Exchange Traded Funds vs. Open – end Mutual Funds

A Comparison Analysis Considering Risk-Adjusted Performance, Tracking & Market Timing Ability

By

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Abstract

The following research paper provides a comparison analysis between ETFs and open-end mutual funds considering their risk adjusted performance, tracking and market timing ability. To conduct the research, seventeen groups including active and passive ETFs, active and passive mutual funds along with their benchmarks have been constructed all of them tracking unique indices from 2019 to 2023. Past literature indicated that active funds fail to outperform their passive equivalents along with their corresponding benchmarks, index (passive) mutual funds underperform relative to passive ETFs and they also demonstrate an inferior tracking ability. Furthermore, all research conducted thus far indicated that the managers of both types of active funds destroy value by trying to time the market. This paper's findings are in line with prior ones considering only the underperformance of active mutual funds relative to passive mutual funds, the better tracking ability of passive ETFs over the index mutual funds and the fact that managers destroy value by trying to time the market although exceptions are displayed. Finally, this particular research is the first one that tries to fill in the scientific gap by taking into account the "tetraptych" of active and passive ETFs, active and passive mutual funds in order to provide a solid ground for asset manager practitioners and future researchers who aim to examine which type of fund suits best their portfolios in terms of generating excess risk adjusted returns and tracking better the common benchmark.

Keywords: active ETFs, passive ETFs, active mutual funds, passive mutual funds, risk adjusted performance, tracking ability, market timing ability

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1. Introduction

Asset management refers to the ability of people to make the proper decisions in order to capitalize on market trends and fluctuations and generate positive returns, given their investment goals, risk tolerance, and beliefs. Taking into consideration the level of scientific research and technology that investors and managers have access to, they have realized how important it is to invest in well-diversified portfolios to be able to survive and "win" in the long term and two of the most profound investment vehicles used to construct such portfolios are the ETFs and open–end mutual funds. Yet, each one of the two investment products provides those seeking to direct fund flows to them with different characteristics and features making the decision between which one to be used not an easy task.

1.1 ETFs

Exchange Traded Funds, or ETFs as they are more widely known, were originally introduced to the financial industry in 1993 with the launch of the SPDR ETF, whose primary function was to track the S&P 500 index. Three decades later the market segment related to such products has evolved tremendously given that institutional investors are increasing their exposure to them. Overall, the industry in terms of capitalization stands approximately at 10 trillion U.S. dollars.

Yet, what is in practice an Exchange Traded Fund, and what are their key features and types?

An Exchange Traded Fund (ETF) is a basket of securities considering financial assets and its main goal is to replicate an index providing investors with the opportunity to create portfolios with identical characteristics to that of the underlying benchmark. Furthermore, one of the most important reasons that such a financial investment tool has become so successful is its cost-effectiveness since portfolios identical to an index can be constructed without the necessity of acquiring all the underlying securities of the index.

However, cost-effectiveness is not the only characteristic that makes ETFs desirable. Diversification, liquidity, transparency, and flexibility are key features that investors and asset managers appreciate and rely on. Diversification can be achieved by investing in a variety of assets such that investors do not suffer losses from market fluctuations and as already stated, ETFs provide diversification since they hold a basket of securities and thus acquiring them spreads the risk of the portfolio. ETFs are daily traded in stock exchanges and investors can at any point in time buy or sell them to perform both long and short–term investment strategies. This characteristic of ETFs is the line of reasoning behind their flexibility and liquidity.

In addition to the aforementioned, ETFs are investment tools for every type of investor taking into consideration also the fact that there are different types of them. Investors and asset managers can choose from a wide range of assets starting from bond and equity ETFs which are the most known, to commodity and synthetic or even real estate ETFs and leveraged ETFs, which are used by those managers that are extremely confident about their analysis and not afraid to load their portfolios with extreme risk.

1.2 Mutual Funds

In addition to ETFs, mutual funds are older products first introduced in 1924 and they provide investors with a variety of characteristics such that they can achieve their investment goals. In particular, mutual funds can be characterized as pools that attract fund flows from investors having the same goals and they are managed by professional managers. The managers of mutual funds require a management fee for their services and under their supervision investors can benefit from a variety of investment and security types. Similar to ETFs, there is a broad range of mutual funds from which investors can choose based on the asset class that they desire (bond, equity, etc.), their investment objectives, and the geographic focus (global, international, etc.)

The characteristics that make such types of funds so popular among investors are several. First of all, they are managed by professionals, and as a result, the fund owners can capitalize in case, they lack the expertise to do their own research even though this comes with a cost that will be offset by capital gains and positive returns at best. The transparency feature regarding mutual funds is another characteristic from which investors can benefit since mutual fund managers have the obligation to disclose financial information along with the fund's allocation to the fund's owners. Consequently, investors are enabled to decide whether or not they will increase or reduce their exposure to them or even liquidate their whole position. The liquidity and diversification characteristics of mutual funds are in a way identical to that of ETFs but their main differences will be depicted in the following section.

1.3 Differences between ETFs and Mutual Funds

	ETFs	Mutual Funds
Trading	Intraday day trading	Trading once a day (at the end of it)
Liquidity	Immediate transactions, thus few liquidity problems	Transactions at the end of the day. Liquidity problems occur when the fund does not hold enough cash and at the same time investors want to redeem their shares
Transparency	Disclosing holdings on a daily basis	Disclosing holdings on a quarterly basis
Expense Ratios	Lower than Mutual Funds	Greater than ETFS

Diversification	If passive they replicate their Benchmark	If passive they replicate their Benchmark
Market Price	Traded at a premium or a discount from their NAV	Bought and sold at NAV at each trading day's end
Realized Gains from Rebalancing	Minimum because of their redemption mechanism	Moderate
Tax Efficiency	More efficient compared to Mutual Funds, because of the creation/redemption process	Less tax efficient because of the selling of the underlying securities

Note: the above differences depicted are retrieved from Larion's MSc Thesis (Larion, 2013)

1.4 Management style of both ETFs and Mutual Funds

Another factor that should be taken into account during the loading process of ETFs or mutual funds into the portfolio is what the investment objective is and consequently what kind of investment strategy will be followed. In general, there are two types of strategies provided by ETFs or mutual funds namely active and passive ones. Setting the investment objective depends heavily on the type of institution once we refer to institutional investors along with the investment goals in case, we refer to an individual investor. Pension funds as well as life insurance firms are probably the more heavily regulated and their main objective is to meet their liabilities. On the other hand, banks run portfolios to support their balance sheets, and investment firms such as mutual funds in most cases try to outperform the benchmark. To meet their objectives, investors and asset managers have to set their investment strategy which can be either an active one or a passive one. The main idea backing up active strategies is that managers believe that they possess the necessary skills to outperform the market and this can be achieved by either creating alpha

with stock picking or beta by tilting the portfolio towards certain sectors, countries, currencies, etc. Thus, investors can choose to acquire active ETFs and mutual funds to benefit from their above-mentioned characteristics and create portfolios not replicating the benchmarks perfectly but instead having over- or under-exposure to certain securities and factors according to each manager's beliefs. Contrary to active ETFs and mutual funds, passive ones are those that have as their main task to replicate the benchmark as well as possible to provide risk-adjusted performance equal to the underlying index. The most widely known method of indexing is the cell-based approach followed by both passive ETFs and mutual funds and it refers mainly to a method during which the index is divided into different cells with each one of them representing a different characteristic of the index. After doing so, managers can choose only those assets of the index that match their criteria in terms of index characteristics and construct a portfolio that tries to replicate the index as well as possible. In the past, several papers have been published mainly studying and comparing the performance of active and passive funds, the majority of which indicated the poor performance of active management associated with high management advisory fees.

2. Literature Review

Moving forward, a lot of scientific research has been conducted in the past three decades trying to cover those two financial products. Researchers have examined the performance of the two investment products in terms of risk and return, tracking ability, substitutability, etc. In this section, a brief presentation of past academic research will be given to support the hypotheses formulated and tested.

2.1 Passive vs active management

A huge debate among asset management practitioners along with academics has to do with whether or not active management is able to generate excess risk-adjusted returns that justify the management fees considering the fund manager.

As far as I know, Ippolito (1989) is the first to conduct research studying the mutual funds' performance compared to the one of the corresponding index funds. His findings indicate that the mutual funds' risk-adjusted returns over a sample period of 20 years, net of fees and expenses are similar to those of the index funds that they are tracking.

Contrary to the above-mentioned research, Elton, Gruber, Das, and Hlavka, (1993) use data from 1965 to 1984 and they reject the previous results since when they take into account non – S&P Assets (in particular stocks and bonds), findings indicate that active mutual funds underperform relative passive ones in terms of Jensen's alpha.

Additionally, in 1993, Blake, Elton, and Gruber study two samples of bond mutual funds. The first sample is constructed in such a way that eliminates survivorship bias and it consists of 46 nonmunicipal bond funds over a 10–year period. The second sample includes all bond funds that existed at the end of 1991. The authors use several indexes to measure the funds' performance and they find that most of the bond funds fail to generate excess returns in comparison to the relative indices. Blake et all argue that the underperformance occurs mainly because of management fees.

Malkiel (1995) is also one of the first researchers trying to give an answer to the above-mentioned debate. To do so, he chose equity mutual funds for the time period between 1971 and 1991. In his research, the author includes both still-existing and defaulted mutual funds and as a result, his research is free of the survivorship bias. Taking into account the returns of the funds, the

corresponding benchmarks and the risk-free rate he arrives at the conclusion that actively managed mutual funds are not capable of generating excess returns.

Later on, in 2003, Malkiel conducted another study and its results support once again the concept of passive over active management since the majority of the active large-cap mutual equity funds that are used provide worse returns when compared to the S&P 500 Index.

Gruber (1996) examines a set of 270 equity mutual funds starting from 1985 until 1994. In particular, he examines the importance of open–end mutual funds, the reasons for holding mutual funds as well as the performance of actively managed open-end equity funds relative to the corresponding indices. His findings confirm that active mutual funds fail to outperform their passive equivalents along with the market indices (benchmarks) even though investors increase their demand.

Harper, Madura, and Schnusenberg (2006) compare the risk and return performance of ETFs relative to closed–end funds. Their sample consists of monthly returns based on prices and not NAV and to be more specific the authors use 14 country ETFs and 29 closed–end country funds for a period of 6 years (from 1996 until 2001). The outcome of their research is in line with prior academic findings that passive investment vehicles outperform active ones. On average, the open–end ETFs' risk-adjusted returns as measured by the Sharpe ratio and their mean exceed those of closed–end country mutual funds (CEFs).

Three years later, Rompotis (2009) focused his research relative to active vs. passive management in the U.S. ETF industry. The researcher compares actively managed ETFs to their corresponding passively managed equivalents and their benchmarks. He compares their risk-adjusted returns using both the Sharpe and Treynor ratios which depict that actively managed ETFs underperform

relative passive ones and their market indices. Rompotis through his research indicates also the fact that ETFs' managers of both management style categories do not possess market timing skills. Lastly, he finds that the tracking errors of active ETFs depict greater values than that of the passive ones which is a logical outcome considering that such funds do not try to perfectly replicate their benchmarks as they aim to beat the market.

In 2010 conducting his Master Thesis, Vossestein compared five active ETFs pairing them with the corresponding passive ones that replicate the same indices. Covering approximately a one-year period, the author finds that actively managed funds underperform both their passive ones and the benchmarks and both types of management funds fail to generate excess returns when regressed so as the Jensen's alpha to be derived. Once the researcher evaluates the tracking ability, it is logically displayed that the tracking error of active ETFs is greater than the corresponding of the passive ones.

