004). The European global market and global size factors are downloaded from the Kenneth French website[2]. Additionally, the global market factor is adjusted by adding back the 1-month US Treasury bill and deducting the 1-month Euribor rate. Further, for the calculation of the two bond factors the original model proposed by Fama and French (2012) uses the US bond market factors, instead, this study uses the European bond factors. To calculate the change in bond yields ($CEY10$) the 10-year German Government bond yield is used and to reflect the credit risk factor in bond market, the change in European credit spread ($CECSPREAD$) the study considers the difference between yield of iBOXX Euro Corporate AA Bond 7-10 Years Index downloaded from Datastream and the 10-year German Government Bond. Finally, the study applies trend-following factors: ($PTFSBD$) the bond, ($PTFSFX$) foreign change and ($PTFSCOM$) commodity, based on Fund and Hsieh (2001, 2004) to consider the dynamic trading strategies. These three factors were downloaded from Data Library of David Hsieh[3]. All factor returns, other than the two bond factors which are already denominated in Euro, are converted to Euro using month end exchange rates.

[2] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
3 http://faculty.fuqua.duke.edu/~dah7/DataLibrary/TF-FAC.xls

4.2.2. Analysis method

The data sample consists of equally weighted monthly returns of alternative UCITS and hedge funds portfolios over the period span from January 2010 to December 2017. Similar to previous studies performed on hedge funds and alternative mutual funds' performance comparison (Agarwal et al., (2009); Tuschmid et al. (2010 & 2013); Busack et al. (2014)) also this study applies the time series analysis to analyze the data. In order to achieve meaningful conclusion from the time-series regressions following tests of the data sets must be performed: testing for stationarity, autocorrelation, heteroscedasticity and multicollinearity.

Testing for stationarity

Before analyzing the performance results and comparison of alternative UCITS and hedge funds test for the non-stationary must be performed through the unit root test. This test is crucial as most forecasting methods built on the assumption of the stationarity. Lack of stationarity can lead to incorrect regression results such as for instance high R-square which can be assigned to variables that in fact are not correlated at all. The purpose of the unit root test in time-series data is to test for stationarity. Time-series data is stationary only if a movement in time does not create a different shape of the distribution. In order to test the stationarity, this study will rely on the results of the augmented Dickey-Fuller (ADF) test (H0: variable contains a unit root).

Autocorrelation/serial correlation

The autocorrelation in time-series analysis occurs when the error term of the regression model from one period is correlated with the error term of another period. This can lead to incorrect regression results where under- or overestimation of a particular variable in one period can result in under- or overestimation of the same variable in subsequent periods. This study uses the Durbin's alternative test to test for the autocorrelation. The null hypothesis is that there is no serial correlation.

Heteroscedasticity

The problem with heteroscedasticity of dataset appears when the data is widely scattered from the regression line instead of appearing within a similar proximity to the line (homoscedasticity). In case of heteroscedastic data, the regression results in terms of standard error may be biased. This study accounts for heteroscedasticity using Robust Standard Errors when running all the

regressions. The use of robust standard error has no impact on the coefficient estimates as they remained unchanged; however, because standard errors are changes, the t-statistics provides more accurate p-values.

Correlation and Multicollinearity

Multicollinearity occurs typically when there is a moderate or high correlation between two or more independent variables, meaning that one independent variable can be used to predict the other independent variable. Such a situation can skew the regression model's results. One solution to spot the multicollinearity is through calculation of correlation coefficients (correlation matrix) for all pairs of independent variables. In case the correlation coefficient is of value greater than 0.7 one of the independent variables must be removed from the regression model. However, relying only on the correlations of pairs of independent variables is limiting. The results of the pairwise correlation can be small; however, there can exist linear dependence between three or even more variables. To detect the multicollinearity additional test of variance inflation factor (VIF) is performed to verify if the variance increases. This measure shows how much the variance of the coefficient increases due to the correlation with other independent variables in the model. The VIF result of more than 10 means that there is serious multicollinearity in the model which require correction.

4.3. Descriptive statistics

Before conducting the analyzes and comparison of alternative UCITS and hedge funds, a closer look at the dataset is taken. The total number of alternative UCITS and hedge funds in this study sample is 524 and 618 funds respectively. For the first group the largest amount of funds are the long/short debt and equity funds followed by equity market neutral funds (see Panel A of Table 2). These strategies are considered to be least impacted by the UCITS regulation. In the case of hedge funds, the most popular are long/short equity and emerging markets strategies (see Panel B Table 2). Approximately 40% of alternative UCITS funds are domiciled in Luxembourg and above 45% of hedge funds are domiciled in the Cayman Islands (see Panel C and D) which clearly confirms the role of both these centers for European funds and hedge funds respectively.

Table 2. Strategy breakdown and domiciles

This table presents the strategy breakdown per number of alternative UCITS and hedge funds (Panel A and Panel B). Panel C and D show breakdown per number of alternative UCITS and hedge funds depending on funds' domicile.

Panel A: Strategy breakdown (Alternative UCITS Funds)	
Strategy	# funds
EAA Fund Alt - Long/Short Debt	86
EAA Fund Alt - Long/Short Equity - Europe	73
EAA Fund Alt - Market Neutral - Equity	61
EAA Fund Alt - Global Macro	55
EAA Fund Alt - Systematic Futures	54
EAA Fund Alt - Long/Short Equity - Global	48
EAA Fund Alt - Long/Short Equity - UK	40
EAA Fund Alt - Volatility	24
EAA Fund Alt - Debt Arbitrage	22
EAA Fund Alt - Long/Short Equity - Emerging Markets	19
EAA Fund Alt - Currency	18
EAA Fund Alt - Diversified Arbitrage	10
EAA Fund Alt - Long/Short Equity - US	9
EAA Fund Alt - Long/Short Equity - Other	5

Panel B: Strategy breakdown (Hedge Funds)	
Strategy	# funds
Long/Short Equity Hedge	395
Emerging Markets	95
Global Macro	40
Equity Market Neutral	32
Fixed Income Arbitrage	31
Convertible Arbitrage	25

Panel C: Fund domiciles (Alternative UCITS Funds)	
Domicile	# funds
Luxembourg	212
Ireland	80
France	59
United Kingdom	50
Sweden	25
Germany	20
Cayman Islands	10
Spain	9
Liechtenstein	9
Italy	8
Other	42

Panel D: Fund domiciles (Hedge Funds)	
Domicile	# funds
Cayman Islands	280
United States	232
Canada	34
Bermuda	17
Virgin Islands (British)	15
Australia	7
Ireland	6
Guernsey	5
Netherlands	4
South Africa	4
Other	14

Table 3. Seven factors – summary statistics

This table shows the descriptive statistics of the seven-factor model. WMkt is the European market minus the risk-free rate. WSMB is the equal-weight average of the returns on the three small stock portfolios for the European region minus the average of the returns on the three big stock portfolios. CE10Y is the change in the European Government 10 Years bond yields. CECSPREAD is the difference in yields between the European Corporate 7-10 AA Index Bond Yield and the European 10 Year Government Bonds Yield. PTSBD, PTFSFX and PTFSCOM are the three trend factors referring respectively to bonds, foreign change and commodity.

