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Performance and persistence of Belgian mutual funds from 2010 to 2016

Research Master's Thesis submitted by
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ABSTRACT

The evaluation of mutual fund performance and performance persistence is a central problem in finance research. Since the 1960s, many researchers have investigated mutual funds making use of different methodologies, mostly focusing on the US market. This thesis focuses on the Belgian mutual fund market, as mutual funds have an important place in the Belgian household investment market compared to the European average. A sample of 46 Belgian open-ended equity funds with a European investment focus is studied over the period of 2010 until 2016. Fund performance is evaluated using Jensen's, Fama and French's and Carhart's model, and performance persistence is evaluated using both non-parametric and parametric models. The overall results suggest that Belgian equity mutual funds perform well enough to cover their expenses. This is illustrated by the significantly positive alphas post-expenses at an aggregate level. However, subtracting expenses, the performance is statistically indistinguishably from zero. Furthermore, long-term performance persistence results are mixed in this thesis, as there are periods showing no persistence and periods with positive persistence. In addition, no persuasive evidence in favor of short-term persistence is found. The results for performance evaluation are in line with previous European and US studies and confirm Grossman and Stiglitz' view on the Efficient Market Hypothesis. Regarding persistence, the results are largely in line with European studies, as these generally do not identify short-term persistence, and in some cases find long-term persistence.

Key words: mutual funds, performance evaluation, performance persistence.

RESUME

L'analyse de la performance et de la persistance de la performance des fonds communs est un problème central dans la recherche financière. Depuis les années 1960, de nombreux chercheurs ont étudié les fonds communs de placement et les SICAVs sous différents angles en utilisant des approches variées, en mettant principalement l'accent sur les marchés américains. Ce mémoire se concentre sur le marché belge des SICAVs, car celles-ci jouent un rôle important dans le marché belge des investissements domestiques (par rapport à la moyenne européenne). Ce mémoire étudie un échantillon de 46 SICAVs belges ayant investi dans des actions européennes entre 2010 et 2016. La performance est étudiée à l'aide du modèle de Jensen, Fama et French, et Carhart tandis que la persistance de la performance est évaluée à l'aide de divers modèles paramétriques et non-paramétriques. Les résultats globaux suggèrent que les SICAVs belges ont un degré de performance suffisant qui permet d'au moins rentrer dans leurs frais.

Ceci est illustré par les alphas post-dépenses agrégés qui sont signifiants positifs. Néanmoins, lorsque les dépenses sont préalablement soustraites, la performance est statistiquement indistincte de zéro. Les résultats de la persistance de la performance sont peu concluants à long terme car il existe des périodes sans aucune persistance et des périodes où la persistance est positive. En plus, les résultats dénotent l'absence de persistance à court terme. Ces résultats de l'évaluation des performances sont conformes aux études européennes et américaines menées antérieurement et confirment l'opinion de Grossman et Stiglitz sur l'Efficience des marchés financiers. Concernant la persistance, les résultats vont dans le sens d'autres études européennes qui identifient une persistance à long terme dans certains cas et aucune persistance à court terme.

Mots clés : SICAVs, analyse de la performance, persistance de la performance.

PREFACE

This master's thesis marks the end of a journey of five years at university. Looking back, it has been an experience full of learning opportunities, challenges and rewarding encounters. In those five years, the decision to start studying in Louvain-la-Neuve to pursue the MSc in Business Engineering and CEMS MIM double degree has been one that has enabled me to come across a lot of these opportunities and encounters. Studying at the Louvain School of Management (LSM) has put me in touch with a group of international and ambitious CEMS students, has enabled me to considerably improve my French-speaking abilities, and has allowed me to understand and engage more with the French-speaking side of our country. On the international level, CEMS and LSM have given me the opportunity to go on exchange to two top universities: the London School of Economics and Political Science, and ESADE Business School. Moreover, I have proudly represented LSM in the CEMS Student Board in 2017, and this year I have taken on the role of President of this Board.

In light of this context, I feel proud to finish this master's thesis now. But of course, I could not have done this on my own. Some words of appreciation are in place.

J'aimerais tout d'abord remercier mon promoteur, le Professeur Philippe Grégoire, pour ses conseils avisés lors de la sélection de mon sujet, son soutien tout au long du processus de rédaction et ses commentaires pertinents pour affiner les résultats de ma recherche.

I would also like to thank Mr Angelo Luisi for his support regarding the data extraction for this thesis, and his useful comments and guidance to get me started back in March 2017.

Graag zou ik ook mijn ouders en mijn familie bedanken voor hun steun, niet alleen tijdens het schrijven van deze thesis maar gedurende mijn hele studentenperiode. Altijd stonden ze klaar met een luisterend oor, een tweede opinie, en nooit hebben zij getwijfeld om me te steunen bij alles wat ik wilde ondernemen.

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Pieter Bosmans

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I. Introduction

"It is very hard, if not impossible to justify active management for most individual, taxable investors, if their goal is to grow wealth."

- MARK KRITZMAN (President and CEO, Windham Capital Management; Senior Lecturer in Finance, MIT Sloan School of Management)

1 Relevance

Mutual funds are professionally managed investment vehicles that pool together money from many investors, and subsequently invest it in asset classes such as stocks and bonds (Securities and Exchange Commission, 2005). Since the 1960s, the performance of mutual funds has been frequently debated in the academic field. Jensen (1968), who authored one of the earlier and most frequently cited studies in the field, calls the performance evaluation of funds a "central problem in finance". Performance evaluation studies aim to give an answer to the question whether active mutual fund managers add value for investors seeking to maximize their wealth. Managers that actively manage their mutual funds engage in stock-picking and market timing of their investment to increase the value of their fund. For their management services, a fee is charged. Active investing is often compared to passive investing, which refers to funds that passively follow a market index. Passive funds do not charge the same high fees as active mutual funds. The societal value of the question whether fund managers perform well enough to justify the fees they are charging, is further illustrated by press coverage. Newspapers like *Financial Times* (Foley, 2016) and the *Wall Street Journal* (Zhang & Solin, 2015) frequently cover stories and debates about the value of active investment strategies by funds.

Not only performance evaluation is frequently studied, also performance persistence is evaluated. Performance persistence has both academic and practical relevance as well (Le Sourd, 2007). From an academic point of view, "assessing the existence and persistence of mutual fund managerial ability is an important test of the efficient market hypothesis; evidence of persistent ability would support a rejection of its semi-strong form" (Bollen & Busse, 2005). According to Grossman and Stiglitz' (1980) hypothesis, we should not expect fully informationally efficient markets. Otherwise, investors would not be rewarded for the costly efforts of information gathering. The practical relevance of persistence studies deals with the question whether investors can use information about past performance to predict relative mutual fund performance. Mutual fund rankings, for example by the American investment research firm Morningstar, are based on this idea (Le Sourd, 2007). Belgian newspapers cover

the topic as well. *De Tijd* and *L'Echo*, the Dutch and French financial newspapers in Belgium, released their yearly Fund Awards for mutual funds available on the Belgian market in a number of categories in March (De Rijke, 2018). These newspapers also frequently report about fund news, and have tools on their websites to track and discover mutual funds.

While Belgian newspapers seem to follow their international counterparts when covering mutual fund news, in academia much of the focus remains on American mutual funds. Virtually all frequently cited articles consider American fund data, and date from before the Financial Crisis of 2008. Even other European countries are not frequently studied. Though the magnitude of the American mutual fund market vastly exceeds the European market, the practical relevance of fund studies in Europe should not be underestimated. In Belgium, mutual funds have an important place in the household investment market: about 12.4% of household savings were held in mutual funds in 2014, which puts Belgium on the third place in Europe (Belgian Asset Managers Association, 2017a).

Therefore, the main contribution of this thesis is the analysis of Belgian mutual fund performance and persistence post-crisis in 2010 – 2016, which has not been studied before. The funds studied are equity funds with a European geographical investment focus, as a Belgian investment focus would be overly restrictive, and as this allows comparisons with other European fund studies.

2 Main research questions

This thesis analyses the performance and persistence of Belgian equity mutual funds from 2010 until 2016. The main research questions are therefore:

- How did Belgian equity mutual funds perform in comparison to relevant benchmarks in the timeframe of 2010 to 2016, taking into account expenses?
- How did Belgian equity mutual funds perform in comparison to relevant benchmarks in the timeframe of 2010 to 2016, not taking into account expenses?
- Are there signs of persistence in Belgian equity mutual fund performance between 2010 and 2016, i.e., do bad performers keep performing badly and – more importantly – do good performing keep performing well?

3 Structure and scope of this thesis

This section points out the structure of this thesis, and discusses what is in and out of scope of the mutual fund performance and persistence discussion.

Chapter II gives a brief overview of mutual funds. This includes a definition and typology of mutual funds, its advantages and disadvantages linked to its performance and some global statistics to further illustrate the relevance of the topic in the financial world. As this thesis discusses Belgian mutual funds, a brief overview of the place of mutual funds in the Belgian investment landscape will be included. Out of scope of this thesis are issues such as the specific institutional setting of mutual funds and agency conflict. For these issues, the reader is referred to Lückoff (2011). No discussion of the tax situation regarding mutual funds is made, as this is very country-specific and out of scope of performance measurement research.

Chapter III reviews the existing literature. It provides an overview and summary of previous studies in performance measurement and performance persistence. Special focus is given to European results, where possible.

Chapter IV describes all data collected to obtain results about the performance and persistence of the Belgian mutual funds. Summary statistics, missing data, limitations and data sources are mentioned where applicable.

Chapter V introduces the methodologies used to evaluate fund performance, and performance persistence. Performance is evaluated based on three measures: the Jensen (1968) model, the Fama and French (1993) three-factor model, and the Carhart (1997) four-factor model. These measures are applied to net returns and to gross returns (before expenses). The foundation of the methods, their applications and their possible weaknesses are illustrated. Other measures are out of scope, as these three are by far the most frequently used. Performance persistence is evaluated based on the non-parametric Winner-Loser Test (e.g. Goetzmann and Ibbotson (1994)) and a parametric regression on past returns (e.g. Brown, Goetzmann, Ibbotson, and Ross (1992)).

Chapter VI lists and discusses the results of the performance and persistence analysis making use of the methodology introduced in Chapter V. Inferences are drawn, reference to the relevant literature of Chapter III are made, and the needed statistical corrections – in particular regarding heteroskedasticity and autocorrelation – are executed and illustrated where applicable.

Chapter VII concludes this thesis, summarizing the key take-aways while pointing out possible weaknesses in the research and giving suggestions for further research.

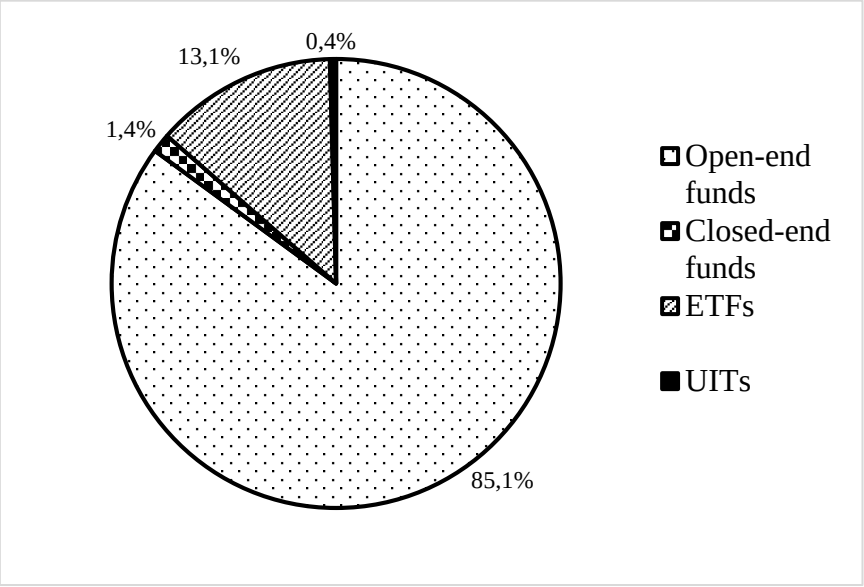
II. Brief overview of Mutual Funds

1 Definition

A mutual fund is "a company that brings together money from many people and invests it in stocks, bonds or other assets" (Securities and Exchange Commission, 2005). These combined holdings of assets the fund owns are known as the fund's portfolio. Investors in the fund hold shares, which represent parts of these holdings (Securities and Exchange Commission, 2005). As such, a mutual fund is a financial intermediary – an intermediary through which investors can invest (Pozen, 2011).

There are four types of mutual funds: open-end mutual funds, closed-end mutual funds, exchange-traded funds (ETFs), and unit investment trusts (UITs) (Elton & Gruber, 2013). These will be briefly defined and their characteristics will be discussed. Open-end mutual funds will be referred to as "mutual funds" in this thesis unless otherwise stated.

Figure 1: Investment Company Total Net Assets by Mutual Fund Type (Investment Company Institute, 2017)



Open-end mutual funds. Open-end mutual funds are by far the most important form of mutual funds in terms of assets under management. About 85% of the total net assets in the US mutual funds in 2016 was invested in open-end mutual funds (Figure 1). What distinguishes them from other funds is that they allow investors to buy and sell shares every business day from and to the fund. The price of the transaction is set at the net asset value of a share at the end of the trading day[1]. Major types of open-end funds are equity funds, hybrid funds, bond funds and

[1] NAV = (Assets – Liabilities)/Number of shares outstanding. E.g., $100 million in assets, $10 million in liabilities, and 10 million shares outstanding would result in a NAV of $9.00. Liabilities of a mutual fund can result from short selling, option writing, borrowing and fees due.

money market funds, of which equity funds have lately been the most prevalent (Elton & Gruber, 2013; Pozen, 2011).

Closed-end mutual funds. Closed-end mutual funds, like open-end, offer investors to buy and sell shares in the fund, which represent the assets the fund holds. The difference between a closed-end and open-end fund is that closed-end fund shares are traded on an exchange instead of between investors and the fund. This results in share prices determined by supply and demand, often well below the net asset value. Furthermore, shares can be bought and sold during the day rather than only at the end of the day (Elton & Gruber, 2013). Figure 1 shows that about 1% of the total net assets in the US mutual funds in 2016 was invested in closed-end mutual funds.