Another paper trying to examine and compare the performance of active management in contrast to passive management is that of Schizas in 2011. To do so, the author investigates the performance of active ETFs compared to passive ETFs, mutual funds, and hedge funds. His findings are in line with prior literature indicating that active ETFs fail to outperform their passive relatives.

Lastly, Anath Madhavan and Aleksander Sobczyk published in 2019 and 2020 two separate papers. The first one investigated the impact of trading by ETFs and mutual funds using time- and dollar - weighted returns. The under-research sample consists of US - domiciled open end mutual funds and ETFs covering a broad range of fixed income and equity type of funds. After conducting their study, the authors report that liquidity and flow – related characteristics are responsible for the cross-sectional variation in return gaps both for ETFs and mutual funds. Moving forward, their second paper focused on the relationship between ESG factors and the investment performance of

fixed income active mutual funds. The findings of their analysis indicated mainly that the returns to static factor exposures, time – varying factor exposures and security selection are responsible for active returns. Moreover, those funds with higher ESG scores generate alpha from static factor exposures since such funds include less volatile bonds and consequently, this can justify the negative relation depicted between funds' total returns and ESG scores.

2.2 Passive ETFs vs. Index mutual funds

Since the aim of this study is to provide evidence on which of the two financial vehicles namely ETFs and mutual funds is superior both in terms of risk and return characteristics along with tracking ability supposing they follow the same benchmarks, this section includes past literature that compares those two financial products.

Starting from 2001, Dellva published a paper trying to compare the two financial instruments (ETFs and index mutual funds) in terms of trading, creation and redemption, cost, and tax efficiency. Due to higher transaction costs, he states that ETFs may seem less attractive to small investors while he also states that ETFs are more flexible products since they can be traded intraday and not only once. Furthermore, the author links the major tax advantages of ETFs to their creation/redemption mechanism.

A year later, Poterba and Shoven (2002) compared both the "before- and after-tax returns" between the SPDR trust tracking the S&P 500 and the Vanguard Index 500 equity index fund. During the sample period from 1994 to 2000, both measures regarding returns indicate a slight outperformance in favor of the ETF. The author states that his findings indicate the tax efficiency of ETFs which can be linked to their redemption process.

Yet, according to Elton, Gruber, Comer, and Li (2002), who investigate the characteristics of spiders and how well they perform in contrast to their benchmark (S&P 500) and their corresponding index mutual funds, the SPDRs underperform. This underperformance arises, as the authors state, because of the management fees and the dividend reinvestment mechanism since dividends are held in non–interest–bearing accounts.

In addition to the above-mentioned research, Kostovetsky (2003) takes a look at the main differences between ETFs and index mutual funds, supporting through his paper the statement that both ETFs and passive mutual funds underperform relative to the benchmark.

Gastineu (2004) takes another route in order to compare conventional indexed mutual funds and indexed ETFs giving emphasis on the operating efficiency of conventional index funds. His paper's findings support the fact that ETFs underperform relative to both indexed mutual funds and their market indices. He attributes such an underperformance to the longer period needed for the ETF portfolios to be rebalanced so as to replicate the market index and to the no reinvestment of dividends on behalf of ETFs. Another finding has to do with the outperformance of the passive mutual funds relative to the other two (passive ETFs and benchmarks) because of the replication strategy they implement which is indicated as not a perfect one.

Rompotis (2005) studies 16 ETFs and index funds from 2001 to 2002 that track the same indices. Both of those types of funds according to Rompotis fail to generate excess returns above the benchmark but they are found to be similar in terms of average returns and tracking ability. Another finding demonstrated is that of the positive relationship between the expense ratio and average return of ETFs while the corresponding relationship in terms of index funds cannot be totally accepted.

Doran, Boney, and Peterson (2006) compare ETFs and index funds from the perspective of the effect of the first ones on the flow of funds towards index mutual funds tracking the S&P 500 Index. In particular, they chose the ETF Spider to represent the ETF asset class and 33 index funds. The data they gather are monthly from 1/1997 until 12/2004. The findings of their research support the hypothesis that the introduction of the SPDR affected the fund flows of indexed mutual funds and overall, over the sample period they have lost more than $2.9 billion.

Kuo and Mateus (2006) investigate the risk-adjusted performance of 20 iShares MSCI country-specific ETFs in comparison to the S&P 500 index over a six-year period (2001 – 2006). Their analysis includes three measures evaluating the risk-adjusted returns namely: Sharpe, Treynor, and Shortino ratio. In addition to the aforementioned measures, the authors conduct a performance persistence analysis using the Spearman Rank Correlation Coefficient and the Winner – loser Contingency Table. Their empirical results indicate that on some occasions ETFs manage to beat the market and also that past performance can predict future performance at an annual level.

Taking a step further, Rompotis conducted and published two papers in the years 2007 and 2008. In the first paper, he conducts empirical research in respect of ETFs. The researcher constructs a daily data sample of 30 U.S. ETFs, the majority of which track broad indices of American capital markets while the others track sector indices and international indices. The time span of the research is one year from 2001 until 2002. Intending to compare those ETFs to their benchmarks he uses a single regression estimation, the sample's return and volatility, and finally, three different measures related to tracking error. All those methods extract the finding that ETFs underperform the market indices but the tracking errors are relatively small. In his second paper, Rompotis (2008) once again uses a research period of one year to compare passive ETFs and index mutual funds. The research evaluates the risk–return characteristics and tracking errors of 16 ETFs and indexed

mutual funds which track the same benchmarks so as the comparison between them to be valid. According to the empirical research, both investment vehicles present approximately the same risk and return characteristics but they are not able to outperform their benchmarks, presenting no excess returns. As regards their tracking errors both financial products are equal.

Svetina (2008) analyzes 584 domestic equity, international equity, and bond ETFs starting from their inception date until 2007 that track 504 unique indices for which they can acquire data. Moreover, the author analyzes the corresponding index mutual funds that track the same benchmarks and for each pair of ETF and index mutual fund, returns, NAVs, inception dates, and expense ratios are used. After doing so and conducting the empirical research, the conclusion arrived is that 83 percent of all ETFs track benchmarks for which there is no index mutual fund. ETFs that are matched to index mutual funds are found to have better performance than retail index funds and are similar relative to institutional index funds. Another significant finding of the paper has to do with the impact of newly incepted ETFs on the reduced net flows to index mutual funds along with the reduction of demand for incumbent ETFs of the same investment style.

A year later, Guedj & Huang (2009) investigated which of the two investment products (ETFs and open–ended mutual funds) can be characterized as a more efficient indexing instrument by focusing on the liquidity aspect. The data sample they use is comprised of 296 OEFs, tracking 63 different indices between 1992 and 2006, and of 320 ETFs tracking 268 different indices. Following the authors' analysis, it is reported that OEFs face flow-induced trading costs, which is an obstacle to good performance. The flow-induced trading is only beneficial regarding redeeming investors. Yet, the OEF structure can be characterized as an instrument providing insurance against future liquidity shocks and thus seems great for risk–averse investors. It is also referred to the paper that moral hazard can be the reason of flow–induced trading leading to increased insurance

fees. As a result, Guedj and Huang state that index mutual funds are preferred by investors facing high liquidity needs.

The same year two more papers were published related to that scientific universe of research. Blitz, Huij, and Swinkels (2009) study the performance of EU index mutual funds and passive ETFs compared to their benchmarks as well as the impact of fund expenses and dividend withholding taxes on the already cited types of passive funds. What they find is that those funds underperform their market indices by approximately 50 to 150 basis points per annum. Additionally, it is supported by the paper's findings that the total expense ratio is not measuring sufficiently all the costs incurred by the funds together with the fact that dividend withholding taxes are one of the main reasons explaining the underperformance. The second paper by Aber, Li, and Can (2009) investigates both the price volatility and replicating ability of ETFs, specifically of four iShares relative to conventional index mutual funds that track the same benchmarks. The researchers choose the premiums or discounts, daily returns, and tracking errors as the measures for comparison and they conclude the following: ETFs trade usually at a premium facing major price fluctuations on a daily basis, both types of funds follow their underlying indices at approximately the same level even though their tracking errors differ slightly. The last finding worth mentioning is that on average Vanguard’s index funds present a better tracking ability than their competitors, namely the iShares ETFs.

Another paper trying to shed light on the debate of ETFs against conventional index mutual funds but from the perspective of substitutability is that published by Agapova (2010). The study ranges from 2000 until 2004 and matches 171 index funds to 11 ETFs following the same benchmarks. The results of the study state that the two types of funds are substitutes but not perfect ones by comparing fund flow on a monthly basis. Moreover, according to the author conventional index

mutual funds are not replaced by ETFs but the last ones offer new features to investors such as intraday trading and a more efficient redeeming process. Concluding, the substitutability of both types of funds can be explained by a clientele effect.

Last but not least, Rompotis (2011) conducts research focusing on the Greek ETF market in which he uses data regarding one ETF, one index mutual fund, and 3 active mutual funds, all tracking the same benchmark. The author's study aims to compare the already mentioned types of funds on risk and return, cost, and tracking performance basis. His results indicate the following: classical mutual funds are better performers and face less risk but that comes with a bigger cost when compared to the examined ETF. The ETF is more conservative than the open-ended mutual funds and more efficient considering its performance relative to the performance of the benchmark than the mutual funds included in the research. Lastly, considering the tracking ability aspect, it is found that the index fund performs better followed by the ETF and reasonably by the actively managed funds, which come last.

2.3 Tracking error

In terms of index investing, tracking error measurement is a key concept for investors trying to create asset portfolios that have the ability to mimic the risk and return characteristics of market indices and for that reason in this section past papers focusing on that characteristic of ETFs and mutual funds will be discussed.

Edelen in 1999 is the first one examining the impact of liquidity in terms of trading activity. The data sample includes 166 open-end mutual funds for the time period between 1985 to 1990. The empirical results demonstrate that index funds' underperformance can be attributed to liquidity costs. Furthermore, liquidity costs in the form of bid–ask spreads affect the tracking performance

of the examined funds driving them to encounter consequently higher tracking errors than ETFs, which do not suffer from liquidity risk to the same extent.

The second paper that came to my notice is that of Frino and Gallagher (2001). The study examines the tracking error determinants of 42 index funds and it provides performance analysis comparing index and active mutual funds tracking the S&P 500 index for five years using a single index model, a four-index model, and a performance attribution model. The empirical results indicate that index funds outperformed the active ones after expenses along with the fact that index revisions, share issuance and redemption, fund size, and replication strategy are the key determinants influencing the tracking error of index funds.

A year later the same two people Frino and Gallagher (2002) were the first to investigate the tracking performance of Australian equity index funds in addition to the main factors affecting it. The authors find through their research that the investigated index funds face tracking errors with the difference between the funds' returns and those of the benchmarks estimated from 7.4 to 22.3 basis points per month considering index funds with a life cycle of more than five years. As regards the tracking error factors, it is supported that fund cash flows, market volatility, transaction costs, and replication strategies are the ones responsible.

Blume and Edelen (2002) describe the corresponding investment strategies trying to create portfolios replicating the S&P 500 index, the levels of the possible tracking errors, and the impact of adding or extracting stocks from the S&P 500 index in terms of volume and return. In their paper, the authors report the small tracking error of SPDRs which generate similar returns compared to the S&P 500 index.

Gastineu (2002) also documents the tracking error's main factors, which happen to be according to his research transaction costs. The study mainly investigates index funds and it is cited that transaction costs mainly occur due to the increased volatility that stocks face when included in an index that is announced to be rebalanced.