Variable	Obs	Mean	St Dev	Min	Max
WMkt	96	0.62	4.97	-12.20	12.08
WSMB	96	0.26	1.69	-4.71	4.49
CE10Y	96	-0.85	12.46	-29.34	59.20
CECSPREAD	96	-0.36	6.84	-50.09	30.55
PTSBD	96	-3.16	15.39	-26.75	47.34
PTFSFX	96	-3.48	17.67	-31.36	64.27
PTFSCOM	96	-1.16	14.95	-24.77	42.32

Table 3 provides the overview of the summary statistics of all the independent variables used in the analysis. The statistics include: mean, standard deviation (St. Dev.), minimum (Min) and maximum (Max) as well as the number of observations (Obs). Looking at the first two factors downloaded from the Kenneth French website the excess European market return ranges between -12.20 and 12.08 with the mean of 0.62 and standard deviation of 4.97 while the Small Minus Big has a lower standard deviation of 1.69 and mean of 0.26. When it comes to the two bond factors (change in the European Government 10 Years bond yields and the change of the difference between the European Corporate 7-10 AA Index Bond and the European Government 10 Years Bond) they both have minus mean values of -0.85 and -0.36 and the standard deviation values of 12.46 and 6.84 respectively. Finally, the three trend factors referring to bonds, foreign changed and commodity presents the negative mean from -1 to -3 and the standard deviation ranging between 14 and 17.

Table 4 gives the overview of annualized monthly raw returns, risk, skewness and excess kurtosis of all analyzed alternative UCITS funds, hedge funds and their strategies. Out of the total sample of analyzed funds 19 alternative UCITS funds and 190 hedge funds ceased to exist due to merger, liquidation or suspension of NAV reporting. The average annualized returns of all funds are 3.17% and 6.22% for alternative UCITS and hedge funds, meaning the second clearly outperform alternative UCITS funds in terms of raw return results.

Table 4. Time series summary statistics

This table presents the descriptive statistics of the alternative UCITS funds (Panel A) and the hedge funds (Panel B) separated per total, active only and dead only funds as well as per the three main strategy categories: Equity Hedge, Relative Value and Global Macro/CTA. Statistics are calculated using monthly data and all returns as expressed in Euro. Column 1 contains the total number of funds per each group category, Column 2 present the number of observations, Column 3 contains the annualized monthly raw returns expressed in %, next is the standard deviation (in %), Sharpe ratio (Column 5) and Column 6 and 7 show the value of skewness and excess kurtosis (kurtosis value minus 3).

	No of Funds	Return	St Dev	Sharpe Ratio	Skewness	Excess kurtosis
Panel A: Alternative UCITS Funds						
UCITS - All	524	3.17	2.18	0.05	-0.20	2.91
UCITS - Active	505	3.16	2.17	0.07	-0.22	2.93
UCITS - Dead	19	3.64	2.50	0.06	0.33	3.07
UCITS - Equity Hedge	194	4.19	2.50	0.10	-0.25	2.56
UCITS - Relative Value	203	1.59	1.24	0.03	-0.48	3.01
UCITS - Global Macro/CTA	127	4.12	2.81	0.02	-0.08	1.55
Panel B: Hedge Funds						
Hedge Funds - All	618	6.22	3.54	0.10	-0.23	2.35
Hedge Funds - Active	428	6.51	3.53	0.13	-0.19	2.36
Hedge Funds - Dead	190	5.39	3.56	0.00	-0.33	2.42
Hedge Funds - Equity Hedge	427	6.47	3.60	0.10	-0.25	2.10
Hedge Funds - Relative Value	56	4.06	1.58	0.25	0.40	3.36
Hedge Funds - Global Macro/CTA	135	6.32	3.91	0.06	-0.18	2.13

The performance of dead hedge funds is lower at the level of 5.39%; however, interestingly the dead alternative UCITS funds' performance is higher than all UCITS funds and is at the level of 3.64%. The dead funds do not exhibit higher standard deviation; however, in case of dead hedge funds investors are more likely to suffer more loses due to negatively skewed returns and higher excess kurtosis. Surprisingly the dead alternative UCITS funds show positively skewed returns.

Panel A of Table 4 provides the descriptive statistics related to alternative UCITS funds. During the analyzed period the alternative UCITS Relative Value strategy provide the lowest return of 1.59%, while the Equity Hedge strategy earns 4.19%. For the overall alternative UCITS portfolio the standard deviation is low at the level of 2.18% which is in line with the previous studies on alternative UCITS funds. The volatility is at similar level of above 4% for the Equity Hedge and Global Macro/CTA; however, only at 1.59% for the Relative Value strategy. The Sharpe ratio does not differ significantly across the strategies with the highest value of 0.10 for Equity Hedge.

Panel B of Table 4 contains information on the hedge funds' descriptive statistics. All hedge funds during the analyzed period achieved the annualized raw return of 6.22%. When it comes to hedge funds' strategies the returns range between 6.47% for Equity hedge and 4.06% for Relative Value. All the hedge funds portfolios in Panel B show similar volatility results except for Relative Value strategy with the standard deviation of 1.58%.

Comparing Panel A and Panel B it is apparent that hedge funds outperform alternative UCITS funds during the sample period on a raw return basis. The annualized raw return of global hedge fund portfolio is 6.22% comparing with 3.17% of global alternative UCITS funds. Although; hedge funds display higher standard deviations then the alternative UCITS funds their Sharpe ratio shows better results than the alternative UCITS funds meaning that the hedge funds investors can expect higher excess returns for the extra volatility of holding a riskier asset. Furthermore, the raw returns of both funds' types are not normally distributed, they all show positive excess kurtosis usually greater than 2 meaning that the distribution is too peak and almost all have negative skewness at around -0.2 level.

5. Empirical results and analysis

Prior to applying the time-series regression models and interpreting the results, the study focuses on performing all the required data tests (as described under methodology part: Analysis method) to achieve meaningful regression results free of any biases. The first test performed is the unit root test to check for the model stationarity. As per the results available in Appendix A the p-values of all the tested variables are equal to 0, the null hypothesis that variable includes the unit root can be rejected, meaning that the time-series data is stationary, free of any unit roots. The further test (alternative Durbin's test) check for the autocorrelation (results available in Appendix B). The tests show low values of chi-square and p-values of above 10% meaning that the null hypothesis of no serial correlation cannot be rejected; thus, the data series can be used without alterations. This applies to all the regressions except for those involving alternative UCITS Relative Value strategy data which has the problem with autocorrelation. To adjust the model for serial correlation within the error terms the variables are regressed using the Prais-Winsten estimation. Finally, the test results of the correlation between the pairs of independent variables (correlation matrix) are presented in the following section of this paragraph. In terms of the linear dependence of more than the pair of independent variables the variance inflation factor (VIF) tests, as presented in

Appendix C, shows no multicollinearity problems between the independent variables with the results below 2.

5.1. Correlation matrix

Table 5. Correlation matrix

The table presents the correlation coefficients of all the independent variables employed in this study.

	WMkt	WSMB	CE10Y	CECSPREAD	PTSBD	PTFSFX	PTFSCOM
WMkt	1						
WSMB	-0.142	1					
CE10Y	-0.062	0.153	1				
CECSPREAD	0.169	-0.041	0.038	1			
PTSBD	-0.572	-0.001	0.136	-0.092	1		
PTFSFX	-0.245	-0.089	0.154	-0.020	0.498	1	
PTFSCOM	-0.188	-0.086	-0.024	0.037	0.212	0.317	1

Table 5 presents the correlation results of all the independent variables used in the regressions. The strength of the correlation coefficients is weak to moderate which indicates that there is no strong relationship between the independent variables. The highest and negative relationship of -.057 is between the change in the bond trend following factor and excess return of the European market. The bond trend factor and the Small Minus Big variable represent the weakest correlation coefficient.

5.2. Single-index model

Table 6 presents results of alternative UCITS funds exposure towards the matched offshore hedge fund strategies and the similarity of the risk-return profiles. During the entire sample period, the alternative UCITS funds separated per each analysed strategy show a moderate exposure towards the respective offshore hedge funds strategies with the estimated coefficients ranging from 0.09 for Relative Value funds to 0.20 for Equity Hedge. The entire group of all alternative UCITS funds shows exposure towards the hedge fund returns with the coefficient of above 0.17. Despite the low economical magnitude of the coefficients they all are statistically significant which support the first hypothesis, although, the low R-squares results suggest that the alternative UCITS funds returns can be directed by some additional or different risk factors than the traditional offshore hedge funds. Out all the three analysed strategies the Equity Hedge strategy provides notable, however, relatively low, exposure to hedge funds.