Exchange-traded funds. Exchange-traded funds (ETFs) are a recent phenomenon. Lately, they have become very popular and they are still continuing to grow. In 2011-2016, the net assets invested in ETFs in the US have risen with 141% (CAGR of 19%) compared to an overall growth in investment company total net assets of 47% (CAGR of 8%) over the same period of time (Investment Company Institute, 2017). In 2016, they made up about 13% of the total net assets in the US mutual funds (Figure 1). ETFs combine characteristics of closed-end and open-end mutual funds. Like closed-end funds, "they trade at a price determined by supply and demand and can be bought and sold at that price during the day" (Elton & Gruber, 2013). Like open-end funds, they are able to "adjust the number of shares outstanding" (Pozen, 2011). In addition, the composition of ETFs is very different from other funds, with an important focus on index funds of passive management (Elton & Gruber, 2013).

Unit investment trusts. Unit investment trusts (UITs) are "significantly different from mutual funds because they don't hire an investment manager" (Pozen, 2011). Instead, a portfolio of securities is created that then "does not change significantly throughout its life" (Pozen, 2011). UITs are not very popular, as they only make up 0.4% of total net assets in the US mutual funds in 2016 (Figure 1).

2 Advantages and disadvantages of open-end mutual funds

Advantages of mutual funds can be summarized around economies of scale. First, the scale of mutual funds allows them to provide liquid access to a diversified basket of securities. Second, it allows mutual funds to gather and process information at a cost lower than that of an individual. Individual investors are then offered a share of this pool of investments (Lückoff, 2011; Pozen, 2011).

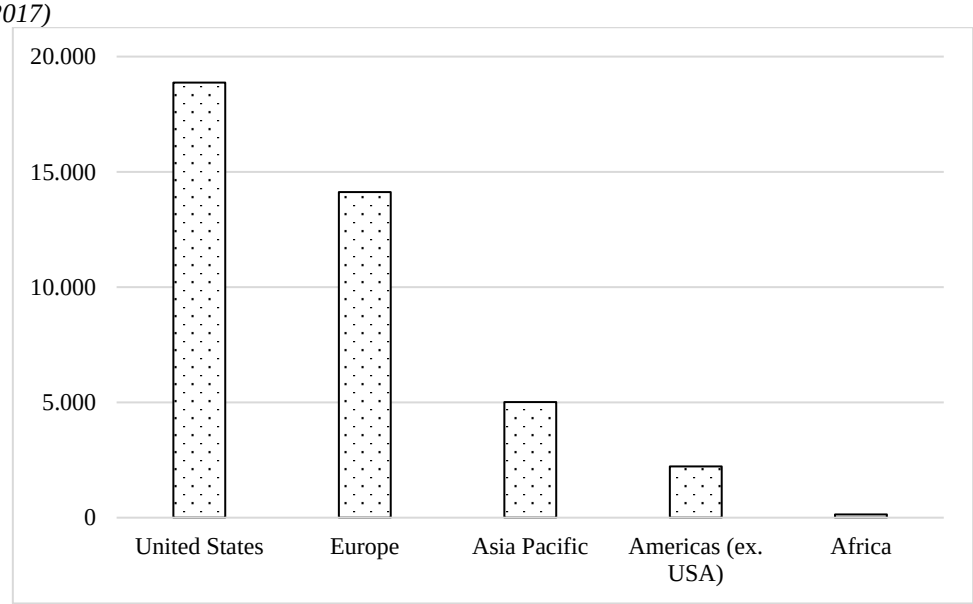
In turn, investors are exposed to fees for the financial services the mutual fund offers, which is the main disadvantage. The annual fee funds charge their shareholders is called the expense ratio. It expresses “the percentage of assets deducted each fiscal year for fund expenses”, including management fees, administrative fees, operating costs and others (Morningstar, 2017a).

In sum, investors “get the advantage of being a part of a professionally managed portfolio, just being exposed to the management fee for the financial service. In return they expect to earn positive profits over the fee discharged during the process” (Bodie, 2013). As such, “the size of the expenses ratio plays a major role in the measured performance of the mutual fund industry and the relative performance of individual mutual funds” (Elton & Gruber, 2013).

3 Global statistics of the mutual fund market

Total net assets invested in worldwide regulated open-end funds have risen by 45% (CAGR of 8%) to $40,364 billion in 2011-2016. To put this number in perspective: in 2016, the Gross World Product was estimated to be $75,642 billion (The World Bank, 2017). The Americas, and especially the United States, make up the largest part of these $40,364 billion: net assets total $21,093 billion (52%) in the Americas of which $18,868 billion are in the United States. The rest is divided across other continents as follows: Europe’s net assets amount to $14,116 billion (35%), Asia and Pacific’s to $5,008 billion (12%) and Africa’s to $146 billion (<1%) (Investment Company Institute, 2017) (Figure 2).

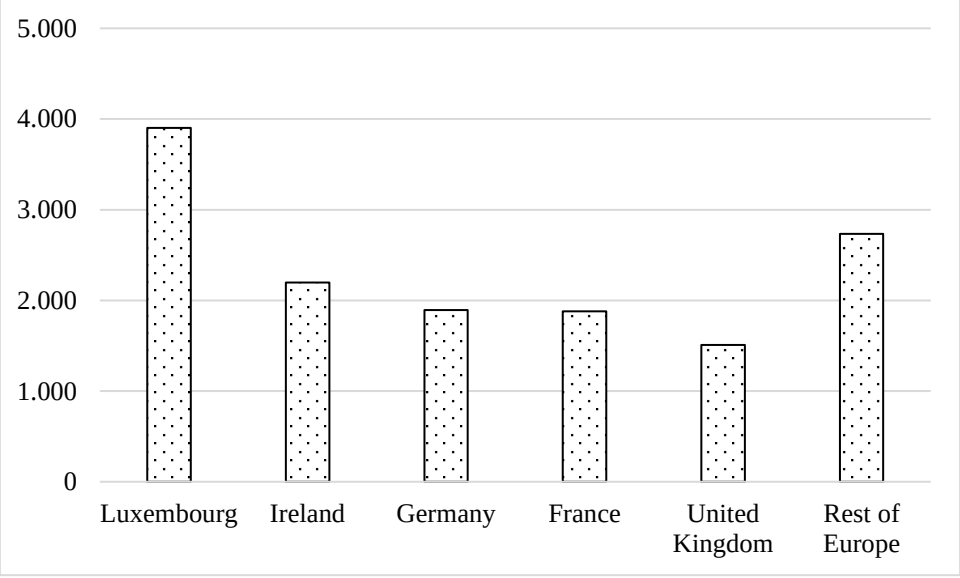
Figure 2: Total net assets invested in worldwide regulated open-end fund, billion USD (Investment Company Institute, 2017)



The important global position of the United States in the mutual fund industry is also reflected within the country: mutual funds are the second largest financial intermediaries in terms of asset under management, almost half of the American families own mutual funds, and mutual funds hold over half of the assets of pension and retirement plans in the United States (Elton & Gruber, 2013; Investment Company Institute, 2017).

In Europe, 81% of total net assets is concentrated within five countries: Luxembourg comes first with $3,901 billion of assets (28%), Ireland has $2,198 billion of assets (16%), Germany has $1,893 billion (13%), France has $1,880 billion (13%) and the United Kingdom has $1,510 billion (11%) (Investment Company Institute, 2017) (Figure 3). Obviously, the Luxembourgish assets include foreign assets next to local assets. The reason why Luxembourg serves as a domicile for cross-distribution of investment products is threefold: the beneficial tax status from which funds benefit in the country; double taxation reliefs the country has negotiated with other countries; and a European directive that allows funds to operate through the European Union once it has been authorized in one member state (Deloitte, 2016). Belgium has about $84 billion of total net assets in regulated open-end funds, representing about 0.6% of the European total (Investment Company Institute, 2017).

Figure 3: Total net assets invested in European regulated open-end fund, billion USD (Investment Company Institute, 2017)



4 Place of mutual funds in the Belgian investment landscape

As pointed out in previous section, Belgium has $84 billion of total net assets in regulated open-end funds. Investment Company Institute (2017) limits this definition to mutual funds, ETFs, and institutional funds and to funds of Belgian nationality. Belgian Asset Managers Association (2017a) identified the total net assets of funds of Belgian as well as foreign nationality through

which Belgian investors invested, which is €169 billion. Of these, €71 billion is invested in balanced funds, €45 billion in equity funds, €35 billion in bond funds, €8 billion in money market funds and €10 billion in others. An estimated 84% of these €169 billion is invested in Belgian funds, although way more foreign funds than Belgian funds exist on the Belgian market (Belgian Asset Managers Association, 2017a).

Mutual funds are also relevant on the Belgian household investment market. In 2014, about 90% of the Belgian mutual fund was taken by retail clients, as opposed to 10% by institutional clients. These households held about 12.4% of their savings in mutual funds. This puts Belgium on the third place in Europe, compared to a European average of 9.5% (Belgian Asset Managers Association, 2017a).

In conclusion, the Belgian mutual fund market does not have the same order of magnitude as the American market or European markets of surrounding countries, even not when controlling for population or Gross Domestic Product. However, mutual funds play a significant role in Belgian household savings and are therefore interesting to be studied.

III. Literature review

The theories and methodologies used and described in this Chapter are all based on classical financial theory concepts such as the Modern Portfolio Theory by Markowitz (1952) and the Capital Asset Pricing Model (CAPM) by Treynor (1961), Sharpe (1964), Lintner (1965) and Mossin (1966). These will not be further discussed in this thesis. Another financial theory concept that relates to mutual fund performance and persistence is the Efficient Market Hypothesis (EMH) (see Fama (1970)). Its relevance for mutual fund performance is that it implies the impossibility to persistently generate portfolio returns in excess of the market return by using a trading strategy on past price information; on public information; or even on insider information besides by pure luck, depending on which form to adapt (Verheyden, 2013). In addition, Grossman and Stiglitz' (1980) view on the EMH implies that mutual fund managers' performance is just high enough to earn the cost of information back.

As illustrated in the first section, Grossman and Stiglitz' (1980) view on the EMH is consistent with most literature regarding mutual fund performance. The majority of mutual fund studies report negative performance post-expenses. Pre-expenses, performance is around zero and sometimes even slightly positive. This is consistent with the view that mutual fund managers do not add value for investors. European fund studies report slightly more positive results compared to American studies, though this result is not found consistently across all European studies.

In the second section, performance persistence is discussed. Generally speaking, American studies find evidence of positive short-term persistence, whereas negative persistence lasts for longer terms. European performance persistence is again less frequently studied. Two of the three studies discussed here show more evidence of persistence than American studies, whereas one study does not find evidence in favor of persistence.

1 Mutual fund performance evaluation

The literature about mutual fund performance is vast. Since the 1960s, many researchers have tried to explain and understand performance of mutual funds through employing different kinds of evaluation models[2] and focusing on various aspects. Although not entirely unanimous, the general idea is that fund managers are not able to outperform the market in excess of costs

[2] As Jensen's alpha, the Fama-French three-factor model and the Carhart four-factor model are the most influential performance methods, they will be explained in the next Chapter. Other methodologies will not be discussed in detail. Yet, the reader is referred to the relevant articles discussed below for in-depth discussions of the concerned methodologies.

made. Yet, when looking at gross returns (before subtracting expenses), slight overperformance is found. This is in line with Grossman and Stiglitz' (1980) idea of informationally efficient markets.

This literature review tries to give an overview of the most important articles on the topic. Articles are selected by looking at influential journals (Journal of Finance, Journal of Financial Economics, etc.) as well as at the literature review by Elton and Gruber (2013). Important to note is that most of this research is focused on the United States as it is the largest market for funds as illustrated in Chapter II, and as investor interest is well developed and long-term data is available (Otten & Bams, 2002).

As this thesis focuses on fund performance in Belgium, studies on European as well as Belgian markets are included in this literature review. Results of European studies tend to conclude slightly more in favor of the ability to outperform the market. A possible explanation is that because of the smaller importance of mutual funds in the European domestic equity market than in the American market, "mutual funds might be in a better position to follow or even beat the market" (Otten & Bams, 2002).

A summary of the most important elements of the studies can be found in Table 1. Some more details and context are provided further on in this section.

Table 1: Summary of mutual fund performance studies in USA, Europe and Belgium

#	Study	Geography	Funds under study	Timeframe	Methodology	Avg performance; post-expenses	Avg performance; pre-expenses
			United States				
1	Jensen (1968)	United States	115 mutual funds	1955-1964	CAPM, single-index	-1.1%	-0.4%
2	Malkiel (1995)	United States	217 equity funds	1971-1991	CAPM, single-index	-0.06%	N/A
			239 equity funds	1982-1991	CAPM, single-index	-0.93%	0.18%
3	Gruber (1996)	United States	270 equity funds	1985-1994	CAPM, single-index	-1.56%	-0.43%
					Multi-factor	-0.65%	0.48%
4	Elton, Gruber, & Blake (1996)	United States	188 equity funds	1977-1993	Multi-factor	-0.91%	N/A
5	Ferson & Schadt (1996)	United States	67 primarily equity funds	1968-1990	CAPM, single-index	-0.37% to 0.26%	N/A
6	Carhart (1997)	United States	1,892 equity funds	1962-1993	CAPM, single-index	-0.62%	0.52%
					Carhart 4-factor	-1.98%	-0.84%
7	Fama & French (2010)	United States	1,308 equity funds	1984-2006	CAPM, single-index	-1.13%	-0.18%
					Fama-French 3-factor	-0.81%	0.13%
					Carhart 4-factor	-1.00%	-0.05%
			Europe				
8	Otten & Bams (2002)	DE,FR,UK,IT,NL	506 equity funds	1991-1998	Fama-French 3-factor	-1.32% to 2.02%	N/A
					Carhart 4-factor	-1.20% to 1.80%	-0.36% to 2.88%
9	Cesari & Panetta (2002)	Italy	82 equity funds	1985-1995	CAPM, single-index	0.90%	2.23%
					Market and bond index	0.10%	1.42%
					Fama-French 3-factor	1.09%	2.41%
10	Christensen (2003)	Denmark	27 equity, 17 fixed income funds	1994-2002	CAPM, single-index	-1.20%	N/A
					Multi-factor	-0.24%	N/A
11	Christensen (2005)	Denmark	34 equity, 13 fixed income funds	1996-2003	CAPM, single-index	-0.58%	N/A
					Multi-factor	-1.18%	N/A
12	Cuthbertson (2008)	Europe	842 equity funds	1975-2002	Fama-French 3-factor	-0.68%	N/A
			Belgium				
13	Crombez (1998)	Belgium	322 equity funds	1999-2001	CAPM, single-index	-1.25%	N/A
					Multi-factor	-1.15%	N/A

1.1 United States mutual fund performance

Jensen (1968) collects yearly data from 115 open-end mutual funds available from Wiesenberger's Investment Companies for 1955-1964. The sample includes equity, bonds as well as balanced funds. The author employs a single-index model based on the CAPM to evaluate the performance of the mutual funds, a methodology now known as *Jensen's alpha*. The average value of α is -1.1% per year net of all management expenses and -0.4% gross of expenses, indicating very little evidence of an ability to forecast security prices in the mutual fund industry. Furthermore, Jensen (1968) finds very little evidence that any of the funds possesses substantial forecasting ability as the distribution of *t* values of the fund αs is symmetric about zero, and lacks values greater than the threshold at 5% significance level.