In 2005, Gallagher and Segara used a sample of index ETFs and open–end index equity funds tracking the Australian market over a two-year (2002 – 2003) period to compare their tracking performance. They choose two tracking error measures and they demonstrate that passive ETFs record a smaller tracking error than index mutual funds, which suffer from liquidity and market impact costs, implying that they replicate the benchmark better. Moreover, it is stated in the paper that the ETFs examined generate analogous returns to that of the benchmark pre-costs.

Rompotis (2006) examines the equity iShares ETFs performance and trading characteristics over a 1-year time span (10/2005 – 9/2006). To be more specific, the sample used consists of 23 international, 27 market capitalization, and 23 sector iShares, and after evaluating it, it is derived that their returns move in line with that of the indices. However, the under-research investment products fail to track their benchmarks accurately and this is more notable in the case of international iShares. In his conclusion, Rompotis supports that after conducting his regression analysis, it is clear that expense ratio and risk affect the tracking performance as well as that there is a correlation among tracking error, premium, and trading volume.

In the same year, Milonas and Rompotis (2006) published a paper exclusively focusing on the EU ETF market and particularly on the Swiss ETFs. The two authors use daily data considering 36 ETFs from 2001 to 2006 and they display the ETFs' underperformance relative to the underlying benchmarks. Moreover, the tracking error of the examined ETFs is 1.02% which indicates the fact that those products fail to fully replicate the indices. Lastly, it is stated in the paper that

management fees are found to positively affect tracking errors and the same situation occurs between intraday price volatility and volume.

Rompotis (2009), by examining the impact of full replication strategy on the tracking errors of ETFs and index funds, records that index mutual funds achieve better tracking performance than ETFs, supporting that index funds are able to better replicate their benchmarks.

Contrary to Rompotis's findings, Guedj and Huang (2009) provide different results once they investigate and compare the indexing efficiency between ETFs and open–ended mutual funds since they state that the tracking error of an open–end mutual fund increases once the fund's size increases together with the fact that index funds face higher liquidity costs and thus, they exhibit higher tracking errors than ETFs.

Chu in 2010 studied 21 ETFs listed on the Hong Kong Exchange. The researcher collects daily prices, dividend yields, and trading volumes from 2009 to 2011 regarding the ETFs and their benchmarks and he states that survivorship bias does not apply in his study. He uses three types of tracking error measurement and after doing so his results point out that the ETFs examined fail to track the selected indices with the same success as the ones listed in the U.S. and Australia, a fact that indicates their inefficient tracking performance. Taking a step further, Chu examines whether or not the gathered, synthetic ETFs have higher tracking errors than the physical ones and he concludes that they do since there is a possibility of them not finding derivatives to exactly replicate the equities listed in the benchmarks, a fact that subsequently leads to worse tracking ability.

Bassie (2012) studies as others before him the tracking error determinants but he focuses on EU ETFs. He examines 40 ETFs over a 5-year period (2007 – 2011) and he points out that expense

ratio, dividend policy, replication strategy, volume, fund size, and NAV deviation are significant tracking error factors. However, in contrast to other prior findings he demonstrates the negative relationship between expense ratio and tracking error. To conclude, it is also stated that the ETFs underperformed their benchmarks.

The last paper demonstrated in this section is that of the Master Thesis of Larion in 2013 which investigates the substitutability between ETFs and index funds along with their tracking performance and expenses. The researcher uses a four-year time span between 2008 to 2012, he gathers data regarding 22 U.S. ETFs and 22 U.S. index funds tracking the same benchmarks and in order to evaluate their tracking performance, he uses three measures as past researchers. His empirical results show that the two investment vehicles can be categorized as complementary products and that ETFs can track better their market. Lastly, it is indicated that the relation between expenses and tracking errors is positive.

2.4 Market Timing

The last section of the literature review provides evidence rejecting the fact that active funds' managers possess market timing skills.

The first of the three papers presented in this section is that of Henriksson and Merton in 1981. The authors are the first to introduce a market timing model and they use it to examine whether or not open-end mutual fund managers possess the skills necessary to time the market in a way sufficient enough to create value. Their research contains monthly data starting from 2/1968 until 6/1980 and after analyzing them, it is clearly stated in the paper that managers of such funds are not able to time the market.

In the same direction as the above-mentioned results are the ones obtained by Rompotis in 2009, but that time regarding the active ETFs' managers. Rompotis shows that once he examines the market timing skills of three actively managed ETFs no indication of market timing ability is derived. Conducting his Master Thesis, Geerlink (2016) arrives to the same argument concerning the market timing abilities of active ETFs managers. The author's empirical analysis involves nineteen actively managed funds, and it is stated that the only statistically significant coefficient displays no market timing skills on behalf of the managers.

2.5 Hypotheses Development

As seen across academic papers, researchers have tried to identify which of the two investment vehicles is the best option considering investors as they position their portfolios in such a way that they generate excess risk-adjusted returns. Moreover, prior literature tries to examine which is the better investment tool in terms of tracking ability along with whether or not managers of active funds possess the necessary skills to time the market.

This Master Thesis, as far as I know, is the first one conducted that tries to include all the above aspects of ETFs and open–end mutual funds and provide evidence about which one of the two types of funds is better. Furthermore, it is the first analysis that includes all management types of U.S. ETFs and open–end mutual funds to fill in the research gap.

After considering all the above-mentioned literature, the following 5 hypotheses will be tested:

H1: Active ETFs underperform passive ETFs.

H2: Active open–end mutual funds underperform index open–end mutual funds.

H3: Index mutual funds underperform passive ETFs that track the same benchmark.

H4: Passive ETFs have a better tracking ability than index mutual funds.

H5: Neither active mutual funds' nor active ETFs' managers possess market timing skills.

3. Data and Methodology

3.1 Data

As already stated, this is the first research that tries to evaluate the risk and return performance along with the tracking ability of all management types of ETFs and open–end mutual funds. I start by downloading U.S. ETFs and open–end mutual funds from Morningstar, and I group them in such a way that each group contains one active ETF, one passive ETF, one active mutual fund, and one index (passive) mutual fund that all track the same benchmark. After doing so, 17 groups are formed all tracking unique benchmarks.

Namely, the groups tested are the ones illustrated in the following table:

Table 1 Groups under examination

Group No	Active ETF	Passive ETF	Active Mutual Fund	Index Mutual Fund	Benchmark	Global Category
1	First Trust Alt Abs Ret Strat ETF	iPath® Bloomberg Cmdty TR ETN	PIMCO Commodity Real Ret Strat Admin	BlackRock Commodity Strategies Instl	Bloomberg Commodity TR USD	Commodities Broad Basket
2	Invesco Total Return Bond ETF	iShares Core US Aggregate Bond ETF	ACPSX	Invesco Core Bond A	Bloomberg US Agg Bond TR USD	US Fixed Income
3	Janus Henderson Mortgage-Backed Sec ETF	iShares MBS ETF	Fidelity Advisor® Mortgage Securities C	BlackRock Allocation Target Shrs Ser M	Bloomberg US MBS TR USD	US Fixed Income

4	FlexShares Ultra-Short Income ETF	SPDR® Blmbg 1-3 Mth T-Bill ETF	Metropolitan West Unconstrained Bd I	Guggenheim Ultra Short Duration A	Bloomberg US Treasury Bill 1-3 M TR USD	US Fixed Income
5	Davis Select International ETF	iShares MSCI ACWI ex-US ETF	Fidelity Advisor® Intl Capital App A	BlackRock International Dividend Instl	MSCI ACWI Ex USA NR USD	Global Equity Large Cap
6	Cambria Global Value ETF	iShares MSCI ACWI ETF	Invesco Global Opportunities A	Vanguard Global Capital Cycles Investor	MSCI ACWI NR USD	Global Equity Large Cap
7	First Trust Hrzn MgdVolatil Dev Intl ETF	iShares MSCI EAFE ETF	Delaware Intl Value Equity R6	iShares MSCI EAFE Intl Idx Instl	MSCI EAFE NR USD	Global Equity Large Cap
8	WisdomTree Intl AI Enhanced Val ETF	iShares MSCI EAFE Value ETF	PIMCO RAE International A	Fidelity Advisor® International Value A	MSCI EAFE Value NR USD	Global Equity Large Cap
9	Cambria Emerging Shareholder Yield ETF	iShares MSCI Emerging Markets ETF	Delaware Emerging Markets A	Invesco EQV Emerging Markets All Cap A	MSCI EM NR USD	Global Emerging Markets Equity
10	ERShares Entrepreneur ETF	iShares Russell 1000 Growth ETF	Invesco American Franchise A	BlackRock Advantage Large Cap Gr Instl	Russell 1000 Growth TR USD	US Equity Large Cap Growth
11	Franklin U.S. Low Volatility ETF	iShares Russell 1000 ETF	Invesco Charter A	BlackRock Advantage Large Cap Core Instl	Russell 1000 TR USD	US Equity Large Cap Blend
12	AdvisorShares Insider Advantage ETF	iShares Russell 1000 Value ETF	PIMCO RAE US A	Vanguard Russell 1000 Value Index I	Russell 1000 Value TR USD	US Equity Large Cap Value
13	Motley Fool Small-Cap Growth ETF	iShares Russell 2000 Growth ETF	Invesco Discovery A	BlackRock Advantage Small Cap Gr Instl	Russell 2000 Growth TR USD	US Equity Small Cap
14	Principal US Small Cap ETF	iShares Russell 2000 ETF	Fidelity® Small Cap Enhanced Index	iShares Russell 2000 Small-Cap Idx Inv A	Russell 2000 TR USD	US Equity Small Cap

15	Opus Small Cap Value Plus ETF	iShares Russell 2000 Value ETF	PIMCO RAE US Small I-2	Vanguard Russell 2000 Value Index I	Russell 2000 Value TR USD	US Equity Small Cap
16	RiverFront Dynamic US Flex-Cap ETF	SPDR® Port S&P 1500 Comps Stk Mkt ETF	Davidson Multi-Cap Equity A	ICON Equity Institutional	S&P 1500 TR	US Equity Mid Cap
17	First Trust Hrzn MgdVolatil Domestic ETF	iShares Core S&P 500 ETF	Calamos Select Fund I	Vanguard 500 Index Admiral	S&P 500 TR USD	US Equity Large Cap Blend

Note: All of the above funds and benchmarks under examination are retrieved from Morningstar

As regards the variables that will be used, I gather the weekly returns of the funds and of their corresponding benchmarks from Morningstar for the time period between 6/1/2019 and 29/7/2023. I also use the Whorton database to collect the weekly risk-free returns based on the one-month Treasury bill rate.