Table 6. Single-index model results

This table presents the time-series regression results of the single-index model. The dependent variable is the excess return of the alternative UCITS funds (separated and regressed also per 3 main analysed strategies: Equity Hedge, Relative Value and Global Macro/CTA). The independent variable is the excess return of the corresponding hedge fund portfolio. All regressions are run over the entire sample period spanning from January 2010 until December 2017. t-statistics is reported as absolute values in parentheses under each coefficient estimate. All the regression account for heteroscedasticity and autocorrelation except of regression (3a). Additional Prais-Winsten regression results, which solves the serial correlation, is presented (3b). *, **, *** denotes that the independent variable is significant at the 1, 5, and 10 percent level respectively.

Dependent Variable: Excess Return	**UCITS All**	**UCITS Equity Hedge**	**UCITS Relative Value**		**UCITS Global Macro/CTA**
	(1)	(2)	(3a)	(3b)	(4)
Independent Variable: Hedge Funds Portfolio - Risk Free Rate					
Hedge Funds All	0.176***				
	(5.14)				
Hedge Funds Equity Hedge		0.206***			
		(3.64)			
Hedge Funds Relative Value			0.150***	0.098***	
			(5.85)	(5.06)	
Hedge Funds Global Macro/CTA					0.187***
					(6.33)
α (alpha)	-0.044	0.066	-0.108*	-0.093	-0.103
	(0.44)	(0.42)	(1.72)	(0.81)	(0.72)
Observations	96	96	96	96	96
adj. R-sq	0.276	0.183	0.343	0.283	0.207

When it comes to the risk-adjusted performance all the results are not statistically significant with all regressions except Equity Hedge showing negative results. The economic magnitude of the alpha is low for all the regressions. The underperformance of the alternative UCITS funds over the hedge funds' portfolios is not surprising considering previous results of the descriptive statistics available in Table 4, indicating lower Sharpe ratio and raw returns of alternative UCITS funds comparing with hedge funds. This can be due to tighter regulation of UCITS funds and most probably also higher costs.

5.3. Seven-factor model

Table 7. Seven-factor model results

This table presents the time-series regression results of the seven-factor model. The dependent variable is the excess return of the alternative UCITS funds and hedge funds (separated and regressed also per 3 main analysed strategies: Equity Hedge, Relative Value and Global Macro/CTA). The independent variables include: WMkt is the European market minus the risk-free rate; WSMB is the equal-weight average of the returns on the three small stock portfolios for the European region minus the average of the returns on the three big stock portfolios; CE10Y is the change in the European Government 10 Years bond yields; CECSPREAD is the difference in yields between the European Corporate 7-10 AA Index Bond Yield and the European 10 Year Government Bonds Yield; PTSBD, PTFSFX and PTFSCOM are the three trend factors referring respectively to bonds, foreign change and commodity. All regressions are run over the entire sample period spanning from January 2010 until December 2017. t-statistics is reported as absolute values in parentheses under each coefficient estimate. All the regression account for heteroscedasticity and autocorrelation except regression (3a). Additional Prais-Winsten regression results, which solves the serial correlation, is presented (3b). *, **, *** denotes that the independent variable is significant at the 1, 5, and 10 percent level respectively.

	Alternative UCITS Funds					**Hedge Funds**			
Dependent Variable: Excess Return	**All**	**Equity Hedge**	**Relative Value**		**Global Macro/CTA**	**All**	**Equity Hedge**	**Relative Value**	**Global Macro/CTA**
Independent Variable:	(1)	(2)	(3a)	(3b)	(4)	(5)	(6)	(7)	(8)
WMkt	0.068**	0.062	0.051**	0.027	0.105**	0.649***	0.655***	0.506***	0.689***
	(2.14)	(1.31)	(2.32)	(1.63)	(2.46)	(14.64)	(15.62)	(11.65)	(11.89)
WSMB	0.280***	0.361***	0.152***	0.088***	0.356***	0.518***	0.516***	0.510***	0.529***
	(4.13)	(3.55)	(3.2)	(2.78)	(3.87)	(5.65)	(5.75)	(5.58)	(4.45)
CE10Y	-0.013**	-0.004	-0.003	-0.003	-0.041***	0.000	0.007	0.001	-0.021
	(2.2)	(0.38)	(0.94)	(0.72)	(4.80)	(0.03)	(0.65)	(0.11)	(1.44)
CECSPREAD	0.006	0.006	0.001	-0.001	0.014	-0.005	-0.006	-0.029	0.008
	(0.25)	(0.14)	(0.07)	(0.07)	(1.04)	(0.12)	(0.16)	(0.78)	(0.13)
PTSBD	-0.013	-0.022*	-0.009	-0.004	-0.007	0.002	0.004	-0.003	-0.002
	(1.45)	(1.75)	(1.34)	(0.63)	(0.52)	(0.15)	(0.31)	(0.24)	(0.13)
PTFSFX	0.006	0.009	0.004	-0.001	0.005	-0.011	-0.013	-0.017	-0.003
	(0.98)	(0.95)	(0.87)	(0.31)	(0.63)	(0.82)	(1.01)	(1.15)	(0.19)
PTFSCOM	0.003	0.002	0.001	0.003	0.006	0.010	0.008	0.024**	0.011
	(0.36)	(0.15)	(0.28)	(1.01)	(0.7)	(0.97)	(0.77)	(2.22)	(0.85)
α (alpha)	-0.145	-0.049	-0.155*	-0.126	-0.270**	-0.321*	-0.281*	-0.234	-0.487**
	(1.25)	(0.27)	(1.96)	(1.00)	(2.00)	(1.81)	(1.68)	(1.29)	(2.05)

Observations	96	96	96	96	96	96	96	96	96
adj. R-sq	0.234	0.149	0.216	0.081	0.267	0.830	0.840	0.750	0.758

The results of the seven-factor analysis of the alternative UCITS funds and hedge funds' portfolios are presented in Table 7 and disclose some interesting features. Although, the factors exposure vary between the alternative UCITS, offshore hedge funds and their strategies almost all of the considered portfolios load significantly on the equity risk factors (including: WMkt - the excess stock market return and WSMB - the difference between returns of the large-capitalization stocks and returns of small-capitalization stocks) with the coefficients of hedge funds' portfolios having the highest economical magnitude between 0.50 and 0.68 and alternative UCITS portfolio between 0.02 and 0.35. These results are consistent with the results of Agarwal et al. (2009). Not only Equity Hedge strategies have exposure to equity factors but also the Relative Value and Global Macro/CTA show statistically significant and positive exposure to stocks. This may indicate that despite the investment strategies they follow focus on commodities, currencies or fixed incomes they also rely heavily on the stock market. Busack et al. (2014) also provide similar results in their seven-factor model analysis.

The next two factors are typically applied under those hedge fund strategies that buy bonds which are less liquid or have lower credit ratings and then hedge the interest rate risk through shorting the 10- year Government Bonds as they usually are more liquid and have a higher credit rating. This difference between the yields of these two bond types is the yield spread (CECSPREAD), the interest rate exposure is captured through the change in the 10-year Government Bond yield (CE10Y). Based on the analysis results only the alternative UCITS all funds' portfolio and UCITS Global Macro/CTA strategy show statistically significant exposure to the change in the government bond yield (CE10Y) with the negative coefficient meaning that falling yields are followed by higher returns of the underlying securities. This result may indicate that there is a significant amount of funds having the systemic exposure to interest rates bets in the selected alternative UCITS funds' sample. However, they do not follow the standard fixed-income strategy as none of the credit spread coefficients (CECSPREAD) are showing the statistically significant results, neither for the alternative UCITS fund nor for the hedge funds.

