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Exchange Traded Funds: Investors' Elasticity of Demand

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Abstract

This thesis studies the effect of lowering expense ratios of U.S. Exchange Traded Funds on subsequent net flow and fund market share. Using a large dataset of quarterly observations, I find investors in U.S. ETFs are fee-sensitive. First, I confirm an intuitive negative relation between size and expense ratios. Second, I find average quarterly net flow to be higher for ETFs decreasing its expense ratio in $t + 2$, $t + 3$ and $t + 4$. Third, in a cross-sectional time-series regression with fund and time fixed effects, a change in expense ratio is positively related to subsequent net flow and fund market share. Remarkably, this implies an increase in expense ratio is associated with higher relative flows. I cast doubt on interpreting this coefficient due to large time invariation. Fourth, following from a probit regression, I find manager market share, fund age and past performance, in particular, to have a significant positive effect on the probability of decreasing fees. Making use of these variables, a treatment-effects estimator provides evidence net flow and fund market share are higher, under certain circumstances, for treated observations relative to untreated ones. In short, this thesis provides mixed evidence on the effect of lowering expense ratios on subsequent flows and market share.

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Chapter 1

Introduction

The past decades in the financial industry can be partly characterized as a shift from active to passive investment strategies (Anadu, Kruttli, McCabe, Osambela, & Shin, 2018; Sushko & Turner, 2018). Albeit Exchange Traded Funds (ETFs) only account for around half of all passive investment vehicles, its growth trajectory has been exemplary for this shift. In 2000, ETFs made up just 1.2% of the entire U.S. investment landscape. In 2017, almost two decades later, its market share has grown to 16.3%[1]. The cause of this shift is often, by financial economists, attributed to negative after-fee risk-adjusted returns of actively managed mutual funds (MFs) due to high management fees (Carhart, 1997; Fama & French, 2010; French, 2008; Gruber, 1996; Malkiel, 2003). Ennis (2005) too identified this trend concluding fees of actively managed mutual funds were implausibly high. Malkiel (2013) regarded an increase of fees as a plain deadweight loss to investors. In addition, Ferri (2010) found actively managed funds with lower fees to outperform the average active fund and Gil-Bazo and Ruiz-Verdú (2009) found mutual funds yielding worse before-fee performance to charge higher fees. All this makes it seem sensible for investors to eschew funds with high expense ratios, presumably putting downward pressure on investment management fees. Thus for good reason, Bogle (1992), the founder of Vanguard and inventor of index funds, mentioned, a few months before the inception of the first and still most popular American ETF (Ticker: 'SPY'), investors simply cannot disregard the heavy burden of costs of actively managed funds.

In short, costs associated with investing have gained more scrutiny over the years. Not only costs, however, but drivers of portfolio returns as well. In that context, Brinson, Hood, and Beebower (1995) found the bulk of portfolio returns can be attributed to asset allocation and static factor tilts.

[1] These percentages are based on own analysis. Figure 1 on page 53 presents the relative growth of Exchange Traded Funds.

Security selection and market timing are thought to be of less importance, downplaying the business case of actively managed mutual funds. Hence, unsurprisingly, asset managers market ETFs as a low-cost and well diversified alternative to said funds.

Exchange traded funds, almost by definition, do not seek to outperform the market[2]. Therefore, provided an ETF enjoys a comfortable level of liquidity and tracks the underlying index reasonably well, it is likely to suspect the key differentiator between ETFs is the total cost of ownership. Accordingly, I expect ETF providers to challenge each other on price, battling for market share. Research on this within the mutual fund industry, found no relation between operating expenses and fund flows (Barber, Odean, & Zheng, 2005). In fact, the authors documented funds with higher expense ratios did not lose market share. To the best of my knowledge, I am not aware of any such research in the ETF industry. For this reason, this thesis focuses on the effect of decreasing expense ratios on subsequent net flow and market share of U.S. ETFs. I use a large data set of 44199 quarterly observations of all U.S. exchange traded funds, from 1998 until 2017.