3.2 Research Methodology

3.2.1 Risk-adjusted Performance

In order to evaluate the risk and return performance of both ETFs and open–end mutual funds three measures will be used namely Jensen's alpha, the Sharpe ratio, and the Treynor ratio of each fund. After that, I will compare those measures to test my first three hypotheses.

i) Jensen's alpha

Jensen's alpha (Jensen, 1972) is the measure that I have chosen to use to evaluate whether or not the under-examination funds are able to generate risk-adjusted returns in terms of their underlying benchmark. In particular, the model that will be used is the following:

$$R_i - R_f = \alpha_i + \beta_i (R_m - R_f) + \varepsilon_i$$

Where R_i depicts the weekly returns in respect of the examined ETFs or mutual funds, R_f constitutes the weekly risk-free rate based on one month U.S. Treasury Bill, and R_m is the benchmark's weekly return. As regards Jensen's alpha, it is calculated by the α_i coefficient and as already mentioned it basically indicates the ability of each fund to generate adjusted returns superior to the corresponding ones of the benchmark for the selected time period. Thus, positive and statistically significant α_i coefficients indicate that the fund is outperforming the underlying benchmark and, on the opposite, negative and statistically significant α_i coefficients indicate that the fund is underperforming. Finally, the β_i coefficient depicts the systematic risk of each fund studied and ε_i depicts the regression's standard errors.

ii) Sharpe ratio

This particular measure is the one that will be used to check how much excess return over the risk-free rate is generated per unit of standard deviation. To be more specific, this measure actually informs us about how well the funds compensate investors in terms of the risk they are willing to load on their portfolio. The calculation of the Sharpe ratio (Sharpe, 1966) is conducted by dividing the average excess return of each fund over the average risk-free rate by the funds' volatility concerning the fund's excess return on the risk-free rate. The formula used in this study is the following:

$$\frac{Ri - Rf}{\sigma i}$$

Where R_i is the funds' average weekly return, R_f denotes the average weekly risk-free rate and σ_i is the standard deviation of the fund's excess return over the risk-free rate.

iii) Treynor ratio

This specific ratio is a measure of risk-adjusted return of an investment such as the Sharpe ratio with the only difference being that it measures risk-adjusted returns per unit of systematic risk, which is measured by the β_i coefficient estimated from the regression described above. The formula that will be used to evaluate the Treynor ratio (Treynor, 1965) is the following:

$$\frac{Ri - Rf}{\beta i}$$

In this case, R_i is the funds' average weekly return, R_f depicts the average weekly risk-free rate and β_i is the systematic risk faced by each fund.

3.2.2 Tracking ability performance

Taking into consideration that one of the goals of this Master Thesis is to examine which one of the two investment vehicles namely the ETFs and open–end mutual funds tracks the corresponding benchmark better, three measures will be used to evaluate their tracking errors following the Frino and Gallagher approach (Frino & Gallagher, Tracking S&P 500 index funds, 2001).

The first tracking error measure used is the following:

$$TE_{1,i} = \sqrt{\frac{1}{n-2}\sum_{t=1}^{n} \varepsilon_1^2}$$

This specific measure calculates the tracking error of each fund by estimating the square root of the sum of the squared residuals (depicted in the regression above) divided by the number of

observations minus two. In this scientific research, the number of observations regarding our sample period is constant for each fund and amounts to 238.

The second tracking measure that will be used is the following:

$$TE_{2,i} = \frac{1}{n}\sum_{t=1}^{n}|e_{i,t}|$$

In this case, the measure depicted above calculates the tracking error of each fund by dividing the sum of the absolute value of $e_{i,t}$ by the number of observations. To give a clearer picture of how the measure is estimated, $e_{i,t}$ displays the absolute value of the fund's weekly return minus the benchmark's weekly return.

Lastly, the final measure of tracking error that will be taken into consideration is described by the following formula:

$$TE_{3,i} = \sqrt{\frac{1}{n-1}\sum_{t=1}^{n}(e_{i,t} - \overline{e_i})^2}$$

In the aforementioned estimation, the total number of n equals 238 and the average e_i is calculated by estimating the average R_i minus R_m, which indicates the fund's returns and benchmark's returns respectively.

3.2.3 Market timing ability

Finally, considering the market timing ability of the active fund's managers, this thesis tries to examine whether or not those managers possess the necessary skills to time the market in such a

way that they create and not destroy value. Thus, to examine their market timing skills, the following model first introduced by Henriksson and Merton in 1981 will be used:

$$R_i - R_f = \alpha_i + \beta_i (R_m - R_f) + \gamma_i (R_m - R_f)^2 + \varepsilon_i$$

The above-displayed model includes the fund's weekly returns (R_i), the weekly risk–free rate (R_f), and the benchmark's weekly returns (R_m) and to evaluate whether or not managers possess market timing skills, the γ coefficient will be used, with positive and statistically significant values indicating that managers have market timing abilities and the opposite if we derive negative and statistically significant values.

4. Results

4.1 Descriptive Statistics

Table 2

Descriptive summary of the mean, median, standard deviation, minimum, and maximum weekly returns of all the funds, benchmarks, and risk-free rate considering the time period starting from 6/1/2019 until 29/7/2023.

Type of Fund	Ticker	Mean	median	SD	min	max
Active ETF	**FAAR**	0.12%	0.13%	1.25%	-3.94%	9.22%
Passive ETF	**DJP**	0.21%	0.33%	2.69%	-9.31%	14.71%
Active MF	**PCRRX**	0.22%	0.41%	2.74%	-13.38%	13.73%
Passive MF	**BICSX**	0.22%	0.41%	2.49%	-11.68%	7.57%
Benchmark	**Bloomberg Commodity TR USD**	0.19%	0.30%	2.32%	-7.74%	13.03%
Active ETF	**GTO**	0.03%	0.11%	0.87%	-5.81%	3.38%
Passive ETF	**AGG**	0.01%	0.09%	0.75%	-3.20%	2.67%
Active MF	**ACPSX**	0.02%	0.12%	0.88%	-6.33%	3.27%
Passive MF	**OPIGX**	0.01%	0.06%	0.80%	-4.62%	3.00%
Benchmark	**Bloomberg US Agg Bond TR USD**	0.01%	0.09%	0.74%	-3.17%	2.66%
Active ETF	**JMBS**	0.01%	0.04%	0.66%	-2.34%	2.81%
Passive ETF	**MBB**	-0.01%	0.04%	0.67%	-2.20%	2.65%

Active MF	**FOMCX**	-0.03%	0.00%	0.69%	-2.42%	2.60%
Passive MF	**BRAMX**	0.00%	0.06%	0.67%	-2.18%	2.43%
Benchmark	**Bloomberg US MBS TR USD**	-0.01%	0.02%	0.67%	-2.21%	2.62%
Active ETF	**RAVI**	0.04%	0.04%	0.19%	-2.21%	0.76%
Passive ETF	**BIL**	0.03%	0.02%	0.03%	-0.02%	0.14%
Active MF	**MWCIX**	0.03%	0.07%	0.66%	-7.07%	2.15%
Passive MF	**GIYAX**	0.03%	0.03%	0.19%	-1.87%	1.06%
Benchmark	**Bloomberg US Treasury Bill 1-3 M TR USD**	0.03%	0.02%	0.03%	-0.01%	0.14%
Active ETF	**DINT**	0.19%	0.53%	3.24%	-12.74%	11.57%
Passive ETF	**ACWX**	0.17%	0.32%	2.65%	-16.46%	9.45%
Active MF	**FCPAX**	0.23%	0.23%	2.95%	-12.20%	11.20%
Passive MF	**BISIX**	0.21%	0.22%	2.36%	-12.08%	8.77%
Benchmark	**MSCI ACWI Ex USA NR USD**	0.17%	0.32%	2.59%	-16.53%	9.31%
Active ETF	**GVAL**	0.12%	0.46%	3.13%	-19.21%	11.03%
Passive ETF	**ACWI**	0.25%	0.33%	2.68%	-12.34%	10.43%
Active MF	**OPGIX**	0.16%	0.38%	3.73%	-14.89%	13.93%
Passive MF	**VGPMX**	0.32%	0.38%	2.91%	-15.88%	11.78%
Benchmark	**MSCI ACWI NR USD**	0.25%	0.34%	2.63%	-12.35%	10.50%
Active ETF	**HDMV**	0.05%	0.24%	2.00%	-14.49%	6.97%
Passive ETF	**EFA**	0.19%	0.31%	2.79%	-18.39%	11.22%
Active MF	**DEQRX**	0.14%	0.23%	2.47%	-13.81%	7.83%
Passive MF	**MAIIX**	0.19%	0.30%	2.75%	-14.78%	11.76%
Benchmark	**MSCI EAFE NR USD**	0.19%	0.34%	2.75%	-18.36%	11.22%
Active ETF	**AIVI**	0.15%	0.18%	2.70%	-19.66%	10.64%
Passive ETF	**EFV**	0.17%	0.26%	3.01%	-20.71%	12.45%
Active MF	**PPYAX**	0.16%	0.13%	2.93%	-16.16%	11.76%
Passive MF	**FIVMX**	0.20%	0.25%	3.10%	-17.34%	14.91%
Benchmark	**MSCI EAFE Value NR USD**	0.17%	0.25%	2.98%	-20.72%	12.45%
Active ETF	**EYLD**	0.18%	0.52%	2.74%	-14.37%	7.43%
Passive ETF	**EEM**	0.10%	0.38%	2.65%	-11.89%	7.79%
Active MF	**DEMAX**	0.13%	0.33%	3.00%	-13.90%	9.18%
Passive MF	**GTDDX**	0.14%	0.36%	2.63%	-14.83%	8.65%
Benchmark	**MSCI EM NR USD**	0.12%	0.38%	2.62%	-11.92%	7.87%
Active ETF	**ENTR**	0.25%	0.44%	4.04%	-13.84%	12.33%
Passive ETF	**IWF**	0.39%	0.51%	3.13%	-14.32%	11.37%
Active MF	**VAFAX**	0.33%	0.32%	3.15%	-12.51%	10.49%
Passive MF	**CMVIX**	0.35%	0.40%	3.12%	-14.75%	11.17%

Benchmark	**Russell 1000 Growth TR USD**	0.39%	0.52%	3.13%	-14.32%	11.37%
Active ETF	**FLLV**	0.29%	0.36%	2.63%	-15.78%	12.54%
Passive ETF	**IWB**	0.32%	0.52%	2.89%	-15.25%	12.63%
Active MF	**CHTRX**	0.27%	0.40%	2.80%	-15.51%	11.52%
Passive MF	**MALRX**	0.31%	0.56%	2.89%	-15.48%	12.20%
Benchmark	**Russell 1000 TR USD**	0.32%	0.52%	2.89%	-15.25%	12.63%
Active ETF	**SURE**	0.27%	0.37%	2.93%	-14.92%	11.15%
Passive ETF	**IWD**	0.24%	0.27%	2.95%	-16.39%	14.19%
Active MF	**PKAAX**	0.26%	0.37%	3.05%	-16.63%	14.30%
Passive MF	**VRVIX**	0.24%	0.28%	2.95%	-16.38%	14.18%
Benchmark	**Russell 1000 Value TR USD**	0.24%	0.28%	2.95%	-16.38%	14.19%
Active ETF	**TMFS**	0.30%	0.33%	3.77%	-13.13%	15.63%
Passive ETF	**IWO**	0.25%	0.44%	3.86%	-16.30%	16.89%
Active MF	**OPOCX**	0.33%	0.49%	3.82%	-14.40%	13.73%
Passive MF	**PSGIX**	0.26%	0.39%	3.85%	-16.30%	16.59%
Benchmark	**Russell 2000 Growth TR USD**	0.25%	0.44%	3.86%	-16.30%	16.87%
Active ETF	**PSC**	0.29%	0.42%	3.90%	-18.72%	21.11%
Passive ETF	**IWM**	0.25%	0.37%	3.77%	-16.48%	18.53%
Active MF	**FCPEX**	0.28%	0.33%	3.80%	-17.01%	17.85%
Passive MF	**MDSKX**	0.24%	0.36%	3.77%	-16.44%	18.49%
Benchmark	**Russell 2000 TR USD**	0.25%	0.37%	3.77%	-16.48%	18.53%
Active ETF	**OSCV**	0.25%	0.34%	3.33%	-17.72%	15.97%
Passive ETF	**IWN**	0.24%	0.39%	3.93%	-17.57%	20.54%
Active MF	**PMJPX**	0.35%	0.60%	4.20%	-18.01%	20.72%
Passive MF	**VRTVX**	0.25%	0.38%	3.93%	-17.54%	20.54%
Benchmark	**Russell 2000 Value TR USD**	0.25%	0.39%	3.93%	-17.57%	20.56%
Active ETF	**RFFC**	0.25%	0.40%	2.97%	-15.46%	14.25%
Passive ETF	**SPTM**	0.32%	0.52%	2.86%	-15.19%	12.66%
Active MF	**DFMAX**	0.31%	0.35%	2.71%	-13.21%	11.97%
Passive MF	**IOLZX**	0.30%	0.56%	3.46%	-17.17%	15.42%
Benchmark	**S&P 1500 TR**	0.32%	0.53%	2.86%	-15.20%	12.65%
Active ETF	**HUSV**	0.23%	0.32%	2.50%	-17.33%	10.98%
Passive ETF	**IVV**	0.32%	0.56%	2.82%	-14.95%	12.14%
Active MF	**CVAIX**	0.29%	0.50%	2.89%	-15.04%	12.64%
Passive MF	**VFIAX**	0.32%	0.56%	2.82%	-14.96%	12.14%
Benchmark	**S&P 500 TR USD**	0.32%	0.56%	2.82%	-14.95%	12.15%

Risk-free rate	0.03%	0.02%	0.04%	0.00%	0.13%

Note: All of the funds and benchmarks under examination are consisted of the same number of total observations over the study period amounting to 238.