The exposure of the alternative UCITS, hedge funds and their strategies to the trend-following factors are not statistically significant for almost all the coefficients. Together with the lack of exposure to the bond factors, these results are quite surprising considering the diverse investment strategies and different underlying assets in which both the alternative UCITS and hedge funds can invest. Although the Relative Value strategy has no CTAs nor Equity Hedge strategy is typically focusing on bonds; however, the results show statistically significant coefficients for commodities and bonds trend-following factors respectively. However, both coefficients show very low economical magnitude. It can be inferred that some trend-following strategies related to bonds and commodities were applied by the funds' managers although their funds were classified under other strategies. The reason also why alternative UCITS funds do not show statistically significant results for the trend-following factor related to the commodity is because the UCITS funds are not allowed to invest in commodity futures and in physical commodities.

The regression results provide the adjusted R-squares between 0.08 and 0.26 for the different alternative UCITS portfolios, which is lower result than previously reported by Tuschmid et al. (2010 & 2013) and Busack et al. (2014). In the case of the hedge funds' portfolios, the adjusted R-squares is higher, ranging between 0.75 and 0.85, which is in line with previous studies. These results indicate that alternative UCITS funds and their different strategies have lower exposure to typical sources of hedge fund's risk.

In terms of the risk-adjusted performance (alpha) under the alternative UCITS funds only the Global Macro/CTA strategy show significant, negative alpha results. In the case of hedge funds all funds, Equity Hedge and the Global Macro/CTA strategy provide significant and negative alpha results. Both the alternative UCITS and hedge funds largely underperform with almost half of the coefficients showing none or low alpha significance indicating there is no added value by the funds' managers beyond the systemic bets (Agarwal et al., 2009). These results may also indicate that managing hedge funds and alternative funds portfolios imposes additional structural costs that are not accounted for in the funds' returns. Furthermore, the funds' portfolio may consist of inefficient and poorly performing funds that drag the alpha values down. Considering these results only the Global Macro/CTA strategy of the alternative UCITS funds supports the 3rd hypothesis with the 5% significance.

Above observations suggest that the alternative UCITS funds have systemic exposure mainly to directional equity, long-short equity and interest rate bets. In case of hedge funds, they are exposed to directional and long-short equity. However; even after adjusting for all these risk factors the alpha results are negative for all the regressions and insignificant for half of the analyzed portfolios.

Table 8. Coefficients comparison

The table presents the p-values of Wald coefficient test performed to compare the coefficients of alternative UCITS portfolios with those of the matched hedge funds' portfolios. The coefficients are estimated using the SUR (Seemingly Unrelated Regression).

	All Funds	Equity Hedge	Relative Value	Global Macro/CTA
WMkt	0.00	0.00	0.00	0.00
WSMB	0.00	0.10	0.00	0.17
CE10Y	0.22	0.39	0.65	0.24
CECSPREAD	0.58	0.60	0.12	0.84
PTSBD	0.19	0.06	0.64	0.79
PTFSFX	0.06	0.04	0.02	0.54
PTFSCOM	0.44	0.59	0.01	0.76
α (alpha)	0.19	0.15	0.55	0.30

The coefficient results, meaning their economical magnitude and statistical significance alone do not provide evidence confirming the difference between the alternative UCITS funds and hedge funds. That is why Table 8 presents the p-value results of the Wald test based on which all individual coefficients of the seven-factor model regression of alternative UCITS funds and their portfolios strategies are compared to the matched coefficients of the hedge funds and their strategies.

Considering the entire sample period and all the funds analyzed there are a few differences between the alternative UCITS and hedge funds. The alternative UCITS funds outperform hedge funds and are less exposed to small-cap stocks and equity markets. The estimated coefficient of the equity market and size factors are 0.06 and 0.28 for alternative UCITS and 0.64 and 0.51

respectively for the hedge funds. This makes alternative UCITS funds better solutions for investors seeking to diversify traditional equity risk. Furthermore, the small-cap stocks can be considered not suitable for the alternative UCITS funds considering their illiquid nature and higher risk compared with the large-cap stocks (Amihud, 2002). When it comes to the bond factors the Wald test shows no significant differences between the two groups of funds; however, all the bond coefficients are insignificant for the hedge funds with the change in government bond yield being negative and significant only for the alternative UCITS funds. In case of bond spread for the alternative UCITS funds it is mostly positive, although not significant, while for hedge funds it is also not significant; however, mostly negative. It is also worth noticing that all bond-related coefficients for both fund groups have very low economical magnitudes. Finally, in case of the trend-following factors there are no significant differences between the alternative UCITS and hedge funds, except for the Equity Hedge and Relative Value strategies; however, the corresponding estimate coefficients are not significant and of very low economical magnitude for the alternative UCITS funds.

Above results do not support the 2nd hypothesis as alternative UCITS funds and offshore hedge funds load on different risk profiles indicating that they follow different strategies. There are only some similarities in case of the bond factor when considering the entire group of funds and the Global Macro/CTA strategy.

5.4. Additional evidence

As a robustness check, I run a regression of Carhart's four-factor model (1997) since it is extensively used in practice by many researchers when analyzing the mutual funds' performance. This model adds the momentum effect to the previously developed three-factor model by Fama and French (1993). The results, as presented in Table 9, of the stock market risk factors match the results of the seven-factor model indicating that both alternative UCITS funds and offshore head funds are exposed to the equity market factors; however, the alternative UCITS funds show lower exposure. Also, the risk-adjusted performance results are similar to those provided by the Fung and Hsieh (2004) model with the negative coefficients and statistically significant only for the hedge funds. In terms of two additional risk factors, not present in the previous regression models, the HML factor coefficients results are positive and statistically significant for all the alternative UCITS and hedge funds portfolios indicating that fund managers are focusing on the value

premium through investments in the high book-to-market stocks. When it comes to the Carhart's momentum factor none of the coefficients are statistically significant thus the portfolios show no exposure to this factor.

Table 9. Four-factor model results

This table presents the time-series regression results of the four-factor model. The dependent variable is the excess return of the alternative UCITS funds and hedge funds (separated and regressed also per 3 main analysed strategies: Equity Hedge, Relative Value and Global Macro/CTA). The independent variables include: WMkt is the European market minus the risk-free rate; WSMB is the equal-weight average of the returns on the three small stock portfolios for the European region minus the average of the returns on the three big stock portfolios; HML (high minus low) is the equally weighted return of portfolios with high book-to-market ratio minus return of portfolios with low book-to-market ratio; MOM (monthly momentum factor) is the equally weighted return on a portfolio of past winner stock minus return on portfolio of loser stocks. All regressions are run over the entire sample period spanning from January 2010 until December 2017. t-statistics is reported as absolute values in parentheses under each coefficient estimate. All the regression account for heteroscedasticity and autocorrelation except regression (3a). Additional Prais-Winsten regression results, which solves the serial correlation, is presented (3b). *, **, *** denotes that the independent variable is significant at the 1, 5, and 10 percent level respectively.