Three decades later, Malkiel (1995) studies the performance of 217 equity funds from 1971 to 1991, using a single-index based on the CAPM – similar to Jensen's alpha. He finds an average α of -0.06%, statistically indistinguishable from zero; corresponding to findings in the literature that mutual funds' excess returns may at least cover their expenses. Looking at individual funds, Malkiel (1995) finds 23 positive and significant α's, and 26 negative and significant α's. In addition, Malkiel (1995) examines the performance of 239 equity funds in 1982-1991. On average, he finds an α of -0.93% after expenses and +0.18% before expenses. This would confirm that mutual funds earn sufficient returns to cover their expenses, as also found by Ippolito (1989) and consistent with Grossman and Stiglitz' (1980) view of market efficiency, including some compensation for information gathering and analysis. However, the Ippolito type results might be a result of inappropriate choice of benchmarks, as argued by Elton, Gruber, Das, and Hlavka (1993). Malkiel (1995) redoes the analysis using the Standard & Poor's 500 (S&P 500) benchmark instead of the Wilshire 5000 resulting in average αs of -3.20% after and -2.03% before expenses, leaving no positive and statistical significant αs (Malkiel, 1995)[3]. This leads Malkiel (1995) to conclude that mutual funds generally underperform the market, after as well as before expenses.

Gruber (1996) studies the performance of 270 equity funds in 1984-1995 by using a single-index and a four-index model. The single-index is based on the CAPM with the S&P 500 as benchmark, and a performance measure similar to Jensen's alpha. The four-index model measures performance of funds controlling for four factors: the market factor (versus the S&P

[3] The Wilshire 5000 index underperformed the S&P500 index in the 1980s, as small stocks underperformed large stocks in this time period and these are included in Wilshire 5000 but not in S&P500. However, small stocks tend to overperform large stocks in other time periods, as identified by Fama and French (1992).

500 index), a size factor controlling for the difference in return between small cap and large cap portfolios, a factor controlling for the difference in return between growth and value portfolios, and a factor representing the excess return on a bond index representing corporate and government bonds. The latter model is similar to Fama and French (1992, 1993), with a bond index factor added. Using the single-index model, Gruber (1996) finds that mutual funds underperformed the market by 1.56%. The four-index model indicates underperformance by 0.65%. With average expense ratios of 1.13% per year, this results in performance pre-expenses of -0.43% and 0.48%, respectively. The difference in results between the two models can be explained by the fact that funds during the period under study tended "to hold stocks that were smaller and more growth oriented than the combination of stocks in the S&P 500 index" (Gruber, 1996); reason behind the difference is therefore similar to reason behind the difference in Malkiel (1995). Gruber (1996) concludes that the results obtained "suggest that active management adds value, but that mutual funds charge the investors more than the value added" (Gruber, 1996).

Elton, Gruber, and Blake (1996a) collect monthly data from 188 equity funds from 1977 to 1993. As they want to avoid the pitfall of not including a size-factor index as illustrated by Elton et al. (1993), they use a four-factor model to explain performance of mutual funds. Very similarly to Gruber (1996), they employ a market factor (S&P 500 index), a size factor (small-cap versus large-cap), a factor accounting for the difference between growth and value portfolio, and a bond index factor (Lehman Aggregate Bond Index) to calculate the fund αs. Average α found is -0.91% (Elton et al., 1996a).

Ferson and Schadt (1996) study monthly return data for 67 primarily equity funds from 1968 to 1990. They find an average α of -0.36% when employing the single-index model based on CAPM and similar to Jensen's measure, using the excess return on the *Center for Research in Security Prices* (CRSP) value-weighted market index as factor. 13 αs are significant on a 5%-level, of which 8 are negative and 5 are positive. This corresponds to traditional findings that when employing measures such as the CAPM, performance tends to be negative more often than positive. However, when Ferson and Schadt (1996) employ a conditional model incorporating lagged information variables such as the CRSP dividend yield and the Treasury yield spread, the average α shifts upwards to 0.24%, leading the authors to conclude that "incorporating public information variables into the analysis of investment performance is an important area for future research" (Ferson & Schadt, 1996).

Carhart (1997) studies the performance of 1,892 equity funds active between 1962 and 1993. Carhart employs two models to measure fund performance. The first is a single-index model based on the CAPM making use of the CRSP value-weight stock index as market index. The second is his own Carhart four-factor model. For this model, he used the market proxy, a size factor and book-to-market factor as developed by Fama and French (1993) in their three-factor model. In addition, Carhart includes a one-year momentum factor as identified by Jegadeesh and Titman (1993) to obtain his four-factor performance attribution model. On average, he finds an α of -0.62% in the single-index model and an α of -1.98% in the four-index model. As the average expense ratio in his sample equates 1.14%, pre-expense αs are 0.52% and -0.84% respectively. Carhart explains the wide difference between the αs using both models by the inability of the CAPM to explain the relative returns on the funds. In contrast, the four-factor model "explains most of the spread and pattern in these portfolios, with sensitivities to the size […] and momentum […] factors accounting for most of the explanation" (Carhart, 1997). Carhart (1997) concludes that the results offer only very slight evidence of skilled or informed fund managers. They are consistent with market efficiency. Although the top funds earn back their investment expenses with higher gross returns, "most funds underperform by about the magnitude of their investment expenses" (Carhart, 1997).

A more recent study by Fama and French (2010) corresponds to that conclusion. Making use of Jensen's measure (Jensen, 1968), the three-factor model of Fama and French (1993) as well as the four-factor model of Carhart (1997), they investigate the performance of on average 1,308 equity funds in the time period of 1984 to 2006. Net of expenses, they report αs of -1.13%, -0.81% and -1.00% (*t*-statistics of -3.03, -2.50 and -3.02) for the single-index, three-factor and four-factor models, respectively. Gross of expenses, they report αs of -0.18%, +0.13% and -0.05% (*t*-statistics of -0.49, 0.40 and -0.15), respectively. Results across the models are similar as the non-market explanatory results are close to zero. Fama and French (2010) report that the results are in line with previous work (see Jensen (1968), Malkiel (1995), Gruber (1996)) and conclude that active mutual funds returns in aggregate mimic market returns. However, the return to investors is reduced by the high expense ratios of funds. In addition, in case skilled fund managers able to produce returns above costs would exist, their tracks are covered in the aggregate results by fund managers with insufficient skill (Fama & French, 2010).

1.2 European mutual fund performance

Otten and Bams (2002) are among the first authors studying mutual fund performance on the European market. They study 506 domestic equity funds from 1991 to 1998, of which 99 French, 57 German, 37 Italian, 9 Dutch and 304 British funds. To evaluate performance, the authors make use of the Fama and French (1993) three-factor model as well as the Carhart (1997) four-factor model. Results net of expenses are similar across the two models. Therefore, results of the four-factor model are discussed here. French, German, Italian, Dutch and British funds have an average α of 0.22%, -1.20%, 0.84%, 1.80% and 1.33% respectively. The British α is significant at the 5% level. Adding back management fees, Otten and Bams (2002) analyze the fund performance gross of expenses. French, German, Italian, Dutch and British funds have an average α of 1.40%, -0.36%, 2.88%, 2.64% and 2.56% respectively. The French and Dutch α are significant at the 10% level, the Italian α at the 5% level, and the British α at the 1% level. The German α is negative yet insignificant. This leads the authors to conclude that "European funds (in contrast to US funds) are sufficiently successful in finding and implementing new information to offset their expenses, and therefore add value for the investor" (Otten & Bams, 2002), in line with the informationally efficient market proposition by Grossman and Stiglitz (1980).

Cesari and Panetta (2002) study the performance of 82 Italian equity funds in 1985-1995. They employ three measures: a measure as developed by Jensen (1968), a two-factor model including the market index and a bond index to mimic Elton et al. (1993), and the Fama and French (1993) three-factor model. The results across the three employed models are in line with each other: the estimated αs are always positive though never significant. The authors find αs of 0.90%, 0.10% and 1.09% for the Jensen's measure, the two-factor model and the Fama-French three-factor model respectively, for net returns. When the authors use gross returns (pre-expenses), the performance becomes positive and always significant: they find αs of 2.23%, 1.42% and 2.41% for the respective models. The two-factor model shows slightly inferior αs as the Italian bond market outperforms the equity market in the period under study. Although the absolute αs found by Cesari and Panetta (2002) are somewhat higher than previous studies seen in this review, they come to the same conclusion as e.g. Malkiel (1995): performance post-expenses is approximately equal to zero and not statistically significant. However, when looking at performance pre-expenses, it is deemed positive and significant, in line with the Grossman and

Stiglitz (1980) view of market efficiency, suggesting that information gathering and processing is compensated.

Christensen (2003) studies 44 Danish mutual funds, of which 27 equity funds and 17 fixed income funds, in 1994-2002. The author makes use of two models. First, he uses a single-index model based on the CAPM (Jensen, 1968), where equity funds are compared to Morgan Stanley Capital International (MSCI) indices such as MSCI Europe, and fixed income funds are compared to bond indices such as the JP Morgan Government Bond Index. Next, they use a multi-index model with a Danish equity index, a World equity index, a Danish bond index and a World bond index as explanatory variables. Motivation for the use of the latter model is that "a fund whose main investment objective is to invest in Danish stocks can according to Danish legislation invest up to 25% of its assets in foreign equities, in Danish bonds or in foreign bonds" (Christensen, 2003), and is similar to the methodology employed by Elton et al. (1993) and Gruber (1996). Average α for the single-index model is -1.20% (negative yet insignificant), and for the multi-index model is -0.24% (negative yet insignificant). Christensen (2003) comes to the same conclusion for both models: he was not able to identify significant performance that is, "Danish mutual funds have not possessed selection ability. In most cases, their performance has been neutral and in a few cases [he finds] even significantly negative performance" (Christensen, 2003).

Christensen (2005) slightly updates previous mentioned paper by now studying 47 Danish mutual funds, of which 34 equity funds and 13 fixed income funds, in 1996-2003. His methodology is similar to Christensen (2003). The single-index model is based on the CAPM like Jensen (1968). The multi-index model is slightly different as he distinguishes between equity and fixed income funds this time: equity funds are compared to Danish and World equity indices (no longer to bond indices); fixed income funds are compared to Danish and World bond indices. Not surprisingly, results are very similar to Christensen (2003). Average α for the single-index model is -0.58% (negative yet insignificant), and for the multi-index model is -1.18% (negative yet insignificant). Accordingly, Christensen (2005) concludes that Danish funds have performed neutrally net of expenses, which is consistent with previous US and European studies and Grossman and Stiglitz' (1980) theory of informationally efficient markets.

Cuthbertson, Nitzsche, and O'Sullivan (2008) study the performance of 842 UK equity funds during 1975-2002. The authors make use of the Fama and French (1993) three-factor model to evaluate performance, as the momentum factor of the Carhart (1997) four-factor is insignificant

at the UK fund level. The authors find an average α of -0.68%, which is a small and statistically insignificant negative value in line with previous UK studies. Although based on a more comprehensive bootstrap analysis later on in their study (out of scope of this thesis), the authors conclude that they cannot find prove of skilled fund managers.

1.3 Belgian mutual fund performance

To my knowledge, Crombez, De Moor, Sercu, and Vanpee (2003) have written the only study on Belgian mutual funds[4]. The authors study the returns of 322 international equity funds sold in Belgium and Luxembourg in 1999-2001. They make use of Jensen (1968) measure, and a multi-factor model accounting for the market excess return (MSCI), a size factor and a momentum factor. Crombez et al. (2003) find an α of -1.25% for the one-factor model, and an α of -1.15% for the three-factor model. Yet, the statistical significance found is ambiguous. Pre-expenses, the authors report that "it is quite likely that […] the performance was about zero or even mildly positive" (Crombez et al., 2003). In conclusion, the study does not contradict any of the previous studies as the authors find that the typical fund subtracts rather than adds value (Crombez et al., 2003).

2 Mutual fund performance persistence

Next to mutual fund performance, mutual fund performance persistence is a topic relevant to consider. The hypothesis of persistence in performance can be defined as "the hypothesis that mutual funds with an above average return in this period will also have an above average return in the next period" (Otten & Bams, 2002). Studying persistence is relevant, as it is used as the major selling point by most fund managers, and as it is the idea on which the publication of fund rankings in the financial press (see Chapter I) are based (Goetzmann & Ibbotson, 1994; Le Sourd, 2007).

In this section, performance persistence in US studies as well as European studies is discussed. No studies on Belgian mutual fund performance persistence are found. Relevant studies of *The Journal of Finance* among others are selected, as well as some more recent and European studies[5].

[4] With exception of Van Liedekerke (2007) who focuses on SRI funds.

[5] A more extensive discussion of the literature around performance persistence can be found in Anderson and Ahmed (2005) and Anderson and Schnusenberg (2005) for US literature until 2000 and 2005 respectively. Le Sourd (2007) includes a discussion about European studies, although also only until 2005.

The general consensus is that "good performance persists, if at all, only a quarter or two after controlling for momentum (Carhart (1997) and Bollen and Busse (2005)), whereas poor performance persists more strongly, typically because of high expenses" (Busse & Tong, 2012). Indeed, although Hendricks, Patel, and Zeckhauser (1993), Goetzmann and Ibbotson (1994) and Brown and Goetzmann (1995) find evidence of performance persistence over short-term horizons, Carhart (1997) argues that this is due to the momentum effect as illustrated by Jegadeesh and Titman (1993). Moreover, Barras, Scaillet, and Wermers (2010) and Fama and French (2010) find little to no evidence of performance persistence over long-term horizons.

As illustrated, European results tend to show slightly more evidence of performance persistence in Vidal-García (2013) and for UK funds in Otten and Bams (2002). However, in other European funds in Otten and Bams (2002), Christensen (2005) and others, generally no evidence of neither short-term nor long-term persistence is found.