As regards Table 1, a few key details have to be discussed. The fund that seems to generate an average weekly return above the others over the sample period is the passive ETF with the IWF ticker. Specifically, IWF manages to generate an average weekly return of 0.39% while the average taking into consideration all the above-mentioned funds amounts to 0.2%. Moreover, FOMCX, which happens to be an active mutual fund is the one depicting the lowest average return which is a negative one indicating that those investors using it as an investment vehicle realized negative returns of around -0.03% over the sample period. The fund that is displaying the highest weekly return regarding the sample period is the PSC, which is an active ETF and it displays a 21.11% maximum weekly return. On the other side, once we examine the funds in terms of minimum weekly returns, EFV depicts the lowest one of about -20.72%.

4.2 Regression Results

Table 3 Performance Regression Results

The following table illustrates the results in terms of the regression considering Jensen's alpha. As already explained, the excess weekly return of each fund over the risk-free rate is the dependent variable and the independent variable is constituted by the weekly excess return of the benchmark over the risk–free rate. R_i illustrates the weekly return of each fund, R_f is the weekly risk-free rate and R_m depicts the benchmark's weekly return. The examined period considered is between 6/1/2019 and 29/7/2023. The table depicts Jensen's alpha of each fund (α), the P–Value, and the beta coefficient, which illustrates the systematic risk faced by each fund as well as the explanatory power of our regression model considering each fund by R^2.

Type of Fund	Ticker	α	P-value	β	P-value	R^2
Active ETF	**FAAR**	0.000268	0.651	0.369***	0.000	0.4713
Passive ETF	**DJP**	-0.0000504	0.347	1.156***	0.000	0.9991
Active MF	**PCRRX**	0.0000771	0.843	1.150***	0.000	0.9527
Passive MF	**BICSX**	0.000434	0.576	0.943***	0.000	0.7726
Benchmark	**Bloomberg Commodity TR USD**					
Active ETF	**GTO**	0.000232	0.349	1.056***	0.000	0.8093
Passive ETF	**AGG**	-0.00000403	0.925	1.006***	0.000	0.9922

Active MF	**ACPSX**	0.000156	0.557	1.049***	0.000	0.7843
Passive MF	**OPIGX**	0.0000414	0.778	1.032***	0.000	0.9202
Benchmark	**Bloomberg US Agg Bond TR USD**					
Active ETF	**JMBS**	0.000156	0.202	0.952***	0.000	0.9187
Passive ETF	**MBB**	-0.00000812	0.874	0.997***	0.000	0.9861
Active MF	**FOMCX**	-0.000207**	0.009	1.027***	0.000	0.9698
Passive MF	**BRAMX**	0.0000859	0.384	0.981***	0.000	0.9486
Benchmark	**Bloomberg US MBS TR USD**					
Active ETF	**RAVI**	-0.0000202	0.878	-0.696	0.449	0.0024
Passive ETF	**BIL**	-0.0000313***	0.000	0.929***	0.000	0.8411
Active MF	**MWCIX**	-0.000102	0.822	-1.649	0.604	0.0011
Passive MF	**GIYAX**	-0.0000746	0.552	-0.447	0.611	0.0011
Benchmark	**Bloomberg US Treasury Bill 1-3 M TR USD**					
Active ETF	**DINT**	0.0000827	0.938	1.079***	0.000	0.7483
Passive ETF	**ACWX**	-0.0000111	0.972	1.002***	0.000	0.9651
Active MF	**FCPAX**	0.000672	0.471	0.993***	0.000	0.7639
Passive MF	**BISIX**	0.000667	0.313	0.823***	0.000	0.8156
Benchmark	**MSCI ACWI Ex USA NR USD**					
Active ETF	**GVAL**	-0.00121	0.322	0.951***	0.000	0.6411
Passive ETF	**ACWI**	-0.0000101	0.936	1.1014***	0.000	0.9948
Active MF	**OPGIX**	-0.00149	0.160	1.274***	0.000	0.8104
Passive MF	**VGPMX**	0.000778	0.397	0.969***	0.000	0.7668
Benchmark	**MSCI ACWI NR USD**					
Active ETF	**HDMV**	-0.000903	0.059	0.678***	0.000	0.8667
Passive ETF	**EFA**	0.0000220	0.948	0.998***	0.000	0.9653
Active MF	**DEQRX**	-0.000182	0.775	0.824***	0.000	0.8431
Passive MF	**MAIIX**	0.0000344	0.942	0.965***	0.000	0.9309
Benchmark	**MSCI EAFE NR USD**					
Active ETF	**AIVI**	0.00000515	0.990	0.880***	0.000	0.9491
Passive ETF	**EFV**	0.0000104	0.974	0.997***	0.000	0.9737
Active MF	**PPYAX**	0.0000544	0.916	0.946***	0.000	0.9271
Passive MF	**FIVMX**	0.000299	0.580	1.000***	0.000	0.9280
Benchmark	**MSCI EAFE Value NR USD**					
Active ETF	**EYLD**	0.000735	0.381	0.922***	0.000	0.7774
Passive ETF	**EEM**	-0.0000900	0.833	0.981***	0.000	0.9386
Active MF	**DEMAX**	0.0000538	0.937	1.073***	0.000	0.8768
Passive MF	**GTDDX**	0.000308	0.666	0.915***	0.000	0.8268

Benchmark	**MSCI EM NR USD**					
Active ETF	**ENTR**	-0.00197	0.109	1.142***	0.000	0.7844
Passive ETF	**IWF**	-0.0000364***	0.000	1.000***	0.000	1.0000
Active MF	**VAFAX**	-0.000563	0.203	0.983***	0.000	0.9540
Passive MF	**CMVIX**	-0.000391**	0.006	0.996***	0.000	0.9952
Benchmark	**Russell 1000 Growth TR USD**					
Active ETF	**FLLV**	0.0000104	0.980	0.882***	0.000	0.9396
Passive ETF	**IWB**	-0.0000265***	0.000	1.000***	0.000	1.0000
Active MF	**CHTRX**	-0.000352	0.186	0.958***	0.000	0.9789
Passive MF	**MALRX**	-0.000142	0.341	0.996***	0.000	0.9938
Benchmark	**Russell 1000 TR USD**					
Active ETF	**SURE**	0.000387	0.441	0.957***	0.000	0.9310
Passive ETF	**IWD**	-0.0000314***	0.000	1.000***	0.000	1.0000
Active MF	**PKAAX**	0.000185	0.688	1.006***	0.000	0.9466
Passive MF	**VRVIX**	-0.0000103***	0.000	1.000***	0.000	1.000
Benchmark	**Russell 1000 Value TR USD**					
Active ETF	**TMFS**	0.000723	0.357	0.924***	0.000	0.8978
Passive ETF	**IWO**	-0.0000107**	0.006	1.000***	0.000	1.0000
Active MF	**OPOCX**	0.001000	0.218	0.936***	0.000	0.8944
Passive MF	**PSGIX**	0.000153	0.445	0.994***	0.000	0.9936
Benchmark	**Russell 2000 Growth TR USD**					
Active ETF	**PSC**	0.000403	0.501	1.004***	0.000	0.9443
Passive ETF	**IWM**	-0.0000188***	0.000	1.000***	0.000	1.0000
Active MF	**FCPEX**	0.000282	0.251	1.002***	0.000	0.9902
Passive MF	**MDSKX**	-0.0000470***	0.000	0.999***	0.000	1.0000
Benchmark	**Russell 2000 TR USD**					
Active ETF	**OSCV**	0.000472	0.441	0.811***	0.000	0.9202
Passive ETF	**IWN**	-0.0000374***	0.000	0.999***	0.000	1.0000
Active MF	**PMJPX**	0.000942	0.127	1.039***	0.000	0.9493
Passive MF	**VRTVX**	0.00000851	0.147	1.000***	0.000	1.0000
Benchmark	**Russell 2000 Value TR USD**					
Active ETF	**RFFC**	-0.000786*	0.016	1.025***	0.000	0.9722
Passive ETF	**SPTM**	0.0000198	0.464	1.001***	0.000	0.9998
Active MF	**DFMAX**	0.000148	0.621	0.934***	0.000	0.9715
Passive MF	**IOLZX**	-0.000564	0.497	1.126***	0.000	0.8652
Benchmark	**S&P 1500 TR**					

Active ETF	**HUSV**	-0.000364	0.614	0.798***	0.000	0.8060
Passive ETF	**IVV**	-0.00000566***	0.000	1.000***	0.000	1.0000
Active MF	**CVAIX**	-0.000410	0.113	1.016***	0.000	0.9813
Passive MF	**VFIAX**	-0.00000672**	0.002	1.000***	0.000	1.0000
Benchmark	**S&P 500 TR USD**					

Note: All of the funds and benchmarks under examination are consisted of the same number of total observations over the study period amounting to 238.

***Statistically significant at a 1% confidence level, ** Statistically significant at a 5% confidence level, *Statistically significant at a 10% confidence level

As can be observed from Table 2, only a few funds depict statistically significant α coefficients, the majority of which are passive ETFs. As regards the funds illustrating statistically significant Jensen's alphas at a 1% confidence level, they are namely the following: BIL, IWF, IWB, IWD, VRVIX, IWM, MDSKX, IWN, and IVV. All of the above-mentioned funds are passive ETFs and only two of them namely VRVIX and MDSKX are passive mutual funds. Moreover, all coefficients considering those funds have negative values indicating the fact that they are generating inferior weekly returns than the benchmarks they are tracking.

As regards the funds depicting significant Jensen's alphas at a 5% confidence level, they display negative results as well and they are constituted of two passive mutual funds (CMVIX, VFIAX), one passive ETF (IWO) and one active mutual fund (FOMCX), which indicates that the managers of the funds are not justifying the management fees they are compensated with.

In addition, only one active ETF namely the RFFC tracking the S&P 500 TR USD index is depicted to have a negative and statistically significant at 10% level alpha coefficient. Thus, it can be stated that the ETF is not capable of generating superior returns compared to its underlying benchmark although its main purpose is to outperform.