	Alternative UCITS Funds					**Hedge Funds**			
Dependent Variable: Excess Return	**All**	**Equity Hedge**	**Relative Value**		**Global Macro/CTA**	**All**	**Equity Hedge**	**Relative Value**	**Global Macro/CTA**
Independent Variable:	(1)	(2)	(3a)	(3b)	(4)	(5)	(6)	(7)	(8)
WMkt	0.051*	0.053	0.437***	0.015	0.063*	0.614***	0.625***	0.437***	0.655***
	(1.7)	(1.17)	(10.47)	(1.18)	(1.76)	(14.15)	(15.24)	(10.47)	(11.28)
WSMB	0.265***	0.363***	0.511***	0.096***	0.299***	0.523***	0.532***	0.511***	0.502***
	(3.96)	(3.86)	(5.66)	(3.24)	(3.00)	(5.58)	(5.87)	(5.66)	(3.99)
HML	0.170***	0.233***	0.270***	0.089***	0.173***	0.175**	0.157**	0.270***	0.189*
	(3.41)	(3.06)	(3.68)	(3.62)	(2.73)	(2.43)	(2.19)	(3.68)	(1.89)
MOM	0.037	0.101	0.007	0.007	-0.054	0.059	0.067	0.007	0.057
	(0.81)	(1.47)	(0.11)	(0.36)	(0.97)	(0.97)	(1.17)	(0.11)	(0.65)
α (alpha)	-0.115	-0.071	-0.111	-0.099	-0.124	-0.312*	-0.291*	-0.111	-0.466**
	(0.97)	(0.38)	(0.67)	(0.82)	(0.84)	(1.94)	(1.85)	(0.67)	(2.16)
Observations	96	96	96	96	96	96	96	96	96
adj. R-sq	0.29	0.22	0.77	0.19	0.25	0.84	0.85	0.77	0.77

6. Conclusion

The financial crisis of 2007-2008 made many institutional and individual investors cautious of the hedge fund sector due to its illiquidity, lack of regulations and transparency. This forced investors to look for more reliable alternative investment products which gave weight to the relatively new sector of alternative UCITS funds. These European-regulated mutual funds try to carry out hedge fund-like strategies and at the same time provide more transparency and liquidity for the investors. This study analyses and compares the performance results of alternative UCITS and offshore hedge funds in order to gain insight into their characteristics and to determine whether the alternative UCITS funds can be the suitable substitute for those investors seeking to entrust their money into offshore hedge fund-like strategies.

The above-mentioned analysis and comparison are performed on the raw returns as well as results of the single-index and seven-factor models. The sample consists of selected alternative UCITS funds and offshore hedge funds for the period between 2010 and 2017.

When it comes to the raw returns the alternative UCITS funds underperform with the average of 3% annualized monthly return compared with 6% for the offshore hedge funds. Despite showing lower volatility alternative UCITS funds end up with smaller Sharpe ratios values comparing with offshore hedge funds. Both fund types have similar tail risks. Based on the single-index model the alternative UCITS funds show moderate exposure towards the matched offshore hedge funds excess returns, with the Equity Hedge strategy delivering the highest results. In terms of seven-factor model results, both funds' groups exhibit large underperformance of the risk-adjusted returns with almost no significant results especially in case of alternative UCITS funds which indicate that there is no added value. Moreover, there are differences in risk profiles between the alternative UCITS and hedge funds meaning that alternative UCITS do not show the exposure towards the offshore hedge funds strategies. Finally, the alternative UCITS funds load differently on the risk factors comparing with the matched hedge funds which indicate that they follow different strategies.

These results might be due to the fact that, although alternative UCITS funds can implement strategies that seem similar to those of hedge funds; however, they are still under huge regulation scrutiny and risk limits imposed by the regulators. The main reason behind it is the investors' protection, liquidity and transparency which comes at the higher costs and which also impacts the alternative UCITS funds' performance.

There are a few limitations that need to be addressed and acknowledged regarding this thesis. The main limitations refer to the application of the multi-factor model. First, Fung and Hsieh (2004) admit that a different set of variables highly correlated with the risk factors can provide similar results. Second, the authors also admit that the seven-factor model has a limited explanatory power to explain the niche styles' performance. When considering, for instance, the merger arbitrage strategy of hedge funds an additional risk factor is required to fit and better describe this niche style. Finally, the analysis in this study is performed on the validity of the alternative UCITS and hedge funds databases. Considering that the alternative UCITS funds' data are publicly available their correctness can be easily verified versus the fund managers' websites or other financial sources; however, there is a possible concern of fraud in case of hedge funds' data, due to their unregulated, private and confidential nature and lack of transparency.

Furthermore, the results of this study provide some recommendation for further research. First, instead of grouping and analyzing only 3 main categories the separation of alternative UCITS and hedge funds can be more detailed showing the risk factor exposure results per each hedge fund-like strategies (i.e. equity long/short, volatility, foreign exchange, etc.). Second, the performance persistence of the UCITS Global Macro/CTA strategy can be investigated since this alternative UCITS funds strategy showed the highest out of all the analyzed portfolios and statistically significant risk-adjusted performance within the seven-factor model analysis.

Literature

Ackerman C., McEnally R. and Ravenscraft D., 1999. 'The Performance of Hedge Funds: Risk, Return and Incentives', *Journal of Finance*, 54, pp.833-874

Agarwal V., Boyson N., Naik N. (2009) Hedge Funds for Retail Investors? An Examination of Hedged Mutual Funds, *Journal of Financial and Quantitative Analysis*, Vol. 44, No. 2, pp. 273-305.

Agarwal, V., Boyson, N. M. and Naik, N. Y. (2009) Hedge funds for retail investors? An examination of hedged mutual funds, Journal of Financial and Quantitative Analysis, 44, 273–305

Amihud, Y. (2002) Illiquidity and stock returns: cross-section and time-series effects, *Journal of Financial Markets*, 5, 31–56

Almazan A., Brown K., Carlson M., Chapman D. (2004) Why Constrain Your Mutual Fund Manager? Journal of Financial Economics, Vol. 73, No. 2, pp. 289-321.

Anderberg K., Bolton L. (2006) UCITS: A Developing Model for the Future of the European Investment Fund Marketplace, *Euro money's International Investment and Securitization* Review, pp.13-18.

Anson, Mark J. P. (2006). The Handbook of Alternative Assets, Second Edition. Hoboken, NJ: John Wiley & Wiley, Inc.

Beaudoin D., Olivier C. (2010) UCITS III Funds: One Size Does Not Fit All, *Swiss Hedge Magazine*, 2nd Half 2010, pp.20-24, Available at: http://www.eurekahedge.com/Research/News/351/UCITS_III_Funds_One_Size_Does_Not_Fit_All, Accessed 2nd June 2018.

Brown, S. J., Goetzmann, W. N., Ibbotson, R. G. (1999) Offshore hedge funds: survival and performance, 1989– 95, *The Journal of Business*, 72, pp.91–117.

Busack, M., Drobetz, W., Tille, J. (2014) Do alternative UCITS deliver what they promise? A comparison of alternative UCITS and hedge funds. *Applied Financial Economics* 24, pp.949–965.

Busack, M., Drobetz, W., Tille, J (2017) Can investors benefit from the performance of alternative UCITS funds? *Financial Markets and Portfolio Management* v31, pp.69-111.

Capocci D., Hubner G., (2004) Analysis of hedge fund performance, *Journal of Empirical Finance*, vol. 11, no. 1, pp. 55–89.

Capocci D. (2013), The Complete Guide to Hedge Funds and Hedge Fund Strategies. ISBN-13: 9781137264435.

Carhart, M.M. (1997), On persistence in mutual fund performance, *Journal of Finance 52*, 57–82

Darolles, S. (2011) Evaluating UCITS Compliant Hedge Fund Performance, *Bankers, Markets & Investors Nov/Dec2014*, Issue 133, p11.

Deli D., Varma R. (2002) Contracting in the Investment Management Industry: Evidence from Mutual Funds, *Journal of Financial Economics*, Vol. 63, No. 1, pp. 79-98.