2.1 United States mutual fund performance persistence

Hendricks et al. (1993) study the persistence of US mutual fund performance over shorter horizons than previous studies. They collect quarterly returns for 165 growth equity funds from 1974 to 1988. The persistence of relatively superior performance "proves to be significant, although it is predominantly a short-run phenomenon" (Hendricks et al., 1993). Indeed, by performing cross-sectional regressions with lags up to eight quarters, the authors find persistence to peak at roughly four quarters after which the effect reverses. Based on this, the authors construct octile portfolios based on the returns of the last quarters. They find that selecting top performers can significantly outperform the average mutual fund. As such, *hot hands* can be exploited, although *icy hands* also show up in their sample: poor performers continue to perform inferiorly in the near term; and this inferiority is more inferior than hot hands are superior.

In another study, Goetzmann and Ibbotson (1994) study the persistence of fund performance of 728 mutual funds over the period 1976-1988. They make use of two-year (to study the impact of relatively long-term performance), one-year, and monthly (to maximize the number of independent time periods) raw results and Jensen α results. They find that "past returns and relative rankings are useful in predicting returns and rankings, [although] it may not be a guide to beating the market" (Goetzmann & Ibbotson, 1994). They employ their Winner-Loser test as evaluation method. In other words, the findings confirm the repeat-winner hypothesis. In addition, the authors find persistence across two-year periods for the upper quartile as well as

the lower quartile. The authors note, however, that fund studies lack statistical power because of the cross-sectional dependence of fund returns.

One year later, Malkiel (1995) studies between 210 and 248 equity funds over the period 1971-1979, and between 252 and 684 equity funds over the period 1980-1990. He studies their performance persistence following Goetzmann and Ibbotson's (1994) Winner-Loser method. The author finds considerable persistence to returns between 1971-1979. Yet, between 1980-1990, this persistency is considerably weaker. As such, the author suggests that persistence may have existed earlier, but has disappeared. However, even when persistence exists, investors cannot act upon it as a strategy as considerable load fees impact investors when switching between funds at periodic intervals.

Brown and Goetzmann (1995) find similar results in their study of equity funds (between 372 and 829) over the period 1976-1988. The authors find that a majority of funds show performance persistence by applying the Winner-Loser test over the whole sample period. However, reversals also occur due to correlation across fund managers, although persistence is more common. In other words, the phenomenon is dependent on the time period of study, as also illustrated by Malkiel (1995). When comparing the funds to an absolute benchmark, the authors find that when considering aggregated results across years, "most of the persistence phenomenon is due to repeat-losers rather than to repeat-winners" (Brown & Goetzmann, 1995). When analyzing results using octiles based on performance of the preceding year, the authors find results corresponding to earlier studies: "top-octile performers do well, and bottom-octile performers do poorly" (Brown & Goetzmann, 1995). However, disaggregated results show that preceding year's low performance is a better predictor of negative alphas than high performance is of positive alphas: in 9 out of 12 years, a negative alpha could be predicted as opposed to a positive alpha in 7 out of 12 years. As such, the authors conclude that the persistence phenomenon "is a useful indicator of which funds to avoid. However, evidence that the pattern can be used to beat absolute, risk-adjusted benchmarks remains weak" (Brown & Goetzmann, 1995).

In a more comprehensive work, Carhart (1997) studies 1,892 equity funds between 1962-1993. As already discussed in previous section, two performance models are used: the CAPM, and the author's four-factor model. Decile portfolios are constructed based on previous year's performance. Using the CAPM, a difference of 8 percent is found by buying last year's top-decile portfolio and selling last year's bottom-decile portfolio, which confirms the hot hands effects as identified by Hendricks et al. (1993). However, the CAPM does not explain the

difference in returns on these portfolios. Therefore, Carhart (1997) employs his four-factor model, which is able to explain most of the spread in these portfolios. Indeed, sensitivities to size and momentum account for most of the difference. As such, the author concludes that his results "suggest that short-run mutual fund returns persist strongly, and that most of the persistence is explained by common-factor sensitivities, [as well as] expenses and transaction costs" (Carhart, 1997). His results contradict Hendricks et al. (1993), meaning that stock-picking skills are not needed to explain one-year short term persistence. In addition, sorting funds on longer horizons (2 to 5 years) yields "smaller spreads in mean returns, all but about 1 percent of which are attributable to common factors, expense ratios, and transaction costs" (Carhart, 1997). In addition, most of this spread is attributable to the strong underperformance of funds in the tenth decile.

Bollen and Busse (2005) study 230 domestic equity funds from 1985-1995 and find contradicting results compared to Carhart (1997), as their methodology is different. First, they use the prior quarter abnormal return to rank funds, as opposed to using prior year absolute returns. Second, Carhart (1997) uses a concatenated time series of post-ranking returns, as opposed to Bollen and Busse (2005) estimating "post-ranking performance over three-month horizons and [averaging] the results in the spirit of Fama and MacBeth (1973)" (Bollen & Busse, 2005). By calculating the generated abnormal returns in the following quarter, the authors find a significant abnormal return of 25-39 basis points in the post-ranking quarter. As such, they provide evidence regarding short-term persistence. However, when measuring absolute rather than abnormal returns, and when increasing the length of the time, post-ranking top-decile abnormal returns disappear. The authors conclude that although their short-term persistence results are statistically significant and robust, their economic significance is questionable, as transaction costs and taxes would eliminate the abnormal returns documented in their study (Bollen & Busse, 2005).

2.2 European mutual fund performance persistence

Otten and Bams (2002) study persistence on the European market from 1991 to 1998. Funds in France, Germany, Italy and United Kingdom are ranked into 4, 3, 3 and 10 equally weighted portfolios respectively, based on past 12-month return. For all countries, monotonically decreasing excess returns are observed when moving form high- to low-past performance portfolios. The average spread between the high- and low-past performance portfolio varies significantly, however, from 0.83% per year for France to 6.08% for the UK. The only significant spread is exhibited in the UK. Likewise, when performing the same analysis with

risk-adjusted returns based on the Carhart four-factor model, the authors find the only significant result with UK funds, in line with Blake and Timmermann (1998). Contrary to Carhart (1997), the UK spread "cannot be explained by common factors" (Otten & Bams, 2002). Therefore, the authors conclude "that most European funds provide only weak evidence of persistence in performance, except for UK funds" (Otten & Bams, 2002).

Christensen (2005) studies the long-term persistence of 47 Danish mutual funds between 1996-2003. He uses a Winner-Loser test following Brown et al. (1992), Goetzmann and Ibbotson (1994) and Malkiel (1995). In addition, he employs two parametric tests by regressing returns obtained in a latter 2.5-year period on a previous 2.5-year period, and by analyzing the 20% best-performing and 20% worst-performing funds in the previous period on their alpha in the current period. For all tests, the author concludes "in favor of non-persistence concerning the Danish mutual fund returns" (Christensen, 2005). Only in one case, he finds some evidence of performance persistence for the worst-performing bond portfolio. As such, the author concludes that his results are "consistent with the results for a number of other European mutual funds, but not with the US evidence" (Christensen, 2005), as for the latter, short-term persistence is found.

Vidal-García (2013) examines the persistence of 1,050 European equity mutual funds in 1988-2010. He uses a regression analysis and the Winner-Loser test to evaluate the existence of the persistence phenomenon. As opposed to other European studies, he finds strong evidence of significant performance persistence, both on an annual basis as on 2-year and 3-year intervals. For the latter, however, persistence is "much more pronounced for the top and bottom performers" (Vidal-García, 2013). As such, the author concludes that "past performance of European mutual funds have explanatory power for future performance and investors can obtain useful evidence from past performance data" (Vidal-García, 2013).

IV. Data

1 Selection of mutual funds and data collection

For the selection of mutual funds to analyze, the online fund database of the Belgian Asset Managers Association (BEAMA) is used. This database "provides an overview of the funds and subfunds that are commercialized in Belgium, [and] highlight is set on the organization, typology, categorization and the cost structure of the funds" (Belgian Asset Managers Association, 2017b).

The following criteria are applied to the database to obtain the selection of funds.

- Nationality of the fund is *Belgian*, as this is in scope of this thesis. Funds of other nationalities that are also commercialized in Belgium are not analyzed. As explained in the introduction, Belgian funds are analyzed in this thesis as these have not been studied after the Financial Crisis of 2008.
- Main type of the fund is *open-ended*.
- Investment type of the fund is *equity fund*, as bond or balanced fund were less prevalent in the BEAMA sample and require different calculations.
- Geography of the invested portfolio is *Europe* or *Eurozone*. Restricting the sample to a Belgian geographical investment focus would be overly restrictive and leave only 11 funds in the sample; having a European investment focus instead allows to compare results with other European studies in the literature review.
- Funds are *accumulation* funds, as distribution funds would complicate the calculation of excess returns due to dividends.
- The funds are founded on or before January 1, 2010 as the scope of this thesis reaches from 2010 to 2016.
- The funds are available to the public, meaning the sample does not include institutional funds.

Applying these criteria leaves 50 funds. Leaving out funds for which no complete data were available leaves 46 funds. For these funds, Net Asset Value (NAV) data are collected from the Bloomberg Terminal in the ESPO-library at Université catholique de Louvain (Bloomberg, 2017). The full list of 46 funds can be found in Appendix A. The sample contains two fund-of-funds and six index funds in the sample of 46.

Weekly NAV data are collected from January 1, 2010 until December 30, 2016 included. As funds that contain only fortnightly data are removed from the sample, missing data is below 0.001% and is imputed making use of a linear interpolation towards the next available price.

Survivorship bias, which leads to overstatement of performance according to Elton, Gruber, and Blake (1996b), is not taken into account as the sampling period only covers 6 years. The latter authors give estimates of bias as of sampling periods of 10 years.

Summary statistics for the sample can be found in Table 2. Average return and standard deviation of the returns is calculated based on an equally weighted portfolio of the 46 respective funds. This equally weighted portfolio is used in this thesis to evaluate average performance across funds, and as a simple average does not yield meaningful t-statistics and p-values (Grinblatt & Titman, 1994).

Table 2: Summary statistics for Belgian mutual funds 2010-2016

	Number of funds	Average return*	Stdev returns*	Average expense ratio
Sample	46	7.90%	15.84%	1.49%

** annualized; based on equally weighted portfolio*

2 Market benchmark

As making use of different benchmarks has an impact on the inferences drawn from the performance evaluation (Grinblatt & Titman, 1994), the MSCI Europe Index is used. This index is reported by a large amount of the funds in the sample as their benchmark index in either their prospectus or on Morningstar. The MSCI Europe Index "captures large and mid-cap representation across 15 Developed Markets countries in Europe[6]. With 445 constituents, the index covers approximately 85% of the free float-adjusted market capitalization across the European Developed Markets equity universe" (MSCI, 2017)[7]. To match the data obtained for the mutual funds, weekly data from January 1, 2010 until December 30, 2016 are obtained from Morningstar (Morningstar, 2017b).

Important to note is that data are gathered for the Net Results (NR) index, which indicates that the index includes reinvestment of net dividends. This MSCI Europe NR Index is also the index the six index funds in the sample mimic, which assures this is an appropriate index to use as benchmark.

[6] Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK.

[7] For further information about the index and its methodology, see MSCI's website, https://www.msci.com/index-methodology.

3 Risk-free rate

Damodaran (2008) suggests to use the lowest bond rates in the Euro-area if looking for Euro bond rates, as this will come closest to the true risk-free rate. Therefore, the three-month German bond yield as risk-free rate is used, obtained from OECD's Main Economic Indicators database (OECD, 2017). The rate is obtained on a monthly basis, and is formatted as a yearly rate. To convert this data into weekly risk-free rates, the same risk-free rate for all the weeks in one month is used (i.e., for 01/01, 08/01, 15/01, 22/01, and 29/01, the rate obtained for January is used). The yearly rate is converted into a weekly format:

$$r_{f,weekly} = \left(1 + r_{f,yearly}\right)^{1/52} - 1$$

4 SMB, HML and MOM factors

The Small-Minus-Big (SMB) and High-Minus-Low (HML) factors from the Fama and French (1993) three-factor model, as well as the additional Momentum (MOM) factor from the Carhart (1997) four-factor model are obtained from Kenneth French's website for the European market (French, 2017). SMB, HML and MOM factors are constructed according to the methodology described in the next Chapter. Factors are obtained from French (2017) on a daily basis. They are transformed into a weekly basis to match the return data obtained for the mutual funds according to following formula:

$$\text{Factor}_{weekly} = \left(\prod_{i \in day} \left(\frac{\text{Factor}_{daily}}{100} + 1 \right) - 1 \right) \times 100$$

Though the Fama-French factors are given in USD, they are assumed to be identical in EUR as they represent risk factors. Summary statistics (annualized) for the market (R_m - R_f), SMB, HML, and MOM factors can be found in Table 3.

Table 3: Summary statistics for the factor-mimicking portfolios 2010-2016

			Cross correlations			
Factor portfolio	Average return	Standard deviation	Rm - Rf	SMB	HML	MOM
Rm - Rf	7.16%	17.03%	1.000			
SMB	1.94%	6.90%	-0.631	1.000		
HML	-2.47%	8.39%	0.387	-0.366	1.000	
MOM	11.69%	11.97%	-0.147	0.259	-0.520	1.000

5 Total expense ratio

To analyze the fund returns both net and gross of expenses, total expense ratios are obtained from Morningstar's summary pages for each of the funds. Gross returns are obtained mimicking Fama and French (2010) approach, using the following formula.

$$\text{Gross return}_{\text{weekly}} = \text{Net return}_{\text{weekly}} + \frac{\text{Expense ratio}}{52}$$

The average total expense ratio in the sample is 1.49% (Table 2). The total expense ratio per fund can be found in Appendix B.

V. Methodology

1 Performance evaluation

1.1 Jensen's alpha

The Jensen's alpha methodology is based on the CAPM. As Jensen (1968) points out, the CAPM represents the expected one-period return. Since these expectations are strictly unobservable, he recasts the CAPM equation "in terms of the objectively measurable realizations of returns on any portfolio *j* and the market portfolio *M*". As long as returns are measured "as continuously compounded rates of return" and "assuming that the asset pricing model is empirically valid", reached excess returns on any portfolio ($R_{jt} - R_{Ft}$) can be expressed as a linear function of its systematic risk (β_j), the realized excess returns on the market portfolio ($R_{Mt}-R_{Ft}$) and a random error (e_{jt}) with an expected value of zero. This equation is as follows,

$$R_{jt} - R_{Ft} = \beta_j [R_{Mt}-R_{Ft}] + e_{jt}$$

where the subscript *t* denotes "an interval of time arbitrary with respect to length and starting (and ending) dates" (Jensen, 1968).