All the rest funds not discussed already generate mixed results in terms of negative or positive values although the majority of them have positive values. The number of those funds denoting positive values is 34 while those denoting negative values amount to 19. From the 34 funds generating positive but not statistically significant alphas 11 of them are active ETFs (FAAR, GTO, JMBS, DINT, AIVI, EYLD, FLLV, SURE, TMFS, PSC, OSCV), 3 are passive ETFs (EFA, EFV, SPTM), 10 are active mutual funds (PCRRX, ACPSX, FCPAX, PPYAX, DEMAX, PKAAX, OPOCX, FXPEX, PMJPX, DFMAX) and 10 are passive mutual funds (BICSX, OPIGX, BRAMX, BISIX, VGPMX, MAIIX, FIVMX, GTDDX, PSGIX, VRTVX). On the other hand, 5 active ETFs (RAVI, GVAL, HDMV, ENTR, HUSV), 5 passive ETFs (DJP, AGG, MBB, ACWI, EEM), 6 active mutual funds (MWCIX, OPGIX, DEQRX, VAFAX, CHTRX, CVAIX) and 3 passive mutual funds (GIYAX, MALRX, IOLZX) depict negative and not statistically significant Jensen's alphas.

Beta coefficients in terms of signs indicate whether or not the funds' excess returns above the risk-free rate follow the same direction as the excess returns of the benchmarks above the risk-free rate. Taking a look at the results, it can be observed that all funds except three of them (RAVI, MWCIX, GIYAX) illustrate positive and statistically significant (at 1% confidence level) beta coefficients, and their values range from 1.274 to 0.678. More specifically, 21 funds display statistically significant and positive beta coefficients with values greater than one. Those funds include 5 active ETFs (GTO, DINT, ENTR, PSC, RFFC), 5 passive ETFs (DJP, AGG, ACWX, ACWI, SPTM), 9 active mutual funds (PCRRX, ACPSX, FOMCX, OPGIX, DEMAX, PKAAX, FCPEX, PMJPX, CVAIX) and 2 passive mutual funds (OPIGX, IOLZX) and it can be stated that all of them generated returns during the research period that were more volatile than that of the benchmarks. In addition, 33 funds depict positive and statistically significant beta coefficients with values less than 1 and they are consisted of 10 active ETFs (FAAR, JMBS, GVAL, HDMV, AIVI, EYLD,

FLLV, SURE, TMFS, HUSV), 6 passive ETFs (MBB, BIL, EFA, EFV, EEM, IWN), 7 active mutual funds (FCPAX, DEQRX, PPYAX, VAFAX, CHTRX, OPOCX, DFMAX) and 10 passive mutual funds (BICSX, BRAMX, BISIX, VGPMX, MAIIX, GTDDX, CMVIX, MALRX, PSGIX, MDSKX). Thus, fluctuations regarding benchmarks' returns result in similar fluctuations in the fund's returns but in a less severe way. Lastly, only 6 passive ETFs (IWF, IWB, IWD, IWO, IWM, IVV) and 4 passive mutual funds (FIVMX, VRVIX, VRTVX, VFIAX) generate beta coefficients with a value of one, indicating the fact that they comove with their underlying benchmarks with the same intensity.

To summarize all the already mentioned results we can conclude there is no type of fund generating positive and statistically significant alpha coefficient. From the 17 active ETFs investigated there is one (RRFFC) that depicts a statistically significant but negative Jensen's alpha indicating that it failed to outperform its benchmark, 5 active ETFs (RAVI, GVAL, HDMV, ENTR, HUSV) illustrate negative Jensen's alphas with no statistical significance and 11 from the sample examined (FAAR, GTO, JMBS, DINT, AIVI, EYLD, FLLV, SURE, TMFS, PSC, OSCV) generated positive Jensen's alphas but we cannot take them into account since there is no statistical significance. As regards the passive ETFs, 8 of them (BIL, IWF, IWB, IWD, IWO, WIWM, IWN, IVV) illustrate negative and statistically significant alpha coefficients, five of them (DJP, AGG, MBB, ACWI, EEM) display negative values but not statistically significant and another 3 (EFA, EFV, SPTM) denote positive values but once again not statistically significant. When evaluating the performance of active mutual funds only one of them, the FOMCX presents a statistically significant and negative value while the majority of the rest of them depict positive but not statistically significant results in terms of alpha coefficients (6 of them depict negative values while 10 of them depict positive ones). Lastly, four passive mutual funds (CRCIX, MDSKX, VFIAX,

CMVIX) can be taken into account since they are the only ones to illustrate negative and significant values and similar to the active mutual funds, the majority of the remaining display positive yet not statistically significant results (10 of them illustrate positive alphas while the other 3 of them illustrate negative alphas).

4.3 Performance Rating Results

Table 4 Performance Rating Results

Table 4 depicts the Total Return, Sharpe ratio, Treynor ratio, and Jensen's alpha considering all active ETFs, passive ETFs, active mutual funds, passive mutual funds, and benchmarks under examination.

Group No	Type of Fund	Ticker	Total Return	Sharpe ratio	Treynor ratio	Jensen's alpha
	Active ETF	FAAR	30.15%	6.75%	0.23%	0.0002683
	Passive ETF	DJP	51.09%	6.52%	0.15%	-0.0000504
1	Active MF	PCRRX	54.74%	6.83%	0.16%	0.0000771
	Passive MF	BICSX	58.30%	7.64%	0.20%	0.0004337
	Benchmark	Bloomberg Commodity TR USD	47.47%	6.71%	N/A	0
	Active ETF	GTO	6.95%	-0.21%	0.00%	0.0002322
	Passive ETF	AGG	1.64%	-3.24%	-0.02%	-0.00000403
2	Active MF	ACPSX	5.06%	-1.06%	-0.01%	0.0001562
	Passive MF	OPIGX	2.50%	-2.55%	-0.02%	0.0000414
	Benchmark	Bloomberg US Agg Bond TR USD	1.78%	-3.20%	N/A	0
	Active ETF	JMBS	2.07%	-3.51%	-0.02%	0.0001563
	Passive ETF	MBB	-2.27%	-6.21%	-0.04%	-0.00000812
3	Active MF	FOMCX	-7.11%	-9.03%	-0.06%	-0.0002067
	Passive MF	BRAMX	0.09%	-4.69%	-0.03%	0.0000859
	Benchmark	Bloomberg US MBS TR USD	-2.11%	-6.14%	N/A	0
	Active ETF	RAVI	8.69%	0.67%	0.00%	-0.0000202
	Passive ETF	BIL	6.48%	-55.02%	-0.01%	-0.0000313
4	Active MF	MWCIX	7.22%	-0.36%	0.00%	-0.000102
	Passive MF	GIYAX	7.00%	-2.93%	0.01%	-0.0000746
	Benchmark	Bloomberg US Treasury Bill 1-3 M TR USD	7.19%	-35.07%	N/A	0
	Active ETF	DINT	37.43%	4.70%	0.14%	0.0000827
5	Passive ETF	ACWX	36.52%	5.01%	0.13%	-0.0000111
	Active MF	FCPAX	57.15%	6.77%	0.20%	0.0006717
	Passive MF	BISIX	54.22%	7.47%	0.21%	0.0006672

	Benchmark	MSCI ACWI Ex USA NR USD	37.23%	5.14%	N/A	0
	Active ETF	GVAL	17.24%	2.65%	0.09%	-0.0012124
	Passive ETF	ACWI	66.55%	8.10%	0.21%	-0.0000101
6	Active MF	OPGIX	23.61%	3.34%	0.10%	-0.0014917
	Passive MF	VGPMX	93.14%	9.81%	0.30%	0.0007784
	Benchmark	MSCI ACWI NR USD	66.24%	8.15%	N/A	0
	Active ETF	HDMV	6.79%	0.71%	0.02%	-0.0009031
	Passive ETF	EFA	42.99%	5.59%	1.56%	0.000022
7	Active MF	DEQRX	30.54%	4.41%	0.13%	-0.0001819
	Passive MF	MAIIX	42.22%	5.54%	0.16%	0.0000344
	Benchmark	MSCI EAFE NR USD	42.75%	5.61%	N/A	0
	Active ETF	AIVI	30.79%	4.31%	0.13%	0.00000515
	Passive ETF	EFV	32.89%	4.38%	0.13%	0.0000104
8	Active MF	PPYAX	33.15%	4.43%	0.14%	0.0000544
	Passive MF	FIVMX	41.83%	5.21%	0.16%	0.0002993
	Benchmark	MSCI EAFE Value NR USD	32.99%	4.41%	N/A	0
	Active ETF	EYLD	40.91%	5.43%	0.16%	0.0007354
	Passive ETF	EEM	17.98%	2.68%	0.07%	-0.00009
9	Active MF	DEMAX	21.37%	3.09%	0.09%	0.0000538
	Passive MF	GTDDX	28.09%	4.00%	0.12%	0.0003079
	Benchmark	MSCI EM NR USD	21.22%	3.11%	N/A	0
	Active ETF	ENTR	47.63%	5.23%	0.18%	-0.0019738
	Passive ETF	IWF	123.76%	11.31%	0.35%	-0.0000364
10	Active MF	VAFAX	94.38%	9.38%	0.30%	-0.0005634
	Passive MF	CMVIX	105.00%	10.15%	0.32%	-0.0003915
	Benchmark	Russell 1000 Growth TR USD	125.73%	11.43%	N/A	0
	Active ETF	FLLV	82.30%	9.65%	0.29%	0.0000104
	Passive ETF	IWB	92.55%	9.82%	0.28%	-0.0000265
11	Active MF	CHTRX	74.20%	8.55%	0.25%	-0.000352
	Passive MF	MALRX	86.86%	9.39%	0.27%	-0.0001417
	Benchmark	Russell 1000 TR USD	93.77%	9.91%	N/A	0
	Active ETF	SURE	73.22%	8.21%	0.25%	0.0003869
	Passive ETF	IWD	59.98%	7.04%	0.21%	-0.0000314
12	Active MF	PKAAX	67.72%	7.55%	0.23%	0.0001846
	Passive MF	VRVIX	60.78%	7.11%	0.21%	-0.0000103
	Benchmark	Russell 1000 Value TR USD	61.18%	7.14%	N/A	0

	Active ETF	TMFS	74.28%	7.18%	0.29%	0.0007226
	Passive ETF	IWO	50.67%	5.52%	0.21%	-0.0000107
13	Active MF	OPOCX	86.18%	7.86%	0.32%	0.0009997
	Passive MF	PSGIX	56.28%	5.93%	0.23%	0.0001529
	Benchmark	Russell 2000 Growth TR USD	51.06%	5.55%	N/A	0
	Active ETF	PSC	66.18%	6.56%	0.25%	0.0004031
	Passive ETF	IWM	51.72%	5.64%	0.21%	-0.0000188
14	Active MF	FCPEX	62.70%	6.40%	0.24%	0.0002816
	Passive MF	MDSKX	50.69%	5.57%	0.21%	-0.000047
	Benchmark	Russell 2000 TR USD	52.41%	5.69%	N/A	0
	Active ETF	OSCV	59.39%	6.57%	0.27%	0.0004716
	Passive ETF	IWN	47.57%	5.27%	0.21%	-0.0000374
15	Active MF	PMJPX	85.12%	7.47%	0.30%	0.0009422
	Passive MF	VRTVX	49.20%	5.39%	0.21%	0.00000851
	Benchmark	Russell 2000 Value TR USD	48.91%	5.37%	N/A	0
	Active ETF	RFFC	61.76%	7.16%	0.21%	-0.0007861
	Passive ETF	SPTM	94.19%	10.01%	0.29%	0.0000198
16	Active MF	DFMAX	93.38%	10.35%	0.30%	0.000148
	Passive MF	IOLZX	75.82%	7.62%	0.23%	-0.0005643
	Benchmark	S&P 1500 TR	93.20%	9.94%	N/A	0
	Active ETF	HUSV	59.20%	7.73%	0.24%	-0.0003642
	Passive ETF	IVV	95.39%	10.21%	0.29%	-0.00000566
17	Active MF	CVAIX	78.54%	8.72%	0.25%	-0.0004103
	Passive MF	VFIAX	95.35%	10.21%	0.29%	-0.00000672
	Benchmark	S&P 500 TR USD	95.65%	10.23%	N/A	0

Note: All of the funds and benchmarks under examination are consisted of the same number of total observations over the study period amounting to 238.