Dewaele B., Markov I., Pirotte H., Tuchschmid N., (2011) Does manager offshore experience count in the alternative UCITS universe? *Journal of Alternative Investments*, vol. 16, no. 1, pp. 72–85.

Fermaud, N. (2014) UCITS—The New Panacea for US Hedge Fund Managers? *The Investment Lawyer*, Vol.21, No.5, pp. 12-21.

Fama, E.F., French, K.R. (1993), Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics 33*, 3–56

Fama, E. F. and French, K. R. (2012) Size, value and momentum in international stock returns, *Journal of Financial Economics*, 105, pp. 457–72.

Fieldhouse, S. (2010). Harnessing the Potential of UCITS Hedge Funds. *The Hedge Fund Journal*. July-August 2.

Fung, W., Hsieh, D. A. 1997b. Survivorship Bias and Investment Style in the Returns of CTAs. *Journal of Portfolio Management*, vol. 24, no. 1 (Fall):30-41.

Fung, W., Hsieh, D. A. (2001) The Risk in Hedge Fund Strategies: Theory and Evidence from Trend Followers. *Review of Financial Studies*, vol. 14, no. 2 (Summer):313-341

Fung, W., Hsieh, D. A. (2004) Hedge fund benchmarks: a risk-based approach, *Financial Analysts Journal*, 60, pp. 65–80.

Koski J., Pontiff J. (1999) How Are Derivatives Used? Evidence from the Mutual Fund Industry, *Journal of Finance*, Vol. 54, No. 2, pp. 791-816.

Luxhedge - (January 15, 2018) Another Year of double digit asset growth for alternative UCITS http://www.luxhedge.com/2018/01/15/another-year-of-double-digit-asset-growth-for-alternative-ucits/

Markov I., Tuchschmid N. (2011) Hedge Fund Replication in a Regulatory Environment, In: Gregoriou G., Kooli M. (2011) *Hedge Fund Replication*, Palgrave-MacMillan.

Stowell, D. P. (2010a). 11 - Overview of Hedge Funds. *An Introduction to Investment Banks, Hedge Funds, and Private Equity* (pp. 199-218). San Diego: Academic Press.

Stowell, D. P. (2010b). 15 - Hedge Fund Issues and Performance. *An Introduction to Investment Banks, Hedge Funds, and Private Equity* (pp. 269-282). San Diego: Academic Press.

Tuchschmid N., Wallerstein E., Zanolin L. (2010) Will alternative UCITS ever be loved enough to replace hedge funds? *Working Paper*.

Tuchschmid N., Wallerstein E., (2013) UCITS: can they bring funds of hedge funds on-shore? *Journal of Wealth Management*, vol. 15, no. 4, pp. 94–109.

Appendix A: Unit root test

```
. dfuller WMkt , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -10.360            -3.517            -2.894            -2.582
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller WSMB , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -10.255            -3.517            -2.894            -2.582
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller CE10Y , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -8.011            -3.517            -2.894            -2.582
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller CECSPREAD , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -9.555            -3.517            -2.894            -2.582
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller PTSBD , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -8.348            -3.517            -2.894            -2.582
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller PTFSFX , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -9.704            -3.517            -2.894            -2.582
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller PTFSCOM , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ------------ Interpolated Dickey-Fuller ------------
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -9.806            -3.517            -2.894            -2.582
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. dfuller HFGlobalIndexRF , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ———— Interpolated Dickey-Fuller ————
               Test         1% Critical       5% Critical      10% Critical
             Statistic           Value             Value            Value
————————————————————————————————————————————————————————————————————————
 Z(t)          -10.011           -3.517            -2.894           -2.582
————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller HFEquityHedIndexRF , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ———— Interpolated Dickey-Fuller ————
               Test         1% Critical       5% Critical      10% Critical
             Statistic           Value             Value            Value
————————————————————————————————————————————————————————————————————————
 Z(t)          -10.064           -3.517            -2.894           -2.582
————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller HFRelativeValIndexRF , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ———— Interpolated Dickey-Fuller ————
               Test         1% Critical       5% Critical      10% Critical
             Statistic           Value             Value            Value
————————————————————————————————————————————————————————————————————————
 Z(t)          -9.701            -3.517            -2.894           -2.582
————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller HFGlobalMacrIndexRF , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ———— Interpolated Dickey-Fuller ————
               Test         1% Critical       5% Critical      10% Critical
             Statistic           Value             Value            Value
————————————————————————————————————————————————————————————————————————
 Z(t)          -9.874            -3.517            -2.894           -2.582
————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. dfuller UCITSGlobalIndexRF , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ———— Interpolated Dickey-Fuller ————
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
——————————————————————————————————————————————————————————————————————————
 Z(t)             -6.906           -3.517            -2.894            -2.582
——————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller UCITSEquityHedIndexRF , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ———— Interpolated Dickey-Fuller ————
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
——————————————————————————————————————————————————————————————————————————
 Z(t)             -7.380           -3.517            -2.894            -2.582
——————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller UCITSRelativeValIndexRF , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ———— Interpolated Dickey-Fuller ————
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
——————————————————————————————————————————————————————————————————————————
 Z(t)             -5.059           -3.517            -2.894            -2.582
——————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller UCITSGlobalMacrIndexRF , lag(0)

Dickey-Fuller test for unit root                   Number of obs   =        95

                                 ———— Interpolated Dickey-Fuller ————
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value             Value
——————————————————————————————————————————————————————————————————————————
 Z(t)             -9.481           -3.517            -2.894            -2.582
——————————————————————————————————————————————————————————————————————————
MacKinnon approximate p-value for Z(t) = 0.0000
```

Appendix B: Autocorrelation test

Single-index model

```
. regress UCITSGlobalIndexRF HFGlobalIndexRF , vce(robust)

Linear regression                               Number of obs     =         96
                                                F(1, 94)          =      26.43
                                                Prob > F          =     0.0000
                                                R-squared         =     0.2837
                                                Root MSE          =     .98682
```

UCITSGlobalI~F	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
HFGlobalInde~F	.1758152	.0342014	5.14	0.000	.1079076	.2437229
_cons	-.0443755	.1008779	-0.44	0.661	-.244671	.15592

```
. estat durbinalt, force

Durbin's alternative test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	1.053	1	0.3048

H0: no serial correlation

```
. regress UCITSEquityHedIndexRF HFEquityHedIndexRF , vce(robust)

Linear regression                               Number of obs     =         96
                                                F(1, 94)          =      13.25
                                                Prob > F          =     0.0004
                                                R-squared         =     0.1915
                                                Root MSE          =     1.4992
```

UCITSEquityH~F	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
HFEquityHedI~F	.2061191	.0566278	3.64	0.000	.0936833	.3185549
_cons	.0654659	.155414	0.42	0.675	-.2431123	.3740441

```
. estat durbinalt, force

Durbin's alternative test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	0.028	1	0.8680