Then, the author goes on to allow superior forecasting ability of portfolio managers to be reflected in the equation by allowing for the possible existence of a non-zero constant (α_j) in previous equation.

$$R_{jt} - R_{Ft} = \alpha_j + \beta_j [R_{Mt}-R_{Ft}] + e_{jt}$$

This equation is used by Jensen (1968), and later on by many others, to evaluate portfolio performance, where α_j is referred to as Jensen's alpha.

To comply with the condition of making use of continuously compounded rates of return for the model to be valid, weekly returns of the mutual funds as well as the market benchmark were calculated logarithmically.

$$return_t = \ln (p_t/p_{t-1}) \quad or \quad return_t = \ln (NAV_t/NAV_{t-1})$$

Jensen's alpha reflects two ways of identifying the manager's "forecasting ability". First, this ability may consist of forecasting price movements of individual securities in the manager's

portfolio. Second, it may consist of forecasting the general behavior of future security prices[8] (Jensen, 1968)[9]. As such, a positive measure for Jensen's alpha would imply positive forecasting ability regarding these two items. It represents the average incremental rate of return on the portfolio per unit time due to this ability. Next, it is interesting to note that "a naïve random selection buy and hold policy can be expected to yield a zero intercept". Last, a negative alpha can exist as well, meaning that the portfolio did worse than a random selection policy. This may be caused by "the generation of too many expenses in unsuccessful forecasting attempts". Furthermore, the measure "can be legitimately compared across funds of different risk levels and across differing time periods irrespective of general economic and market conditions" (Jensen, 1968).

1.2 Fama-French three-factor model

The construction of the Fama-French three-factor model is based on anomalies found to the CAPM, as Fama and French (1992) find no relationship between market betas and average stock returns. Anomalies discussed are the size effect of Banz (1981), who finds that average returns on stocks with low market cap are too high given their beta; the leverage effect of Bhandari (1988), who finds that leverage helps explaining stock returns although it should be included in the beta; the book-to-market equity ratio effect by Rosenberg, Reid, and Lanstein (1985), who find that stock returns are positively related to this ratio; and the earnings-price ratio effect by Basu (1983), who finds that this ratio helps explain returns if size and market beta are also included.

Fama and French (1992) study the joint roles of these anomalies, and find that "the combination of size and book-to-market equity seems to absorb the roles of leverage and E/P in average stocks returns". As such, they create their three-factor model with common risk factors in stock returns. The equation is (Fama & French, 1993, 1996):

$$R_{it} - R_{Ft} = \alpha_i + \beta_{im}(R_M - R_{Ft}) + \beta_{iS}SMB + \beta_{iH}HML + \varepsilon_{it}$$

[8] Jensen's alpha equation has a stationary risk parameter, since β_j does not have a time subscript. This implicitly assumes a constant risk level of the portfolio under consideration through time. However, the portfolio manager can easily alter the portfolio's risk level, e.g. by consciously switching portfolio holdings between risky and less risky asset classes. As such, Jensen (1968) shows that if the manager shows forecasting ability of market movements to some extent, β_j will be biased downwards, and consequently α_j will be biased upwards. Therefore, forecasting ability regarding the general behavior of future security prices is also included in Jensen's alpha (Jensen, 1968).

[9] The latter is related to market timing ability of fund managers. As this is not further discussed throughout this thesis, the reader is referred to Treynor and Mazuy (1966), Henriksson and Merton (1981) and Henriksson (1984) who provide insight into the topic.

where $R_{it} - R_{Ft}$ is the reached excess return on any portfolio; and where $R_M - R_{Ft}$, SMB and HML are the respective expected premiums for the market, the size and the book-to-market ratio (also seen as value versus growth stocks return). β_{im}, β_{iS} and β_{iH} are the sensitivities or loadings to those premiums (Fama & French, 1996).

SMB and HML are constructed by comparing returns across portfolios meant to mimic the underlying risk factors. SMB is the equal-weight average of the returns of the small-stock portfolios (bottom 10% market cap) minus the average of the returns of the large-cap portfolios (top 90% market cap). HML is the equal-weight average of the returns of the high book/market portfolios (top 30% book/market value) minus the returns of the low book/market portfolios (bottom 30% book/market value) (Fama & French, 1992, 1993).

Fama and French (1993) argue that, at a minimum, their model does a good job in explaining the cross-section of average results. In addition, Fama and French (1993) suggest that the size-related factor explains why small-stock returns are more variable than big-stock returns, and that book-to-market equity is related to relative profitability. Furthermore, Fama and French (1996) suggest that HML is related to relative distress, although this is contradicted by Griffin and Lemmon (2002). In the end, the choice of factors is motivated by empirical experience. Therefore, the authors conclude that "detailed stories for the slopes and average premiums associated with particular versions of the factors are suggestive, but never definitive" (Fama & French, 1993).

1.3 Carhart four-factor model

Carhart (1997) includes the one-year momentum anomaly identified by Jegadeesh and Titman (1993) in his four-factor model, adding to the three factors of Fama and French (1993). The model can be summarized as:

$$R_{it} - R_{ft} = \alpha_i + \beta_{im}(R_M - R_{ft}) + \beta_{iS}SMB + \beta_{iH}HML + \beta_{iM}MOM + \varepsilon_{it}$$

where the SMB and HML factors and betas are the same as those in Fama and French (1993). In addition, MOM is the momentum return factor, and β_{iM} the sensitivity to this return.

Carhart (1997) constructs MOM as "the equal-weight average of firms with the highest 30 percent eleven-month returns lagged one month minus the equal-weight average of firms with the lowest 30 percent eleven-month returns lagged one month". Fama and French (2010) do this similarly. For daily momentum factors, "the lagged momentum return is a stock's

cumulative return for day t–250 to day t–20" (French, 2017), as dropping the last month's return is common in the momentum literature (Fama & French, 2010).

The four-factor model is "consistent with a model of market equilibrium with four risk factors" (Carhart, 1997). Alternatively, it could be interpreted as "a performance attribution model, where the coefficients and premia on the factor-mimicking portfolios indicate the proportion of mean return attributable to four elementary strategies: high versus low beta stocks, large versus small market capitalization stocks, value versus growth stocks, and one-year return momentum versus contrarian stocks" (Carhart, 1997). As such, Carhart (1997) uses the model to explain returns and leaves risk interpretations to the reader.

1.4 Criticism and weaknesses of the methods

Most mutual funds studies prior to the 90s make use of a single index model similar to Jensen's measure (Grinblatt & Titman, 1989; Ippolito, 1989; Otten & Bams, 2002). However, the method has been subject to criticism. On a theoretical level, Roll (1977) argues that the market portfolio is unobservable, as it would include every single possible asset. Moreover, he argues that the proxies used for the market portfolio are highly correlated to each other. This will make it seem that "the exact composition is unimportant, whereas it can cause quite different inferences" (Roll, 1977). In a similar vein, Ross (1976) argues that one factor of risk is too limited to represent systematic risk. As such, he came up with the arbitrage pricing theory (APT) as alternative, explaining the expected asset return by different factors of risk, with each their respective factor sensitivity. However, no details about which specific factors to include are provided.

On a more practical note, models more specific than Jensen's measure have been developed, such as the Fama-French three-factor and Carhart four-factor model. These have their own weaknesses as well. For instance, some argue the HML factor is a premium for distress and a result of data snooping (Black (1993), MacKinlay (1995)). Moreover, Fama and French (1996) acknowledge themselves that their model cannot explain "the continuation of short-term returns documented by Jegadeesh and Titman (1993) and Asness (1994)".

Evaluating the appropriateness of using these methods would be a study on its own. However, it is worth noting that fund performance evaluation is subject to the joint-hypothesis problem: "measured abnormal returns can result from market inefficiency, a bad model of market equilibrium, or problems in the way the model is implemented" (Fama, 1991).

That said, Anderson and Schnusenberg (2005) argue that "any study attempting to assess mutual fund performance today would be remiss in not correcting performance for the size and book-to-market factors identified by Fama and French (1993), and for the momentum factor incorporated into the assessment of fund performance by Carhart (1997)". Therefore, this thesis continues to use the methods described in this section.

1.5 Statistical inferences drawn from the methods

If the alphas found in Jensen's, Fama-French's and Carhart's models measure turn out to be positive, a judgment should be made to see whether or not this observation was due to random chance or to the manager's forecasting ability. Ordinary least squares (OLS) regression provides an estimate of the standard error of the performance measure. Furthermore, "the sampling distribution of the estimate, $\hat{\alpha}_j$, is a student *t* distribution with $n_j - 2$ degrees of freedom" (Jensen, 1968). For Fama-French and Carhart, the t distribution has $n_j - 4$ and $n_j - 5$ degrees of freedom, respectively. A two-tail t-test can be executed with following hypotheses,

H_0: $\alpha_j = 0$

H_1: $\alpha_j \neq 0$

with $\hat{t}_j = \hat{\alpha}_j / se(\hat{\alpha}_j)$ (Gujarati & Porter, 1999).

However, several statistical violations may occur. First of all, the assumption of normality of the fund returns may be violated. If fund returns are not normally distributed, Jensen's measure is biased (Dybvig & Ross, 1985; Grinblatt & Titman, 1989). Normality is tested making use of the Jarque Bera (1980) test, through the function 'jarque.bera.test' of the *normtest*-package in R. The null hypothesis is that the returns are normally distributed with skewness of 0 and kurtosis of 3. If normality is rejected for (part of) the funds in the sample, carefulness is needed when interpreting Jensen's measure.

Second, heteroskedasticity and autocorrelation may arise in time series regressions. They do not cause bias or inconsistency in the OLS regression coefficients. They do, however, cause bias in the standard errors and *t*-statistics: OLS no longer yields best linear unbiased estimators (BLUE) and test statistics are no longer valid (Wooldridge, 2015). Heteroskedasticity is tested using White (1980) test, through the function 'bptest' of the *lmtest*-package in R[10]. The null hypothesis is that no heteroskedasticity exists. Autocorrelation is tested using the Durbin

[10] As the Breusch-Pagan test (Breusch & Pagan, 1979), on which the 'bptest' function is based, only includes the original explanatory variables to explain the squared residuals, "the squares of the explanatory variables and their cross-products" must be manually added to the auxiliary regression in R to execute the White test (Brooks, 2014).

Watson (1951) test, through the function 'dwtest' of the *lmtest*-package in R. The null hypothesis is that no autocorrelation exists (i.e., a two-sided Durbin Watson test will be performed).

Most authors (e.g. Kothari and Warner (2001), Christensen (2005) and Cuthbertson et al. (2008)) make use of Newey-West heteroskedasticity and autocorrelation adjusted standard errors (Andrews, 1991; Newey & West, 1987, 1994) to overcome the violated OLS assumptions. Using Newey-West standard errors is preferred over using the heteroskedasticity-consistent standard errors procedure of White (1980), as White standard errors are still biased when the residuals are not independent (Petersen, 2009). Following Kothari and Warner (2001), the Newey-West correction will be applied for up to five lags. This is consistent with Newey and West's (1987) recommendation of $4\times(n/100)^{2/9}$, which corresponds to 5.33 for n=365 (the amount of weekly data in the dataset).

2 Performance persistence evaluation

2.1 Winner-Loser Test

2.1.1 Foundation and construction of the measure

To assess performance persistence, a Winner-Loser Test is used following Brown et al. (1992), Goetzmann and Ibbotson (1994) and Malkiel (1995). Making use of this non-parametric contingency table analysis "is a common test for persistence to examine the frequency with which winners or losers funds maintained that category over consecutive time periods" (Vidal-García, 2013). Winners are identified as funds with a return equal to or higher than the median return, whereas losers have returns lower than the median return. Contingency tables "are preferred to other methods when there is a limited sample of funds" (Vidal-García, 2013), as is the case in this study. Following Christensen (2005), the sample is split up in three periods. This results in periods of 122 weeks each: January 2010 – April 2012, May 2012 – August 2014, September 2014 – December 2016.

The Winner-Loser Test is performed by looking at total returns, risk-adjusted return by Jensen's measure, and the Carhart four-factor model (cf. Christensen (2005)). Different results may be obtained depending on the type of results used. Total returns usually reveal performance reversals. At the same time, risk-adjusted returns may reveal the existence of persistence.

Based on the winner-loser categorization, two-way contingency tables are developed as follows.

Table 4: Winner-Loser Test

		Consecutive period	
		Winner	Loser
Previous period	Winner	WW	WL
	Loser	LW	LL

As such, two contingency tables can be constructed. One for 2010.1/2012.4 – 2012.5/2014.8, and one for 2012.5/2014.8 – 2014.9/2016.12.

2.1.2 Testing the robustness of the possible performance persistence effect

Following Vidal-García (2013) and Christensen (2005), results are examined using the repeat winner approach (Malkiel, 1995), the log-odds ratio test (Brown & Goetzmann, 1995) and the χ^2-test of independence (Kahn & Rudd, 1995).

Malkiel (1995) binomial test. The binomial test of $p > 0.50$ checks the significance of the proportion of WW to (WW+WL). The z-statistic is:

$$Z = \frac{(y - np)}{\sqrt{np(1-p)}}$$

where $Z \sim N(0,1)$ when n is reasonably large ($n \geq 20$), y is the number of WW, n is the number of (WW+WL) and p is 0.50. Persistence is found when the Z-statistic is significantly above zero. Therefore, H_0 is $p \leq 0.5$ and H_a is $p > 0.5$.

Brown and Goetzmann (1995) log-odds ratio test. The log-odds ratio, or cross-product ratio, is defined as:

$$LOR = \ln\left[\frac{WW \cdot LL}{WL \cdot LW}\right]$$

In case of no persistence (the null hypothesis), this ratio will equal 1 and the LOR will equal 0. In other words, H_0 is $LOR = 0$ and H_a is $LOR \neq 0$. A positive LOR indicates positive persistence whereas a negative LOR indicates negative persistence. The significance of the LOR can be tested using a t-statistic defined as:

$$t = \frac{LOR}{\sigma_{LOR}}$$

where σ_{LOR} is given by:

$$\sigma_{LOR} = \sqrt{\frac{1}{WW} + \frac{1}{WL} + \frac{1}{LW} + \frac{1}{LL}}$$

The t-statistic approximates a standard normal distribution. However, for small sample sizes, results might be misleading (Vidal-García, 2013).