To evaluate our first 3 hypotheses a comparison between the funds will be made in terms of total return, Sharpe ratio, and Treynor ratio all over the estimated period.

Starting from the first hypothesis tested it can be accepted considering only 5 out of the 17 groups of funds. More precisely, H1 can be accepted regarding the groups with numbers 6,8,10,16, and 17, it is not accepted considering groups number 2,3,4,9,12,13,14, and 15 and we cannot arrive at a certain argument since mixed results are depicted in terms of groups number 1,5,7 and 11.

Generally speaking for the majority of groups tested, the H1 hypothesis is not accepted although it can be for only a few of them.

Moving forward, and after taking a look at the Table 4 results evaluating the H2 hypothesis stating that active mutual funds underperform the passive mutual funds tracking the same benchmark, no certain argument can be made. As regards the 17 groups tested, H2 can be accepted for 9 of them (group number: 1,3,6,7,8,9,10,11,17) and it cannot for 6 out of them (group number: 2,12,13,14,15,16). The rest of the groups examined (group numbers: 4 and 5) provide mixed values contradicting each other so no conclusion can be made with certainty.

Lastly, taking into consideration the third hypothesis tested, most of the groups but not all of them denote the same patterns. Groups 1,2,3,4,5,6,8,9,12,13, and 15 are the ones for which H3 cannot be accepted although it can regarding groups 10,11,14,16 and 17. The only group that provides mixed results is that of number 7 so no final argument can be made.

4.4 Tracking Ability Results

Table 5 Tracking Error Results

Table 5 depicts the results considering the tracking ability of all funds under examination relative to their benchmarks. Three measures of tracking error have been used along with their average.

Group No	Type of Fund	Ticker	TE1	TE2	TE3	TE average
	Active ETF	FAAR	0.9120%	1.2878%	1.7263%	1.3087%
	Passive ETF	DJP	0.0824%	0.2767%	0.3715%	0.2435%
1	Active MF	PCRRX	0.5973%	0.4080%	0.6906%	0.5653%
	Passive MF	BICSX	1.1923%	0.8214%	1.1972%	1.0703%
	Benchmark	Bloomberg Commodity TR USD				
	Active ETF	GTO	0.3812%	0.2018%	0.3827%	0.3219%
	Passive ETF	AGG	0.0662%	0.0201%	0.0662%	0.0508%
2	Active MF	ACPSX	0.4092%	0.2187%	0.4099%	0.3459%
	Passive MF	OPIGX	0.2259%	0.1252%	0.2267%	0.1926%
	Benchmark	Bloomberg US Agg Bond TR USD				

	Active ETF	JMBS	0.1883%	0.1065%	0.1906%	0.1618%
	Passive ETF	MBB	0.0786%	0.0379%	0.0785%	0.0650%
3	Active MF	FOMCX	0.1204%	0.0732%	0.1216%	0.1051%
	Passive MF	BRAMX	0.1517%	0.0891%	0.1519%	0.1309%
	Benchmark	Bloomberg US MBS TR USD				
	Active ETF	RAVI	0.1909%	0.0673%	0.1919%	0.1500%
	Passive ETF	BIL	0.0055%	0.0043%	0.0055%	0.0051%
4	Active MF	MWCIX	0.6609%	0.3277%	0.6605%	0.5497%
	Passive MF	GIYAX	0.1824%	0.0847%	0.1830%	0.1500%
	Benchmark	Bloomberg US Treasury Bill 1-3 M TR USD				
	Active ETF	DINT	1.6266%	1.2221%	1.6362%	1.4949%
	Passive ETF	ACWX	0.4951%	0.2776%	0.4941%	0.4222%
5	Active MF	FCPAX	1.4347%	1.0380%	1.4318%	1.3015%
	Passive MF	BISIX	1.0171%	0.8531%	1.1136%	0.9946%
	Benchmark	MSCI ACWI Ex USA NR USD				
	Active ETF	GVAL	1.8784%	1.3427%	1.8789%	1.7000%
	Passive ETF	ACWI	0.1938%	0.1136%	0.1966%	0.1680%
6	Active MF	OPGIX	1.6268%	1.3604%	1.7768%	1.5880%
	Passive MF	VGPMX	1.4109%	1.0535%	1.4103%	1.2916%
	Benchmark	MSCI ACWI NR USD				
	Active ETF	HDMV	0.7317%	0.8717%	1.1479%	0.9171%
	Passive ETF	EFA	0.5209%	0.2809%	0.5390%	0.4469%
7	Active MF	DEQRX	0.9784%	0.8423%	1.0939%	0.9716%
	Passive MF	MAIIX	0.7236%	0.4745%	0.7415%	0.6465%
	Benchmark	MSCI EAFE NR USD				
	Active ETF	AIVI	0.6098%	0.5210%	0.7057%	0.6122%
	Passive ETF	EFV	0.4901%	0.2697%	0.4892%	0.4164%
8	Active MF	PPYAX	0.7934%	0.5738%	0.8079%	0.7250%
	Passive MF	FIVMX	0.8331%	0.5855%	0.8314%	0.7500%
	Benchmark	MSCI EAFE Value NR USD				
	Active ETF	EYLD	1.2929%	0.9814%	1.3062%	1.1935%
	Passive ETF	EEM	0.6572%	0.3463%	0.6578%	0.5538%
9	Active MF	DEMAX	1.0544%	0.8027%	1.0694%	0.9755%
	Passive MF	GTDDX	1.0981%	0.8109%	1.1179%	1.0090%
	Benchmark	MSCI EM NR USD				
10	Active ETF	ENTR	1.8782%	1.3286%	1.9264%	1.7111%
	Passive ETF	IWF	0.0032%	0.0041%	0.0033%	0.0035%

	Active MF	VAFAX	0.6765%	0.5109%	0.6772%	0.6216%
	Passive MF	CMVIX	0.2165%	0.1675%	0.2165%	0.2001%
	Benchmark	Russell 1000 Growth TR USD				
	Active ETF	FLLV	0.6469%	0.5722%	0.7306%	0.6499%
	Passive ETF	IWB	0.0027%	0.0031%	0.0027%	0.0029%
11	Active MF	CHTRX	0.4072%	0.3225%	0.4245%	0.3847%
	Passive MF	MALRX	0.2279%	0.1756%	0.2278%	0.2104%
	Benchmark	Russell 1000 TR USD				
	Active ETF	SURE	0.7711%	0.5547%	0.7799%	0.7019%
	Passive ETF	IWD	0.0039%	0.0041%	0.0039%	0.0040%
12	Active MF	PKAAX	0.7076%	0.5082%	0.7063%	0.6407%
	Passive MF	VRVIX	0.0043%	0.0028%	0.0043%	0.0038%
	Benchmark	Russell 1000 Value TR USD				
	Active ETF	TMFS	1.2064%	0.9657%	1.2393%	1.1371%
	Passive ETF	IWO	0.0060%	0.0042%	0.0060%	0.0054%
13	Active MF	OPOCX	1.2455%	0.9325%	1.2670%	1.1483%
	Passive MF	PSGIX	0.3076%	0.2270%	0.3079%	0.2808%
	Benchmark	Russell 2000 Growth TR USD				
	Active ETF	PSC	0.9220%	0.6376%	0.9201%	0.8266%
	Passive ETF	IWM	0.0069%	0.0047%	0.0069%	0.0062%
14	Active MF	FCPEX	0.3770%	0.2932%	0.3763%	0.3489%
	Passive MF	MDSKX	0.0203%	0.0167%	0.0206%	0.0192%
	Benchmark	Russell 2000 TR USD				
	Active ETF	OSCV	0.9422%	0.8947%	1.1983%	1.0118%
	Passive ETF	IWN	0.0111%	0.0078%	0.0114%	0.0101%
15	Active MF	PMJPX	0.9474%	0.6826%	0.9580%	0.8627%
	Passive MF	VRTVX	0.0090%	0.0055%	0.0091%	0.0079%
	Benchmark	Russell 2000 Value TR USD				
	Active ETF	RFFC	0.4971%	0.3830%	0.5013%	0.4604%
	Passive ETF	SPTM	0.0415%	0.0188%	0.0414%	0.0339%
16	Active MF	DFMAX	0.4583%	0.3735%	0.4946%	0.4422%
	Passive MF	IOLZX	1.2742%	0.9924%	1.3218%	1.1961%
	Benchmark	S&P 1500 TR				
	Active ETF	HUSV	1.1059%	0.9566%	1.2417%	1.1014%
	Passive ETF	IVV	0.0022%	0.0012%	0.0022%	0.0019%
17	Active MF	CVAIX	0.3962%	0.2960%	0.3978%	0.3633%
	Passive MF	VFIAX	0.0033%	0.0019%	0.0034%	0.0029%

Benchmark	S&P 500 TR USD

Note: All of the funds and benchmarks under examination are consisted of the same number of total observations over the study period amounting to 238.

The above illustrated Table 5 provides the results considering the tracking error measures used to check whether or not passive ETFs present a better tracking ability than their corresponding passive mutual funds tracking the same benchmark. Out of the 17 groups formed and examined, only two of them, groups number 12 and 15 provide values that force not to accept the H4 hypothesis. On the other hand, 15 out of 17 groups provide evidence that passive ETFs are a better investment vehicle compared to passive mutual funds in terms of tracking ability and thus they should be selected by those investors who want to create identical portfolios to the benchmarks. Thus, for those groups (1,2,3,4,5,6,7,8,9,10,11,13,14,16,17)) we have to accept the H4 hypothesis. However, there are some discrepancies worth to be discussed. As regards groups number 1, 3,8,9, and 16 it can be observed that the active ETFs track the underlying indices better than the passive mutual funds. A possible explanation of such anomalies can be that the managers of the active mutual funds have a better understanding of how to construct portfolios similar to the index or that passive mutual funds in order to avoid realizing negative returns during the Covid period rebalanced their portfolios in such a way that they lost their efficiency in terms of tracking ability. The only certain fact is that such passive mutual funds should be avoided by investors and asset managers desiring to follow the benchmark.

4.5 Market Timing Ability Regression Results

Table 6 Market Timing Ability Regression Results

The following table illustrates the results in terms of the regression considering the market timing ability of the managers of active funds. As already explained, the excess weekly return of each fund over the risk-free rate is the dependent variable and the independent variables are constituted by the weekly excess return of the benchmark over the risk–free rate as well as by the square of it. R_i illustrates the weekly return of each fund, R_f is the weekly risk-free rate and R_m depicts the benchmark's weekly return. The examined period considered is between 6/1/2019 and

29/7/2023. The table depicts the alpha coefficient, the P–Value, and the beta coefficient, which illustrates the systematic risk faced by each fund, the gamma coefficient, depicting the managers' market timing abilities, and the explanatory power of our regression model considering each fund by R^2.