H0: no serial correlation

```
. regress UCITSRelativeValIndexRF HFRelativeValIndexRF , vce(robust)

Linear regression                               Number of obs     =         96
                                                F(1, 94)          =      34.27
                                                Prob > F          =     0.0000
                                                R-squared         =     0.3497
                                                Root MSE          =     .60249

------------------------------------------------------------------------------
             |               Robust
UCITSRelativ~F |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
HFRelativeVa~F |    .149584   .0255537     5.85   0.000     .0988465    .2003215
       _cons |   -.107558   .0625153    -1.72   0.089    -.2316837    .0165677
------------------------------------------------------------------------------

. estat durbinalt, force

Durbin's alternative test for autocorrelation
---------------------------------------------------------------------------
    lags(p) |          chi2               df                 Prob > chi2
------------+--------------------------------------------------------------
          1 |         22.156               1                      0.0000
---------------------------------------------------------------------------
                            H0: no serial correlation

. prais UCITSEquityHedIndexRF HFEquityHedIndexRF , vce(robust)

Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.0172
Iteration 2:  rho = 0.0244
Iteration 3:  rho = 0.0275
Iteration 4:  rho = 0.0287
Iteration 5:  rho = 0.0292
Iteration 6:  rho = 0.0294
Iteration 7:  rho = 0.0295
Iteration 8:  rho = 0.0296
Iteration 9:  rho = 0.0296
Iteration 10:  rho = 0.0296
Iteration 11:  rho = 0.0296
Iteration 12:  rho = 0.0296
Iteration 13:  rho = 0.0296

Prais-Winsten AR(1) regression -- iterated estimates

Linear regression                               Number of obs     =         96
                                                F(1, 94)          =      12.38
                                                Prob > F          =     0.0007
                                                R-squared         =     0.1799
                                                Root MSE          =     1.4988

------------------------------------------------------------------------------
             |             Semirobust
UCITSEquityH~F |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
HFEquityHedI~F |   .1980334   .0562815     3.52   0.001     .0862852    .3097815
       _cons |   .0677414   .1600155     0.42   0.673     -.249973    .3854559
-------------+----------------------------------------------------------------
         rho |   .0295801
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    1.963615
Durbin-Watson statistic (transformed) 2.004827
```

```
. regress UCITSGlobalMacrIndexRF HFGlobalMacrIndexRF , vce(robust)

Linear regression                               Number of obs     =         96
                                                F(1, 94)          =      40.05
                                                Prob > F          =     0.0000
                                                R-squared         =     0.2150
                                                Root MSE          =     1.4066

------------------------------------------------------------------------------
             |               Robust
UCITSGlobalM~F |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
HFGlobalMacr~F |   .1871244   .0295684     6.33   0.000     .1284157    .2458332
       _cons |  -.1031994   .1436785    -0.72   0.474    -.3884764    .1820775
------------------------------------------------------------------------------

. estat durbinalt, force

Durbin's alternative test for autocorrelation
----------------------------------------------------------------------------
    lags(p) |          chi2               df                 Prob > chi2
------------+---------------------------------------------------------------
          1 |          0.285               1                      0.5933
----------------------------------------------------------------------------
                            H0: no serial correlation
```

Seven-factor model

```
. regress UCITSGlobalIndexRF WMkt WSMB CE10Y CECSPREAD PTSBD PTFSFX PTFSCOM , vce
> (robust)

Linear regression                               Number of obs     =         96
                                                F(7, 88)          =       5.38
                                                Prob > F          =     0.0000
                                                R-squared         =     0.2905
                                                Root MSE          =     1.0151

------------------------------------------------------------------------------
             |               Robust
U~balIndexRF |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        WMkt |   .0680909   .0318403     2.14   0.035     .0048151    .1313667
        WSMB |   .2797933   .0677501     4.13   0.000     .1451542    .4144324
        CE10Y |  -.0129702    .005886    -2.20   0.030    -.0246674   -.0012729
   CECSPREAD |   .0060522      .0241     0.25   0.802    -.0418416     .053946
       PTSBD |  -.0134008    .009262    -1.45   0.151    -.0318071    .0050055
       PTFSFX |   .0059214   .0060138     0.98   0.328    -.0060298    .0178727
      PTFSCOM |   .0025724    .007113     0.36   0.718    -.0115632     .016708
       _cons |  -.1449964    .116174    -1.25   0.215    -.3758678     .085875
------------------------------------------------------------------------------

. estat durbinalt, force

Durbin's alternative test for autocorrelation
----------------------------------------------------------------------------
    lags(p) |          chi2               df                 Prob > chi2
------------+---------------------------------------------------------------
          1 |          0.940               1                      0.3324
----------------------------------------------------------------------------
                            H0: no serial correlation
```

```
. regress UCITSEquityHedIndexRF WMkt WSMB CE10Y CECSPREAD PTSBD PTFSFX PTFSCOM ,
> vce(robust)

Linear regression                               Number of obs     =         96
                                                F(7, 88)          =       2.71
                                                Prob > F          =     0.0137
                                                R-squared         =     0.2119
                                                Root MSE          =     1.5298

------------------------------------------------------------------------------
             |               Robust
UCITSEquit~F |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        WMkt |   .0617768   .0471447     1.31   0.193    -.0319134     .155467
        WSMB |   .3610368   .1016931     3.55   0.001     .1589431    .5631306
        CE10Y |  -.0039988   .0104881    -0.38   0.704    -.0248417    .0168441
   CECSPREAD |   .0063949   .0441722     0.14   0.885    -.0813881     .094178
        PTSBD |   -.022379   .0127826    -1.75   0.083    -.0477818    .0030238
       PTFSFX |   .0086356   .0090584     0.95   0.343     -.009366    .0266373
      PTFSCOM |   .0016481   .0109702     0.15   0.881    -.0201528    .0234491
        _cons |  -.0491715   .1820518    -0.27   0.788    -.4109613    .3126182
------------------------------------------------------------------------------

. estat durbinalt, force

Durbin's alternative test for autocorrelation
----------------------------------------------------------------------------
    lags(p) |          chi2               df                 Prob > chi2
------------+---------------------------------------------------------------
          1 |         0.008                1                       0.9279
----------------------------------------------------------------------------
                            H0: no serial correlation

. regress UCITSRelativeValIndexRF WMkt WSMB CE10Y CECSPREAD PTSBD PTFSFX PTFSCOM
> , vce(robust)

Linear regression                               Number of obs     =         96
                                                F(7, 88)          =       4.12
                                                Prob > F          =     0.0006
                                                R-squared         =     0.2742
                                                Root MSE          =     .65782

------------------------------------------------------------------------------
             |               Robust
UCITSRelat~F |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        WMkt |    .051267   .0221173     2.32   0.023     .0073135    .0952205
        WSMB |   .1520664   .0475806     3.20   0.002     .0575099    .2466228
        CE10Y |  -.0034557   .0036779    -0.94   0.350    -.0107648    .0038535
   CECSPREAD |   .0012231   .0179108     0.07   0.946    -.0343709    .0368171
        PTSBD |  -.0085301   .0063626    -1.34   0.183    -.0211745    .0041143
       PTFSFX |   .0036538    .004214     0.87   0.388    -.0047207    .0120282
      PTFSCOM |   .0012495   .0044934     0.28   0.782    -.0076802    .0101793
        _cons |  -.1549945   .0791335    -1.96   0.053    -.3122557    .0022668
------------------------------------------------------------------------------
```

```
. estat durbinalt, force

Durbin's alternative test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	13.544	1	0.0002

H0: no serial correlation

```
. prais UCITSRelativeValIndexRF WMkt WSMB CE10Y CECSPREAD PTSBD PTFSFX PTFSCOM ,
> vce(robust)

Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.3573
Iteration 2:  rho = 0.4829
Iteration 3:  rho = 0.5094
Iteration 4:  rho = 0.5138
Iteration 5:  rho = 0.5145
Iteration 6:  rho = 0.5146
Iteration 7:  rho = 0.5146
Iteration 8:  rho = 0.5146
Iteration 9:  rho = 0.5146