A weakness of the LOR is that it cannot be applied when either WL or LW is zero. Then, no LOR can be calculated, and no inference about persistence can be drawn (Christensen, 2005).

Kahn and Rudd (1995) χ^2-test of independence. The χ^2-statistic is calculated as:

$$\chi^2 = \frac{(WW\text{-}D1)^2}{D1} + \frac{(WL\text{-}D2)^2}{D2} + \frac{(LW\text{-}D3)^2}{D3} + \frac{(LL\text{-}D4)^2}{D4}$$

where:

$$D1 = \frac{(WW+WL)\times(WW+LW)}{N}$$

$$D2 = \frac{(WW+WL)\times(WL+LL)}{N}$$

$$D3 = \frac{(LW+LL)\times(WW+LW)}{N}$$

$$D4 = \frac{(LW+LL)\times(WL+LL)}{N}$$

where N is the number of funds. The χ^2 test has 1 degree of freedom. The Yates (1934) correction is applied as the sample size is small, making use of the 'chisq.test' function in R.

2.2 Parametric regression test

As the Winner-Loser Test is a non-parametric test, a parametric test is added to analyze the robustness of the results following Christensen (2005). Grinblatt and Titman (1992), Brown et al. (1992) and Elton et al. (1993) test persistence by regressing returns of a subsequent period on returns of a precedent period. The regression equation is as follows (Christensen, 2005):

$$r_S = a_0 + a_1 r_P + e$$

where r_S and r_P are the returns of the subsequent and precedent periods, respectively. If r_S can be predicted by r_P, performance is persistent. A positive a_1 would then indicate positive persistence. This exercise is done by looking at total returns, risk-adjusted return by Jensen's measure, and the Carhart four-factor model (cf. Christensen (2005)).

The sample is first split up in the same subperiods as used in the Winner-Loser Test, i.e. 2010.1/2012.4 – 2012.5/2014.8, and 2012.5/2014.8 – 2014.9/2016.12. Then, in order to test somewhat more short-term persistence, the sample is split up in 7 years, i.e. 2010/11 – 2011/12, 2012/13 – 2013/14 and 2014/15 – 2015/16.

T-statistics are used to assess the statistical significance of the OLS slope coefficients. Both *t*-statistics obtained through OLS as through the Newey-West correction for up to 5 lags (cf. Kothari and Warner (2001)) will be reported.

VI. Results

1 Performance evaluation

1.1 Results using Ordinary Least Squares (OLS) regression

This section describes the results of performance evaluation using Jensen's alpha (Table 5, Table 6), Fama-French three-factor (Table 7, Table 8) and Carhart four-factor (Table 9, Table 10) as described in Chapter V, for net returns and gross returns respectively. Equations are estimated by OLS, assuming no OLS assumptions are violated. Minimum, average, and maximum for the relevant metrics across the sample of 46 funds are reported. Next, results for the equally weighted portfolio are presented to evaluate the average performance across funds. Reported αs are annualized[11]. Finally, the α distribution between significantly positive (+) αs, αs non-significantly different from zero (0), and significantly negative αs (-) is given at a significance level of 0.05.

The respective figures display a fairly consistent message. Looking at net returns, Jensen's alpha, Fama-French and Carhart regressions, all report positive yet insignificant αs for the equally weighted portfolio. The three models report 1 or 2 out of 46 significantly positive risk-adjusted fund returns. Looking at gross returns, Jensen's alpha and Fama-French report a significantly positive equally weighted portfolio α at the 0.05 significance level, and the Carhart model reports a positive α with p-value of 0.066. Jensen's alpha, Fama-French, and Carhart report 8, 6, and 3 significantly positive risk-adjusted fund returns out of 46, respectively. No significantly negative risk-adjusted gross fund returns remain.

The respective risk factors have similar βs across the three models (and are obviously the same between gross and net returns). The market β, accounting for the market risk factor is 0.92 for Jensen's model, and 0.93 for Fama-French and Carhart. The SMB β, accounting for the size anomaly, is 0.11 for Fama-French and Carhart. The HML β, accounting for the book-to-market anomaly, is 0.07 for Fama-French and 0.08 for Carhart. The momentum β is 0.02 for Carhart.

The (slight) differences in overall αs across the models can be explained by looking at the average returns of the factor-mimicking portfolios (Table 3). Adding an explanatory variable with a positive average return during the period of study, and having a positive exposure to that variable (measured by its β) results in a lower α (cf. Cesari and Panetta (2002)). Fama-French

[11] Following other papers, αs are annualized by multiplying weekly αs by 52. Strictly speaking, this underestimates annual αs due to the effect of compounding. However, the impact is negligible and has no effect on the p-values.

α is 17 basis points lower than Jensen's α for the equally weighted portfolio, as the SMB and HML factor are added as explanatory variables. The average return of the HML factor is negative, and the average return of SMB is positive. However, the exposure to the latter factor (measured by β_{SMB}) is on average higher than the exposure to the HML factor (measured by β_{HML}). This results into a lower α for the Fama-French model, with SMB and HML included. Similarly, the equally weighted portfolio's Carhart α is 17 basis points lower than its Fama-French α, as the MOM portfolio average return is positive, and the equally weighted portfolio's exposure to this factor (β_{MOM}) is positive.

The explanatory power, as summarized by the adjusted R^2, is around 98% for the equally weighted portfolio and around 80% for the average of the 46 funds across all three models. This R^2 may seem high, but is in line with other mutual fund studies. Fama and French (2010), for instance, report R^2 of 96%, 98% and 98% for Jensen's, Fama-French's and Carhart's model respectively. The R^2 of 100%, which can be found as the maximum R^2 in the right panel of the tables, can be explained by the fact that six index funds are included in the sample. These are designed to follow the market index, and therefore are expected to have a R^2 of 100%[12].

Table 5: Performance summary, Jensen's alpha net returns

	Equally Weighted Portfolio		**Summary (n= 46 funds)**		
	Estimate	p-value	Min	Avg	Max
α	0.59%	0.545	-7.24%	0.13%	8.30%
β_market	0.92 ***	0.000	0.33	0.93	1.27
Adj. R^2	0.974		0.11	0.80	1.00
α distribution +/0/-	2/43/1				

Note: for this table, and all following, ***, **, and * mean significant at the 1%, 5% and 10% level, respectively.

Table 6: Performance summary, Jensen's alpha gross returns

	Equally Weighted Portfolio		**Summary (n= 46 funds)**		
	Estimate	p-value	Min	Avg	Max
α	2.08% **	0.033	-5.29%	1.62%	10.37%
β_market	0.92 ***	0.000	0.33	0.93	1.27
Adj. R^2	0.974		0.11	0.80	1.00
α distribution +/0/-	8/38/0				

[12] Index funds may have a R^2 lower than, but close to, 100%. This can occur if the index fund does not exactly follow the market, as measured by its *tracking error*.

Table 7: Performance summary, Fama-French net returns

	Equally Weighted Portfolio			**Summary (n= 46 funds)**		
	Estimate		p-value	Min	Avg	Max
α	0.42%		0.653	-6.16%	0.11%	6.70%
β_market	0.93	**	0.010	0.32	0.94	1.19
β_SMB	0.11	**	0.024	-0.12	0.10	0.52
β_HML	0.07	**	0.017	-0.45	0.09	0.71
Adj. R^2	0.976			0.15	0.82	1.00
α distribution +/0/-	1/43/2					

Table 8: Performance summary, Fama-French gross returns

	Equally Weighted Portfolio			**Summary (n= 46 funds)**		
	Estimate		p-value	Min	Avg	Max
α	1.91%	**	0.042	-4.21%	1.60%	8.77%
β_market	0.93	**	0.010	0.32	0.94	1.19
β_SMB	0.11	**	0.024	-0.12	0.10	0.52
β_HML	0.07	**	0.017	-0.45	0.09	0.71
Adj. R^2	0.976			0.15	0.82	1.00
α distribution +/0/-	6/40/0					

Table 9: Performance summary, Carhart net returns

	Equally Weighted Portfolio			**Summary (n= 46 funds)**		
	Estimate		p-value	Min	Avg	Max
α	0.25%		0.791	-5.96%	0.04%	7.58%
β_market	0.93	**	0.010	0.34	0.94	1.19
β_SMB	0.11	**	0.025	-0.12	0.10	0.50
β_HML	0.08	**	0.019	-0.38	0.10	0.66
β_MOM	0.02	**	0.013	-0.28	0.01	0.11
Adj. R^2	0.976			0.17	0.82	1.00
α distribution +/0/-	1/43/2					

Table 10: Performance summary, Carhart gross returns

	Equally Weighted Portfolio			**Summary (n= 46 funds)**		
	Estimate		p-value	Min	Avg	Max
α	1.74%	*	0.066	-4.01%	1.53%	8.21%
β_market	0.93	**	0.010	0.34	0.94	1.19
β_SMB	0.11	**	0.025	-0.12	0.10	0.50
β_HML	0.08	**	0.019	-0.38	0.10	0.66
β_MOM	0.02	**	0.013	-0.28	0.01	0.11
Adj. R^2	0.976			0.17	0.82	1.00
α distribution +/0/-	3/43/0					

1.2 Statistical tests

1.2.1 Normality of fund returns

Normality of fund returns is tested with the Jarque Bera test. Table 11 reports results of the test for the equally weighted portfolio, and the minimum, average, and maximum as a summary for the 46 funds. The p-value of the test-value for the equally weighted portfolio is 0.000, indicating that the null hypothesis of a normal distribution can be rejected. In other words, the equally weighted portfolio returns are non-normally distributed. The same can be said of all 46 funds, for which the null hypothesis can be rejected in all cases at a significance level of 0.05.

As said, this means the alphas will need to be interpreted with caution. Though this may look worrisome, other studies like Moreno and Rodríguez (2009) for instance report a p-value of 0.000 for the market portfolio as well.

Table 11: Jarque Bera Test for normality of fund returns

	Equally Weighted Portfolio		**Summary (n= 46 funds)**			
	χ-squared	p-value	Min	Avg	Max	% p<0.05
Jarque Bera Test	133.26 ***	0.000	6.72	130.33	581.22	100%

1.2.2 Heteroskedasticity

The White test for heteroskedasticity is summarized for the Jensen, Fama-French, and Carhart model in Table 12, Table 13, and Table 14 respectively. Results are, obviously, not different for net and gross return models. For all of them, the null hypothesis of no heteroskedasticity in the equally weighted portfolio's regression is rejected with a p-value of 0.000. In the summary of the 46 funds, the null hypothesis is rejected at the 5% significance level for 57%, 57% and 61% of the funds' regressions for Jensen, Fama-French, and Carhart respectively.

This means that, for these, the OLS is no longer BLUE and *t*-statistics will therefore be biased.

Table 12: White's test for heteroskedasticity, Jensen

	Equally Weighted Portfolio		**Summary (n= 46 funds)**			
	BP	p-value	Min	Avg	Max	% p<0.05
White Test	34.32 ***	0.000	0.00	12.18	70.81	57%

Table 13: White's test for heteroskedasticity, Fama-French

	Equally Weighted Portfolio		**Summary (n= 46 funds)**			
	BP	p-value	Min	Avg	Max	% p<0.05
White Test	44.86 ***	0.000	2.16	28.09	110.16	57%

Table 14: White's test for heteroskedasticity, Carhart

	Equally Weighted Portfolio		**Summary (n= 46 funds)**			
	BP	p-value	Min	Avg	Max	% p<0.05
White Test	54.12 ***	0.000	4.81	37.96	118.71	61%

1.2.3 Autocorrelation

The Durbin Watson test for autocorrelation is summarized for the Jensen, Fama-French, and Carhart model in Table 15, Table 16, and Table 17 respectively. Results are, again, not different for net and gross return models. For all of them, the null hypothesis of 'no autocorrelation' cannot be rejected in the equally weighted portfolio regressions as the p-values are 0.246, 0.974 and 0.974 respectively. In the summary of the 46 funds, the null hypothesis is rejected at the 5% significance level for 30%, 37% and 41% of the funds' regressions for Jensen, Fama-French and Carhart respectively.

This means that, for these, the OLS is no longer BLUE and *t*-statistics will therefore be biased.

Given the results for the White and Durban Watson test, it seems appropriate to opt for Newey-West heteroskedasticity and autocorrelation standard errors in the regression to avoid bias in the t-statistics.

Table 15: Durbin Watson test for autocorrelation, Jensen

	Equally Weighted Portfolio		**Summary (n= 46 funds)**			
	DW	p-value	Min	Avg	Max	% p<0.05
Durbin Watson Test	1.88	0.246	1.69	2.13	3.01	30%

Table 16: Durbin Watson test for autocorrelation, Fama-French

	Equally Weighted Portfolio		**Summary (n= 46 funds)**			
	DW	p-value	Min	Avg	Max	% p<0.05
Durbin Watson Test	2.00	0.974	1.73	2.22	3.01	37%

Table 17: Durbin Watson test for autocorrelation, Carhart

	Equally Weighted Portfolio		**Summary (n= 46 funds)**			
	DW	p-value	Min	Avg	Max	% p<0.05
Durbin Watson Test	2.00	0.974	1.70	2.21	3.00	41%

1.3 Results using the Newey-West correction

This section describes the results of performance evaluation using Jensen's alpha (Table 18, Table 19), Fama-French three-factor (Table 20, Table 21) and Carhart four-factor (Table 22, Table 23) using the Newey-West correction, for net returns and gross returns respectively. Minimum, average, and maximum for the relevant metrics across the sample of 46 funds are reported, as well as results for the equally weighted portfolio. Like before, αs are annualized, and the α distribution (+/0/-) is given at a significance level of 0.05.

The Newey-West correction only changes standard errors (thus, t-statistics and p-values) and does not change OLS estimators nor the R^2 value. Therefore, conclusions in this section can only be different from conclusions in section 1.1 in their statistical significance.

Like before, all three models report positive yet insignificant αs for the equally weighted portfolio for net returns. For all three, 1 out of 46 funds has significantly positive returns, whereas between 3 and 4 are significantly negative. For gross returns, p-values of the equally weighted portfolios are slightly higher in this section, but the main conclusion remains: Jensen's alpha and Fama-French report a significantly positive equally weighted portfolio α at the 0.05 significance level, and the Carhart model reports a positive α with p-value of 0.066. In the funds' summary, 9, 8 and 6 funds are significantly positive with Newey-West for Jensen, Fama-French, and Carhart versus 8, 6 and 3 before.