Type of Fund	Ticker	α	P-value	β	P - value	γ	P - value	R^2
Active ETF	FAAR	-0.000885	0.145	0.348***	0.000	2.194***	0.000	0.5251
Active MF	PCRRX	0.000918*	0.020	1.166***	0.000	-1.599***	0.000	0.9587
Benchmark	Bloomberg Commodity TR USD							
Active ETF	GTO	0.000860**	0.001	1.019***	0.000	-11.60***	0.000	0.8303
Active MF	ACPSX	0.000850**	0.003	1.008***	0.000	-12.81***	0.000	0.8094
Benchmark	Bloomberg US Agg Bond TR USD							
Active ETF	JMBS	0.000262	0.051	0.952***	0.000	-2.418	0.061	0.9199
Active MF	FOMCX	-0.000179*	0.040	1.027***	0.000	-0.640	0.440	0.9699
Benchmark	Bloomberg US MBS TR USD							
Active ETF	RAVI	-0.0000276	0.839	-0.679	0.463	405.2	0.820	0.0026
Active MF	MWCIX	-0.000189	0.687	-1.447	0.651	4740.8	0.442	0.0037
Benchmark	Bloomberg US Treasury Bill 1-3 M TR USD							
Active ETF	DINT	-0.00115	0.292	1.121***	0.000	1.762***	0.001	0.7603
Active MF	FCPAX	-0.000367	0.704	1.028***	0.000	1.480**	0.001	0.7741
Benchmark	MSCI ACWI Ex USA NR USD							
Active ETF	GVAL	-0.0000460	0.972	0.932***	0.000	-1.617*	0.014	0.6502
Active MF	OPGIX	-0.00247*	0.029	1.290***	0.000	1.361*	0.017	0.8149
Benchmark	MSCI ACWI NR USD							
Active ETF	HDMV	-0.000352	0.470	0.660***	0.000	-0.695***	0.000	0.8741
Active MF	DEQRX	-0.000291	0.663	0.827***	0.000	0.138	0.593	0.8433
Benchmark	MSCI EAFE NR USD							
Active ETF	AIVI	0.000359	0.379	0.868***	0.000	-0.380**	0.003	0.9509
Active MF	PPYAX	-0.000496	0.345	0.965***	0.000	0.592***	0.000	0.9309
Benchmark	MSCI EAFE Value NR USD							
Active ETF	EYLD	0.00279**	0.002	0.880***	0.000	-2.965***	0.000	0.7988
Active MF	DEMAX	-0.0000785	0.919	1.076***	0.000	0.191	0.708	0.8768
Benchmark	MSCI EM NR USD							
Active ETF	ENTR	-0.00332*	0.014	1.144***	0.000	1.349*	0.017	0.7896
Active MF	VAFAX	-0.000756	0.121	0.983***	0.000	0.193	0.345	0.9542
Benchmark	Russell 1000 Growth TR USD							

Active ETF	FLLV	0.000281	0.532	0.878***	0.000	-0.312	0.090	0.9404
Active MF	CHTRX	-0.0000524	0.851	0.954***	0.000	-0.345**	0.003	0.9797
Benchmark	Russell 1000 TR USD							
Active ETF	SURE	0.000613	0.247	0.953***	0.000	-0.249	0.184	0.9315
Active MF	PKAAX	0.000236	0.628	1.005***	0.000	-0.0565	0.744	0.9466
Benchmark	Russell 1000 Value TR USD							
Active ETF	TMFS	0.0000938	0.913	0.925***	0.000	0.420	0.071	0.8992
Active MF	OPOCX	0.00107	0.231	0.936***	0.000	-0.0441	0.855	0.8944
Benchmark	Russell 2000 Growth TR USD							
Active ETF	PSC	0.000375	0.561	1.004***	0.000	0.0197	0.904	0.9443
Active MF	FCPEX	0.000410	0.120	1.002***	0.000	-0.0895	0.181	0.9903
Benchmark	Russell 2000 TR USD							
Active ETF	OSCV	0.00144*	0.023	0.809***	0.000	-0.622***	0.000	0.9265
Active MF	PMJPX	0.00117	0.074	1.039***	0.000	-0.150	0.300	0.9495
Benchmark	Russell 2000 Value TR USD							
Active ETF	RFFC	-0.000803*	0.021	1.025***	0.000	0.0199	0.890	0.9722
Active MF	DFMAX	0.0000479	0.881	0.935***	0.000	0.117	0.375	0.9716
Benchmark	S&P 1500 TR							
Active ETF	HUSV	0.000896	0.226	0.782***	0.000	-1.517***	0.000	0.8233
Active MF	CVAIX	-0.000485	0.081	1.016***	0.000	0.0897	0.451	0.9813
Benchmark	S&P 500 TR USD							

Note: All of the funds and benchmarks under examination are consisted of the same number of total observations over the study period amounting to 238.

***Statistically significant at a 1% confidence level, ** Statistically significant at a 5% confidence level, *Statistically significant at a 10% confidence level

Table 6 presents the results considering the examination of active ETFs' and mutual funds' managers' market timing abilities. It can be easily observed from the table that the gamma coefficients depict different values in terms of both signs and statistical significance and thus mixed arguments can be made.

At a 1% confidence level, two active ETFs (FAAR and DINT) along with one active mutual fund (PPYAX) depict positive and statistically significant gamma coefficients and thus it seems that their managers possess market timing skills. On the other hand, the gamma coefficients considering five active ETFs (GTO, HDMV, EYLD, OSCV, and HUSV) and two active mutual funds (PCRRX and ACPSX) illustrate negative and significant values, a fact that indicates that the corresponding managers destroy value by trying to time the market.

At a 5% confidence level, one active mutual fund (FCPAX) depicts a positive gamma coefficient, while the AIVI active ETF and AHTRX active mutual fund display negative values. Moreover, one active ETF (ENTR) and one active mutual fund (OPGIX) illustrate positive gamma coefficients at a 10% level contrary to the GVAL active ETF, which denotes a negative value in terms of gamma coefficient.

The rest of the active funds examined provide mixed results relative to signs but neither of them is statically significant and thus we cannot take them into account. To wrap up the abovementioned results, it seems like the H5 hypothesis can be accepted regarding 10 funds (7 active ETFs and 3 active mutual funds), while it cannot relative to 3 active ETFs and 3 active mutual funds. For the rest of the sample, no clear argument can be made.

4.6 Patterns

After carefully examining the results of all tables, several patterns concerning the groups formulated have been derived. More precisely, when examining the groups of U.S. fixed income (group 2,3,4) it can be stated that for all over the period, the active ETFs outperformed their passive equivalents indicating the ability of their managers to reallocate funds and make the proper decisions in order to justify the fees they are compensated with. Another pattern identified is that of the outperformance of index mutual funds relative to the passive ETFs along with the fact that

passive ETFs as estimated before the analysis, track the benchmarks at a higher level. Yet, how do such patterns coexist? The explanation that can be given is that the passive ETFs track the benchmark better and since the benchmark provides a Total return and Sharpe ratio less than the index mutual funds is reasonable to obtain the aforementioned results.

Evaluating the group designed to track the Bloomberg Commodity TR USD, it is clear that the active mutual fund selected underperforms compared to the passive one as well as that the last one manages to outperform the passive ETF since, it tracks the benchmark at a better pace. The same line of reasoning as that used for the fixed income groups backs up the findings displayed. Additionally, it seems that only the active mutual fund's manager can time the market without destroying value.

As regards the Global Equity Large Cap category (groups 5 to 8), the only crystal-clear patterns observed is that the passive ETFs constructed to track the benchmarks are capable of doing so greater than the index mutual funds as well as that the managers of the active mutual funds destroy value when they try to time the market.

Concluding, I would like to discuss the patterns that can be observed following the U.S. Equity Small Cap category represented by group 13 to 15. H1 and H2 are not accepted, consequently leading to the statements that active funds outperformed through the examined period their passive antagonists.

5. Conclusion

5.1 Summary

All in all, asset management practitioners and researchers from all over the globe have tried to identify patterns concerning both ETFs and mutual funds. The last decades such investment vehicles have become major in terms of capitalization, attracting fund flows from both institutional and individual investors, and it has to be mentioned their critical role with respect to portfolio diversification over the long term. Moreover, Central Banks of the western world have directed a significant part of their own liquidity towards such investment tools, with their goal estimated to be the protection of their economies especially during the Covid Crisis period. Thus, and based on the fact that such products attract attention in a major way, this thesis goal is to identify which one of the two vehicles is better regarding risk adjusted performance and tracking ability. Furthermore, taking into consideration the management style of ETFs and mutual funds, this thesis tries to provide evidence about the market timing ability of the managers in order to give a clearer picture relative to whether or not market timing destroys value. Consequently, and as far as I know this is the first study trying to compare all the management types of ETFs and open-end mutual funds, filling the scientific gap and providing future researchers with insights that might help them investigate such matters in more depth. In addition, several measures considering all the abovementioned aspects have been used along with 3 different types of benchmarks (equity, fixed income and commodity), as examining a variety of them could provide a more solid ground and not a study that is not capable of producing reliable results.

In general, plenty of arguments can be made as mixed results have been derived. Starting from examining each fund in terms of outperforming the corresponding indices, there is no evidence of statistical significance that they do outperform. On the contrary, all statistically significant values

indicate that the funds under examination failed to outperform their benchmarks and so in the case of both active ETFs and mutual funds, the management fees cannot be justified. Moving forward, this thesis tried to evaluate the performance of each fund by comparing the actively managed with the passively managed of the same type. Out of the 17 groups constructed and examined, only 5 are perfectly in line with prior literature when examining and comparing active and passive ETFs. However, the picture changes regarding the comparison between active and passive mutual funds since the majority of them depicts findings similar to that of past studies. Opposite to that, this thesis's results contradict prior literature as the index mutual funds used in most cases (11 out of 17) manage to outperform the passive ETFs. Yet, when evaluating the H4 hypothesis, for the larger part of the groups tested (15 out of 17) it can be claimed that passive ETFs are better trackers than index mutual funds. Lastly, taking into consideration the market timing abilities of managers mixed results are obtained although the greater part of the findings is in line with prior research.

5.2 Limitations & Further Research Suggestions

This Master Thesis tried to contribute to the already existed literature by being the first to directly compare ETFs and mutual funds regarding risk adjusted–performance, tracking, and market timing ability. However, it can be stated that as all past research has some limitations the same applies to this particular thesis. Starting from the range period, it includes 4 years of weekly data during the Covid Crisis. Moreover, it does not take into account the management fees and as a result it provides findings pre costs. Another drawback is that it includes only three types of global categories namely, fixed income, equity and commodity.

Future researchers could address the abovementioned limitations in several ways. First, they can include a longer time period to compare ETFs and mutual funds. Second, they can take into account management fees in order to check whether or not the after-cost results are in line or not with prior

literature, providing a clearer view. Additionally, more categories of funds can me studied including real estate funds, leveraged funds or even synthetic ones.

Further research in this field could take into account and compare ETFs and mutual funds during different market crisis periods. Such research could be conducted by investigating the impact of the 2008 financial crisis relative to the Covid crisis. Moreover, researchers could examine whether or not the same factors influence the tracking ability of both ETFs and mutual funds as well as how the low trading activity during the Covid Crisis period impacted the manager's decision to time the market correspondingly creating or destroying value relative to both types of funds.

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