Prais-Winsten AR(1) regression -- iterated estimates

Linear regression                               Number of obs     =         96
                                                F(7, 88)          =       2.50
                                                Prob > F          =     0.0217
                                                R-squared         =     0.1490
                                                Root MSE          =     .58777
```

UCITSRelat~F	Coef.	Semirobust Std. Err.	t	P>|t|	[95% Conf.	Interval]
WMkt	.0267911	.0164276	1.63	0.106	-.0058554	.0594375
WSMB	.0876819	.0315408	2.78	0.007	.0250012	.1503627
CE10Y	-.0026237	.0036694	-0.72	0.476	-.0099159	.0046685
CECSPREAD	-.0006726	.0102424	-0.07	0.948	-.0210272	.019682
PTSBD	-.0038031	.0059988	-0.63	0.528	-.0157246	.0081183
PTFSFX	-.0011018	.003595	-0.31	0.760	-.0082461	.0060425
PTFSCOM	.0031346	.0030961	1.01	0.314	-.0030183	.0092876
_cons	-.1264351	.1268246	-1.00	0.322	-.3784724	.1256021
rho	.5146124					

```
Durbin-Watson statistic (original)    1.275518
Durbin-Watson statistic (transformed) 2.222507
```

```
. regress UCITSGlobalMacrIndexRF WMkt WSMB CE10Y CECSPREAD PTSBD PTFSFX PTFSCOM ,
>  vce(robust)

Linear regression                               Number of obs     =         96
                                                F(7, 88)          =       9.81
                                                Prob > F          =     0.0000
                                                R-squared         =     0.3208
                                                Root MSE          =     1.3523

------------------------------------------------------------------------------
             |               Robust
UCI~rIndexRF |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        WMkt |   .1053335   .0428999     2.46   0.016     .0200791    .190588
        WSMB |   .3561993   .0920117     3.87   0.000     .1733455    .5390531
        CE10Y |  -.0413186   .0086105    -4.80   0.000    -.0584301   -.0242071
   CECSPREAD |   .0139197   .0133685     1.04   0.301    -.0126474    .0404868
        PTSBD |  -.0073063   .0141029    -0.52   0.606    -.0353328    .0207202
       PTFSFX |   .0052749   .0083676     0.63   0.530     -.011354    .0219037
      PTFSCOM |   .0062542   .0089599     0.70   0.487    -.0115516     .02406
        _cons |  -.2698109   .1348329    -2.00   0.048    -.5377629   -.0018588
------------------------------------------------------------------------------

. estat durbinalt, force

Durbin's alternative test for autocorrelation
----------------------------------------------------------------------------
    lags(p) |          chi2               df                 Prob > chi2
------------+---------------------------------------------------------------
          1 |          0.132               1                      0.7162
----------------------------------------------------------------------------
                            H0: no serial correlation

. regress HFGlobalIndexRF WMkt WSMB CE10Y CECSPREAD PTSBD PTFSFX PTFSCOM , vce(ro
> bust)

Linear regression                               Number of obs     =         96
                                                F(7, 88)          =      53.61
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8424
                                                Root MSE          =     1.4494

------------------------------------------------------------------------------
             |               Robust
HFGlobalIn~F |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        WMkt |   .6491742   .0443368    14.64   0.000     .5610642    .7372842
        WSMB |   .5182737   .0916908     5.65   0.000     .3360574    .7004899
        CE10Y |   .0003676   .0113789     0.03   0.974    -.0222455    .0229807
   CECSPREAD |  -.0047797   .0401131    -0.12   0.905     -.084496    .0749367
        PTSBD |   .0019976   .0132804     0.15   0.881    -.0243944    .0283896
       PTFSFX |  -.0111513   .0136628    -0.82   0.417    -.0383032    .0160006
      PTFSCOM |   .0098711   .0101877     0.97   0.335    -.0103748    .0301171
        _cons |    -.32125   .1772409    -1.81   0.073    -.6734791     .030979
------------------------------------------------------------------------------

. estat durbinalt, force

Durbin's alternative test for autocorrelation
----------------------------------------------------------------------------
    lags(p) |          chi2               df                 Prob > chi2
------------+---------------------------------------------------------------
          1 |          0.000               1                      0.9902
----------------------------------------------------------------------------
                            H0: no serial correlation
```

```
. regress HFEquityHedIndexRF WMkt WSMB CE10Y CECSPREAD PTSBD PTFSFX PTFSCOM , vce
> (robust)

Linear regression                               Number of obs     =         96
                                                F(7, 88)          =      62.69
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8522
                                                Root MSE          =     1.4063
```

HFEquityHe~F	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
WMkt	.6554937	.0419676	15.62	0.000	.572092	.7388954
WSMB	.5164982	.0897525	5.75	0.000	.338134	.6948623
CE10Y	.0070973	.0108514	0.65	0.515	-.0144677	.0286622
CECSPREAD	-.0056304	.0345177	-0.16	0.871	-.0742272	.0629663
PTSBD	.0040704	.0130842	0.31	0.756	-.0219317	.0300725
PTFSFX	-.0129583	.012813	-1.01	0.315	-.0384213	.0125048
PTFSCOM	.0077244	.0100022	0.77	0.442	-.0121529	.0276016
_cons	-.2814777	.1677731	-1.68	0.097	-.6148915	.0519362

```
. estat durbinalt, force

Durbin's alternative test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	0.031	1	0.8612

H0: no serial correlation

```
. regress HFRelativeValIndexRF WMkt WSMB CE10Y CECSPREAD PTSBD PTFSFX PTFSCOM , v
> ce(robust)

Linear regression                               Number of obs     =         96
                                                F(7, 88)          =      32.24
                                                Prob > F          =     0.0000
                                                R-squared         =     0.7683
                                                Root MSE          =     1.4692
```

HFRelative~F	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
WMkt	.5057938	.0434316	11.65	0.000	.4194826	.5921051
WSMB	.5098054	.0913913	5.58	0.000	.3281844	.6914265
CE10Y	.0013758	.0125331	0.11	0.913	-.0235311	.0262827
CECSPREAD	-.0285594	.0366043	-0.78	0.437	-.1013028	.044184
PTSBD	-.003116	.0131399	-0.24	0.813	-.0292289	.0229969
PTFSFX	-.0167794	.0145999	-1.15	0.254	-.0457936	.0122347
PTFSCOM	.0240511	.0108517	2.22	0.029	.0024855	.0456166
_cons	-.2336941	.1806792	-1.29	0.199	-.592756	.1253678

```
. estat durbinalt, force

Durbin's alternative test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	0.229	1	0.6325

H0: no serial correlation

```
. regress HFGlobalMacrIndexRF WMkt WSMB CE10Y CECSPREAD PTSBD PTFSFX PTFSCOM , vc
> e(robust)

Linear regression                               Number of obs     =         96
                                                F(7, 88)          =      33.98
                                                Prob > F          =     0.0000
                                                R-squared         =     0.7754
                                                Root MSE          =      1.927
```

HFGlobalMa~F	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
WMkt	.6889633	.0579259	11.89	0.000	.5738477	.8040789
WSMB	.5291847	.1188189	4.45	0.000	.293057	.7653123
CE10Y	-.0213489	.0148315	-1.44	0.154	-.0508234	.0081256
CECSPREAD	.0076202	.0589536	0.13	0.897	-.1095378	.1247781
PTSBD	-.0024264	.0182591	-0.13	0.895	-.0387127	.0338598
PTFSFX	-.0033065	.0170445	-0.19	0.847	-.0371789	.0305659
PTFSCOM	.0107309	.0126025	0.85	0.397	-.0143139	.0357756
_cons	-.4867286	.2375565	-2.05	0.043	-.9588223	-.014635

```
. estat durbinalt, force

Durbin's alternative test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	0.376	1	0.5398

H0: no serial correlation

Appendix C: Variance Inflation Factor (VIF) test

```
. vif
```

Variable	VIF	1/VIF
PTSBD	1.88	0.531683
WMkt	1.59	0.629044
PTFSFX	1.46	0.685357
PTFSCOM	1.15	0.872117
WSMB	1.08	0.928154
CE10Y	1.07	0.935632
CECSPREAD	1.04	0.963415
Mean VIF	1.32	