In the risk factors' significance (market, SMB, HML, momentum), p-values are generally lower with Newey-West compared to before. However, this does not change any conclusions as all are and remain significant at the 5% significance level.

The interpretation of the difference in αs between Jensen's, Fama-French's and Carhart's model, and the interpretation of the R^2 is the same as described in section 1.1.

Given that virtually all studies mentioned in Chapter III make use of the Newey-West correction, it is interesting to make comparisons here between results found in this study and those found in the literature. In general, this study finds positive yet insignificant αs for post-expense performance evaluation, and significantly positive αs for pre-expense performance evaluation. In that sense, it is mostly in line with the European studies in the literature. Indeed, Otten and Bams (2002) also find insignificantly positive post-expense performance for three out of five countries in their study, and significantly positive pre-expense performance for four out of five countries in their study. Like Otten and Bams' (2002) results, the results in this thesis are more positive than results found in American studies. Post-expenses performance in American studies (see e.g. Malkiel (1995)) is generally insignificantly negative, whereas results presented here are insignificantly positive. Pre-expenses, performance is generally indistinguishable from zero, whereas results here are significantly positive. The reason for this difference, as suggested by Otten and Bams (2002), may lie in the smaller domestic equity market importance in Europe compared to the United States. The larger mutual funds importance in the equity market, the more difficult it becomes to outperform that market. Like at the time of Otten and Bams' (2002) study, the European (and Belgian) mutual fund market are still significantly smaller than the US market. As such, it is expected that this explanation still holds true. Otten and Bams' (2002) explanation is in line with the 'equilibrium accounting' concept put forward by Fama and French (2008): "at the aggregate level, if we find that the value-weight (VW) portfolio of all mutual funds produces a positive α before costs, we can

infer that the VW portfolio held by investors outside mutual funds has a negative α. In other words, the mutual fund industry wins at the expense of investments held outside mutual funds". This means the results in this study suggest that Belgian mutual funds take positive performance away from other investments in the Belgian market.

Though this study together with other European studies may report more positive results than American studies, post-expenses performance is indistinguishably from zero in both European and American studies. In that sense, the results found here are, like most other studies, consistent with Grossman and Stiglitz' (1980) view on the EMH.

Table 18: Newey-West performance summary, Jensen's alpha net returns

	Equally Weighted Portfolio			**Summary (n= 46 funds)**		
	Estimate		p-value	Min	Avg	Max
α	0.59%		0.569	-7.24%	0.13%	8.30%
β_market	0.92	***	0.000	0.33	0.93	1.27
Adj. R^2	0.974			0.11	0.80	1.00
α distribution +/0/-	1/41/4					

Table 19: Newey-West performance summary, Jensen's alpha gross returns

	Equally Weighted Portfolio			**Summary (n= 46 funds)**		
	Estimate		p-value	Min	Avg	Max
α	2.08%	**	0.045	-5.29%	1.62%	10.37%
β_market	0.92	***	0.000	0.33	0.93	1.27
Adj. R^2	0.974			0.11	0.80	1.00
α distribution +/0/-	9/37/0					

Table 20: Newey-West performance summary, Fama-French net returns

	Equally Weighted Portfolio			**Summary (n= 46 funds)**		
	Estimate		p-value	Min	Avg	Max
α	0.42%		0.656	-6.16%	0.11%	6.70%
β_market	0.93	***	0.000	0.32	0.94	1.19
β_SMB	0.11	***	0.001	0.00	0.16	0.86
β_HML	0.07	***	0.001	-0.45	0.09	0.71
Adj. R^2	0.976			0.15	0.82	1.00
α distribution +/0/-	1/42/3					

Table 21: Newey-West performance summary, Fama-French gross returns

	Equally Weighted Portfolio			**Summary (n= 46 funds)**		
	Estimate		p-value	Min	Avg	Max
α	1.91%	**	0.044	-4.21%	1.60%	8.77%
β_market	0.93	***	0.000	0.32	0.94	1.19
β_SMB	0.11	***	0.001	0.00	0.16	0.86
β_HML	0.07	***	0.001	-0.45	0.09	0.71
Adj. R^2	0.976			0.15	0.82	1.00
α distribution +/0/-	8/38/0					

Table 22: Newey-West performance summary, Carhart net returns

	Equally Weighted Portfolio			**Summary (n= 46 funds)**		
	Estimate		p-value	Min	Avg	Max
α	0.25%		0.791	-5.96%	0.04%	7.58%
β_market	0.93	**	0.010	0.34	0.94	1.19
β_SMB	0.11	**	0.025	-0.12	0.10	0.50
β_HML	0.08	**	0.019	-0.38	0.10	0.66
β_MOM	0.02	**	0.013	-0.28	0.01	0.11
Adj. R^2	0.976			0.17	0.82	1.00
α distribution +/0/-	1/41/4					

Table 23: Newey-West performance summary, Carhart gross returns

	Equally Weighted Portfolio			**Summary (n= 46 funds)**		
	Estimate		p-value	Min	Avg	Max
α	1.74%	*	0.066	-4.01%	1.53%	8.21%
β_market	0.93	**	0.010	0.34	0.94	1.19
β_SMB	0.11	**	0.025	-0.12	0.10	0.50
β_HML	0.08	**	0.019	-0.38	0.10	0.66
β_MOM	0.02	**	0.013	-0.28	0.01	0.11
Adj. R^2	0.976			0.17	0.82	1.00
α distribution +/0/-	6/40/0					

2 Performance persistence

2.1 Winner-Loser Test

This section describes performance persistence considering total return (Table 24), Jensen's alpha (Table 25), and the Carhart four-factor model (Table 26) to determine winners and losers. Performance persistence is evaluated using the non-parametric Winner-Loser Test, and significance of results is tested using the binomial z-test, the Log-Odds-Ratio (LOR), and the χ^2-test of independence, as described in Chapter V.

Results differ somewhat across periods, models and tests used. This is because the natures of the tests differ: the binomial z-test is a one-sided test which aims to discover repeat winners,

the LOR test is a two-sided test which can identify the direction – i.e. whether there is negative or positive persistence, and the χ^2-test can identify independence or dependence yet no direction.

The first contingency table (comparing the period of January 2010 – April 2012 with May 2012 – August 2014) reports negative persistence for total returns, and positive persistence for Jensen's and Carhart model. The binomial test is not applicable for negative persistence, but the LOR test identifies significantly negative persistence at the 5%-level, and the χ^2-test identifies significant persistence at the 10%-level for total returns. For Jensen and Carhart, conclusions are the same for the first contingency level. All tests conclude positive yet insignificant persistence.

The second contingency table (comparing the period of April 2012 – August 2014 with September 2014 – December 2016) reports positive persistence across all models. However, significance differs. Total returns report significantly positive results for the binomial test and the LOR test at the 5% and 1% significance level respectively, and significant results for the χ^2-test at the 1% significance level. Jensen's model reports significantly positive results for the binomial test and the LOR test at the 1% significance level, and significant results for the χ^2-test at the 1% significance level. Carhart's model reports insignificantly positive results across all tests.

Table 24: Winner-Loser Test, Total returns

		Next period		Binomial test			LOR test		χ^2-test		
Initial period		**Winner**	**Loser**	% repeat winners	Z-test	p-value	LOR	p-value	χ^2		p-value
10.1/12.4 - 12.5/14.8	**Winner**	8	15	35%	-1.46	0.928	-1.26 **	0.042	3.13 *		0.077
	Loser	15	8								
12.5/14.8 - 14.9/16.12	**Winner**	17	6	74%	2.29 **	0.011	2.08 ***	0.002	8.70 ***		0.003
	Loser	6	17								

Table 25: Winner-Loser Test, Jensen's alpha

		Next period		Binomial test			LOR test		χ^2-test		
Initial period		**Winner**	**Loser**	% repeat winners	Z-test	p-value	LOR	p-value	χ^2		p-value
10.1/12.4 - 12.5/14.8	**Winner**	14	9	61%	1.04	0.149	0.88	0.144	1.39		0.238
	Loser	9	14								
12.5/14.8 - 14.9/16.12	**Winner**	18	5	78%	2.71 ***	0.003	2.56 ***	0.000	12.52 ***		0.000
	Loser	5	18								

Table 26: Winner-Loser Test, Carhart four-factor

		Next period		Binomial test			LOR test		χ^2-test		
Initial period		**Winner**	**Loser**	% repeat winners	Z-test	p-value	LOR	p-value	χ^2		p-value
10.1/12.4 - 12.5/14.8	**Winner**	14	9	61%	1.04	0.149	0.88	0.144	1.39		0.238
	Loser	9	14								
12.5/14.8 - 14.9/16.12	**Winner**	12	11	52%	0.21	0.417	0.17	0.768	0.00		1.000
	Loser	11	12								

2.2 Parametric regression test

2.2.1 Three-period test

This section describes performance persistence using a parametric regression test. Like previous section, it splits up the sample in three periods. Persistence is evaluated using total returns (Table 27, Table 28), Jensen's model (Table 29, Table 30), and Carhart's model (Table 31, Table 32) as inputs for the regression. The regression is done without and with Newey-West correction, respectively. As before, regression coefficients remain the same but standard errors and p-values change when using the Newey-West correction. A positive α_1 indicates positive persistence.

Results differ significantly across periods and models used. The first period (comparing January 2010 – April 2012 with May 2012 – August 2014) indicates significantly negative α_1 for total returns, insignificantly positive α_1 for Jensen's model, and significantly positive α_1 for Carhart's model. Whereas results for the first period vary, results for the second period (comparing April 2012 – August 2014 with September 2014 – December 2016) point towards highly significantly positive α_1 for total returns, Jensen's model as well as Carhart's model.

Combining these results with results from the Winner-Loser Test leads to the conclusion that there is little evidence of long-term persistence in the first period whereas there is strong evidence of positive persistence in period two. The first period results are in line with Christensen (2005), as he finds no evidence of long-term persistence in Danish mutual funds. They are also in line with most American studies, as e.g. Barras et al. (2010) and Fama and French (2010) find little evidence of long-term persistence. Reasons for the lack of long-term performance persistence may lie in fund flows and manager changes (Bessler, Blake, Luckoff, & Tonks, 2010). Successful open-end mutual funds have inflows of investments, leading to liquidity-motivated trading and increased immediate transaction costs, leading to lower performance (Berk & Green, 2004). Successful mutual funds may also suffer from manager changes, as well-performing managers may move to another fund or organization to increase personal wealth, also leading to lower fund performance (Berk & Green, 2004). The second period results are more in line with Vidal-García (2013) who finds strong evidence of significant positive persistence for a range of European mutual funds. However, the author provides no explanation for his results.

Table 27: Three-period parametric regression test, Total returns

Period	α_0		p-value	α_1		p-value	Adj. R^2
10.1/12.4 - 12.5/14.8	0.449	***	0.000	-0.313	**	0.038	0.074
12.5/14.8 - 14.9/16.12	-0.056		0.177	0.432	***	0.000	0.335

Table 28: Newey-West three-period parametric regression test, Total returns

Period	α_0		p-value	α_1		p-value	Adj. R^2
10.1/12.4 - 12.5/14.8	0.449	***	0.000	-0.313	**	0.021	0.074
12.5/14.8 - 14.9/16.12	-0.056	*	0.074	0.432	***	0.000	0.335

Table 29: Three-period parametric regression test, Jensen's alpha

Period	α_0		p-value	α_1		p-value	Adj. R^2
10.1/12.4 - 12.5/14.8	0.000		0.564	0.109		0.476	-0.011
12.5/14.8 - 14.9/16.12	0.000	***	0.000	0.462	***	0.000	0.451

Table 30: Newey-West three-period parametric regression test, Jensen's alpha

Period	α_0		p-value	α_1		p-value	Adj. R^2
10.1/12.4 - 12.5/14.8	0.000		0.549	0.109		0.361	-0.011
12.5/14.8 - 14.9/16.12	0.000	***	0.000	0.462	***	0.000	0.451

Table 31: Three-period parametric regression test, Carhart four-factor

Period	α_0		p-value	α_1		p-value	Adj. R^2
10.1/12.4 - 12.5/14.8	0.000		0.134	0.524	**	0.034	0.078
12.5/14.8 - 14.9/16.12	0.000	***	0.000	0.242	***	0.002	0.175

Table 32: Newey-West three-period parametric regression test, Carhart four-factor

Period	α_0		p-value	α_1		p-value	Adj. R^2
10.1/12.4 - 12.5/14.8	0.000	*	0.075	0.524	**	0.022	0.078
12.5/14.8 - 14.9/16.12	0.000	***	0.000	0.242	***	0.000	0.175

2.2.2 Seven-period test

This section describes the parametric regression test for seven periods, using total returns (Table 33, Table 34), Jensen's model (Table 35, Table 36), and Carhart's model (Table 37, Table 38) without and with the Newey-West correction respectively. A positive α_1 indicates positive performance persistence.

Results are fairly consistent across models, but vary significantly across periods. Period 2011/2012 and 2015/2016 show highly significantly negative α_1s across all models. Period 2012/2013 shows insignificantly negative α_1s for total returns and Jensen's model, and a significantly negative α_1 for Carhart's model. Period 2014/2015 shows highly significantly positive α_1s across all models. Periods 2010/2011 and 2013/2014 seem inconclusive: they show a combination of (significantly) positive and (significantly) negative α_1s, depending on the model and whether the Newey-West correction is applied.

Given that only one out of six periods displays significantly positive persistence, the results of this thesis conclude against positive short-term persistence. Indeed, two out of six periods even display negative α_1s, indicating that losers of the prior period tend to be winners in the subsequent period. This result is different from American studies, who generally report findings in line with short-term persistence. This thesis' result is more in line with European studies, as e.g. Otten and Bams (2002) and Christensen (2005) report no findings of short-term persistence.

Table 33: Seven-period parametric regression test, Total returns

Period	α_0		p-value	α_1		p-value	Adj. R^2
2010 - 2011	-0.153	***	0.000	0.137		0.285	0.004
2011 - 2012	0.116	***	0.000	-0.794	***	0.000	0.516
2012 - 2013	0.166	***	0.000	-0.086		0.607	-0.017
2013 - 2014	0.028		0.352	0.285		0.110	0.036
2014 - 2015	0.089	***	0.000	0.352	***	0.003	0.160
2015 - 2016	0.111	***	0.000	-0.671	***	0.000	0.494

Table 34: Newey-West seven-period parametric regression test, Total returns

Period	α_0		p-value	α_1		p-value	Adj. R^2
2010 - 2011	-0.153	***	0.000	0.137		0.448	0.004
2011 - 2012	0.116	***	0.000	-0.794	***	0.000	0.516
2012 - 2013	0.166	***	0.000	-0.086		0.631	-0.017
2013 - 2014	0.028		0.575	0.285		0.316	0.036
2014 - 2015	0.089	***	0.000	0.352	***	0.000	0.160
2015 - 2016	0.111	***	0.000	-0.671	***	0.000	0.494

Table 35: Seven-period parametric regression test, Jensen's alpha

Period	α_0		p-value	α_1		p-value	Adj. R^2
2010 - 2011	-0.001	***	0.000	-0.024		0.856	-0.022
2011 - 2012	0.000		0.879	-0.548	***	0.000	0.289
2012 - 2013	0.000		0.736	-0.051		0.774	-0.021
2013 - 2014	0.000		0.700	0.441	**	0.014	0.110
2014 - 2015	0.001	**	0.011	0.429	***	0.000	0.274
2015 - 2016	0.001	***	0.001	-0.528	***	0.000	0.425

Table 36: Newey-West seven-period parametric regression test, Jensen's alpha

Period	α_0		p-value	α_1		p-value	Adj. R^2
2010 - 2011	-0.001	***	0.000	-0.024		0.884	-0.022
2011 - 2012	0.000		0.868	-0.548	***	0.000	0.289
2012 - 2013	0.000		0.599	-0.051		0.747	-0.021
2013 - 2014	0.000		0.513	0.441	*	0.074	0.110
2014 - 2015	0.001	**	0.013	0.429	***	0.000	0.274
2015 - 2016	0.001	***	0.003	-0.528	***	0.000	0.425

Table 37: Seven-period parametric regression test, Carhart four-factor

Period	α_0		p-value	α_1		p-value	Adj. R^2
2010 - 2011	-0.001	***	0.000	-0.314	*	0.089	0.043
2011 - 2012	0.000		0.961	-0.685	***	0.000	0.315
2012 - 2013	0.000		0.338	-0.295	**	0.029	0.084
2013 - 2014	0.000		0.894	-0.098		0.601	-0.016
2014 - 2015	0.000	***	0.008	0.215	**	0.028	0.085
2015 - 2016	0.000	**	0.019	-0.418	***	0.004	0.155

Table 38: Newey-West seven-period parametric regression test, Carhart four-factor

Period	α_0		p-value	α_1		p-value	Adj. R^2
2010 - 2011	-0.001	***	0.000	-0.314	**	0.039	0.043
2011 - 2012	0.000		0.952	-0.685	***	0.000	0.315
2012 - 2013	0.000		0.103	-0.295	**	0.045	0.084
2013 - 2014	0.000		0.792	-0.098		0.757	-0.016
2014 - 2015	0.000	**	0.045	0.215	***	0.005	0.085
2015 - 2016	0.000	**	0.042	-0.418	**	0.018	0.155

VII. Conclusions

Though mutual funds have an important place in the Belgian household investment market, this thesis is the first evaluating Belgian mutual fund performance and persistence for the period after the Financial Crisis of 2008. The thesis analyzes 46 open-ended Belgian equity mutual funds with a European investment focus during the period between January 2010 and December 2016.

Performance is evaluated using the three most frequently used models in the literature: the Jensen (1968) model, the Fama and French (1993) three-factor model, and the Carhart (1997) four-factor model. Performance evaluation results are in line with previous studies. Results considering net risk-adjusted returns are statistically indistinguishable from zero across the three models. When looking at risk-adjusted returns pre-expenses, Jensen's and Fama-French's model yield significantly positive αs at the 5% significance level, and Carhart's model α is significant at the 10% level. In this sense, this thesis is more in line with European mutual funds studies than with US studies. European studies show slightly more positive results than US studies. This could be due to the smaller importance of the European mutual fund market compared to the American mutual fund market: the larger the fund market becomes as a group, the harder it becomes to outperform this group (Otten & Bams, 2002). The positive results before costs, found in this study, also suggest that Belgian mutual funds perform well at the expense of other investment in the Belgian market (cf. Fama and French (2008)). However, when looking at results after subtracting expenses, the performance is indistinguishable from zero. As such, the practical implication for investors is that Belgian mutual funds perform well enough to earn back their transaction costs and investment expenses. However, funds do not provide added value to investors beyond providing liquid access to a diversified portfolio.

Performance persistence is evaluated using both non-parametric and parametric tests. Three 2⅓-year periods, for longer-term persistence, as well as seven 1-year periods, for shorter-term persistence, are considered in the sample. Total returns, Jensen's alpha, as well as Carhart's model are used as input for these persistence tests. There are mixed results in this thesis for long-term persistence: whereas little evidence is found in support of long-term persistence in one period, the results for another period provide strong evidence for positive performance persistence. The results for the first period are in line with most European and American studies, as generally no long term persistence is found. This may be due to inflows of investments in successful funds and to managerial changes, both leading to lower subsequent fund performance (Bessler et al., 2010). The results for the second period are in line with Vidal-

García (2013) who finds significantly positive persistence. No further explanation for these results are given, however. The results of this thesis do not support evidence in favor of short-term persistence. Reversals – where previous losers become the next winners – are even more prevalent than repeated winners. This is in line with European studies, which generally do not find short-term persistence. However, American studies generally do report some form of short-term persistence. The results for persistence, taken together with those for performance, are in line with Grossman and Stiglitz' (1980) view on informationally efficient markets, suggesting that information gathering is compensated. From a practical point of view, the results in this thesis do not seem to indicate that investors can use information about past performance to predict relative mutual fund performance.

Limitations of this study relate to general limitations of fund performance studies: one relies on the appropriateness of the used model to identify abnormal returns, as described as the joint-hypothesis problem. Furthermore, the sample size of this thesis was rather small, as the market for open-ended equity funds within Belgium is smaller than in other countries. This could have had an impact on the performance persistence evaluation, as it is more difficult to find persistent patterns with smaller samples (Otten & Bams, 2002).

Future avenues for research could therefore include broadening the sample, for instance by including mutual funds investing in other asset classes such as bond funds and money market funds. However, these would require other evaluation methods. Within the same sample, one could expand the amount and diversity of models used, including other factors to explain abnormal returns. In addition, another study could focus on whether the Fama-French or Carhart model explain abnormal results better than Jensen's model. Within the results found, one could further inquire into the reasons behind the long-term persistence found for one period. Finally, one could verify the reasons behind the discrepancies between American and European studies, i.e. the importance of the mutual fund market in the domestic equity market.

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Appendices

1 Appendix A

Sample list of funds

#	(Sub)Fund	ISIN	Bloomberg Code	Fund-of-funds	Index fund
1	Amonis Equity Europe	BE0058026205	AMO7904 BB Equity		
2	Amonis Equity Europe Alpha	BE0058028227	AMO7906 BB Equity		
3	Amonis Equity Europe Mid Cap	BE0058025199	AMO7903 BB Equity		
4	Atlas Real Estate EMU	BE6271654228	ATL5623 BB Equity		
5	AXA B Fund Equity Eurozone	BE0948472064	AXAEQEC BB Equity		
6	C + F Euro Equities	BE0946593671	CFEUROC BB Equity		
7	C + F Vega Equity	BE6251880363	CFVEGCA BB Equity		
8	Candriam Equities B Emerging Europe	BE0945516574	DEXEQBE BB Equity		
9	Candriam Equities B Europe Conviction	BE0945524651	DEXBEUR BB Equity		
10	Candriam Equities B Europe Small & Mid Caps	BE0948878245	CRE2809 BB Equity		
11	Candriam Equities B Global Energy	BE0170908918	DEXERND BB Equity		
12	Candriam Equities B Global Property Funds	BE0940608962	DEXEEPC BB Equity	x	
13	Candriam Equities B Global Telecom	BE0172846892	DEXTECC BB Equity		
14	Candriam Equities B Leading Brands	BE0170209713	DEXEUCG BB Equity		
15	Candriam Sustainable Europe	BE0173540072	BAC6167 BB Equity		
16	DMM European Equities	BE6220820169	CSF7663 BB Equity	x	
17	DPAM Capital B Equities EMU Behavioral Value	BE0948777207	OSI9180 BB Equity		
18	DPAM Capital B Equities EMU Index	BE6278392673	OSI2706 BB Equity		x
19	DPAM Capital B Equities Europe Index	BE6278393689	OSI2097 BB Equity		x
20	DPAM Capital B Real Estate EMU Divdend	BE0942186256	OSIREAL BB Equity		
21	DPAM Invest B Equities Euroland	BE0058182792	PAM2726 BB Equity		
22	DPAM Invest B Equities Europe	BE0058179764	PEA2102 BB Equity		
23	DPAM Invest B Equities Europe Dividend	BE0057451271	PAM9868 BB Equity		
24	DPAM Invest B Equities Europe Small Caps	BE0058185829	PAM2633 BB Equity		
25	DPAM Invest B Equities Europe Sustainable	BE0940002729	PAMEETH BB Equity		
26	DPAM Invest B Real Estate Europe	BE0058187841	PAMEURC BB Equity		
27	KBC Eco Fund Impact Investing	BE0175718510	KBEEEUC BB Equity		
28	KBC Equity Fund Buyback Europe	BE0174407016	KBCEFBC BB Equity		
29	KBC Equity Fund Central Europe	BE0176434885	KBC7075 BB Equity		
30	KBC Equity Fund Emerging Europe	BE0156153802	KEE2329 BB Equity		
31	KBC Equity Fund Europe	BE0126161612	KEE2092 BB Equity		
32	KBC Equity Fund Strategic Cyclicals	BE0172711518	KBCEECK BB Equity		
33	KBC Equity Fund Strategic Finance	BE0174093758	KBCEEFK BB Equity		
34	KBC Equity Fund Strategic Telecom & Technology	BE0173086381	KBCEETK BB Equity		
35	KBC Equity Fund Eurozone	BE0175979211	KEE6789 BB Equity		
36	KBC Index Fund Index Fund Europe	BE0163220669	SIV2466 BB Equity		x
37	KBC Index Fund Euroland	BE0171536403	KBCEULK BB Equity		x
38	KBC Institutional Fund Euro Equity	BE0166981440	KBI2690 BB Equity		
39	KBC Institutional Fund Euro Equity Small & Medium Caps	BE0945052786	KIEESMC BB Equity		
40	KBC Institutional Fund Euro Satellite Equity	BE0166983461	KBI2692 BB Equity		
41	KBC Institutional Fund European Real Estate	BE0168584952	KBC2802 BB Equity		
42	KBC Institutional Fund SRI Euro Equities	BE0175761940	KBC6733 BB Equity		
43	KBC Select Immo Europe Plus	BE0166978412	KBS2678 BB Equity		
44	Nagelmackers Institutional European Equity Large Cap	BE0161746475	NII2447 BB Equity		
45	Plato Institutional Index Fund Euro Equity	BE0059874256	PLA9616 BB Equity		x
46	Plato Institutional Index Fund European Equity	BE0059883349	PLA9612 BB Equity		x

2 Appendix B

Total Expenses Ratio per fund

#	(Sub)Fund	ISIN	Total Expenses Ratio
1	Amonis Equity Europe	BE0058026205	0.67%
2	Amonis Equity Europe Alpha	BE0058028227	0.76%
3	Amonis Equity Europe Mid Cap	BE0058025199	0.92%
4	Atlas Real Estate EMU	BE6271654228	1.45%
5	AXA B Fund Equity Eurozone	BE0948472064	1.65%
6	C + F Euro Equities	BE0946593671	0.86%
7	C + F Vega Equity	BE6251880363	1.37%
8	Candriam Equities B Emerging Europe	BE0945516574	2.22%
9	Candriam Equities B Europe Conviction	BE0945524651	2.21%
10	Candriam Equities B Europe Small & Mid Caps	BE0948878245	2.04%
11	Candriam Equities B Global Energy	BE0170908918	2.07%
12	Candriam Equities B Global Property Funds	BE0940608962	2.42%
13	Candriam Equities B Global Telecom	BE0172846892	1.99%
14	Candriam Equities B Leading Brands	BE0170209713	2.07%
15	Candriam Sustainable Europe	BE0173540072	2.02%
16	DMM European Equities	BE6220820169	2.22%
17	DPAM Capital B Equities EMU Behavioral Value	BE0948777207	1.14%
18	DPAM Capital B Equities EMU Index	BE6278392673	0.66%
19	DPAM Capital B Equities Europe Index	BE6278393689	0.91%
20	DPAM Capital B Real Estate EMU Divdend	BE0942186256	0.63%
21	DPAM Invest B Equities Euroland	BE0058182792	1.86%
22	DPAM Invest B Equities Europe	BE0058179764	1.89%
23	DPAM Invest B Equities Europe Dividend	BE0057451271	1.80%
24	DPAM Invest B Equities Europe Small Caps	BE0058185829	1.82%
25	DPAM Invest B Equities Europe Sustainable	BE0940002729	1.96%
26	DPAM Invest B Real Estate Europe	BE0058187841	1.87%
27	KBC Eco Fund Impact Investing	BE0175718510	1.84%
28	KBC Equity Fund Buyback Europe	BE0174407016	1.82%
29	KBC Equity Fund Central Europe	BE0176434885	1.93%
30	KBC Equity Fund Emerging Europe	BE0156153802	1.95%
31	KBC Equity Fund Europe	BE0126161612	1.92%
32	KBC Equity Fund Strategic Cyclicals	BE0172711518	1.80%
33	KBC Equity Fund Strategic Finance	BE0174093758	1.81%
34	KBC Equity Fund Strategic Telecom & Technology	BE0173086381	1.76%
35	KBC Equity Fund Eurozone	BE0175979211	2.19%
36	KBC Index Fund Index Fund Europe	BE0163220669	0.98%
37	KBC Index Fund Euroland	BE0171536403	0.95%
38	KBC Institutional Fund Euro Equity	BE0166981440	0.63%
39	KBC Institutional Fund Euro Equity Small & Medium Caps	BE0945052786	0.70%
40	KBC Institutional Fund Euro Satellite Equity	BE0166983461	0.64%
41	KBC Institutional Fund European Real Estate	BE0168584952	0.92%
42	KBC Institutional Fund SRI Euro Equities	BE0175761940	0.83%
43	KBC Select Immo Europe Plus	BE0166978412	1.88%
44	Nagelmackers Institutional European Equity Large Cap	BE0161746475	1.65%
45	Plato Institutional Index Fund Euro Equity	BE0059874256	0.43%
46	Plato Institutional Index Fund European Equity	BE0059883349	0.43%

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