First, performing a two-sample t-test using a Welch approximation, due to unequal variances and sample sizes, I test whether increases in net flow are higher, relative to periods without change, after an ETF witnessed a decrease in expense ratio. I find net flow to be economically and statistically significantly higher in $t+2$, $t+3$ and $t+4$. Likewise, I find the difference between average net flow after decreases and increases in expense ratios to be significantly larger than zero for the same periods.

Second, using a cross-sectional time-series regression, I estimate the effect of expense ratios on fund size, fund market share and net flow. Conform consensus in academic literature, I find expense ratio is significantly negatively associated with fund size. Counterintuitively, I document a significant positive effect of changes in expense ratio on subsequent net flow and market share. Remarkably, this finding suggests an increase or smaller decrease in expense ratio is associated with an increase in assets and market share, although I am cautious in interpreting these coefficients because of large time invariation.

Third, focusing on the explanatory power of variables influencing the probability of lowering expense ratios, I perform cross-sectional time-series probit regressions. These regressions help provide the variables needed to correct for potential endogeneity in the treatment-effects estimators. Most notably, manager market share, fund age and prior net flow continuously

[2] A small minority of relatively new factor-based ETFs do pursue active investment strategies by leveraging β.

show a significant positive relation to the probability of receiving a 'treatment'.

Lastly, using an inverse probability weighted regression adjustment treatment -effects estimator (IPWRA), I test whether a decrease in expense ratio, in the form of a binary variable, affects subsequent net flow. Decreases are categorized into four quartiles, dependent on the relative degree of its decrease. I document higher net flow for the overall sample, driven by the two highest quartiles. Smaller decreases in expense ratio are associated with significantly smaller net flow than the untreated sample. As follows, large decreases in expense ratio are associated with significantly higher subsequent net flow.

In short, this thesis provides mixed evidence on the effect of lowering expense ratios on subsequent net flow and fund market share. The cross-sectional time-series regression did not provide any evidence in favor of a positive effect, whilst the two-sample t-tests and treatment-effects estimator do point towards a significant effect of lowering expense ratios.

This thesis proceeds as follows. In chapter 2, I describe the underlying mechanism of ETFs, market developments and its constituents. Chapter 3 puts the thesis in context with previous academic research. Building on existing literature, chapter 5 discusses the hypotheses and documents the chosen methodology. In chapter 4, I describe the data sample and provide its summary statistics. Chapter 6 shows results and chapter 7 on page 44 concludes the thesis. The appendix provides additional detail.

Chapter 2

Institutional Background

This chapter provides background information. The chapter is structured as follows. Section 2.1 elaborates on ETFs as a product, section 2.2 on page 9 considers the total cost of ownership, section 2.3 on page 10 identifies trends in the industry and section 2.4 on page 13 documents the most salient industry constituents.

2.1 Features

First and foremost, exchange traded funds are broadly categorized into physical and synthetic financial products. Fundamentally, they differ in the way they mimic the underlying index. Physical ETFs hold all, or a representable weighted sample of, securities of the underlying index in order to replicate its returns. On the other hand, synthetic ETFs, make use of derivates to create a portfolio which tracks the index. As a result, both differ in drivers of risk for the investors. Basically, synthetic ETFs swap the tracking error risk factor for a counterparty risk factor (Ramaswamy, 2011). In line with this, notwithstanding the fact physical ETFs can also expose themselves to counterparty risk by lending securities, Hurlin, Iseli, Pérignon, and Yeung (2017) find counterparty risk to be higher for swap-based ETFs. The authors also document a negative relation between counterparty risk and net flows, suggesting investors closely monitor their counterparty risk exposure and implying a level of financial sophistication. In this thesis, I do not differentiate between both types. Likewise, investigating their ability to track the underlying index is beyond the scope of this thesis[1].

[1]In short, evidence on the topic is mixed. Naumenko and Chystiakova (2015) find that physical ETFs track the underlying indices more closely than synthetics, whilst Mateus and Rahmani (2014) demonstrate it is not so much the type of ETFs affecting tracking

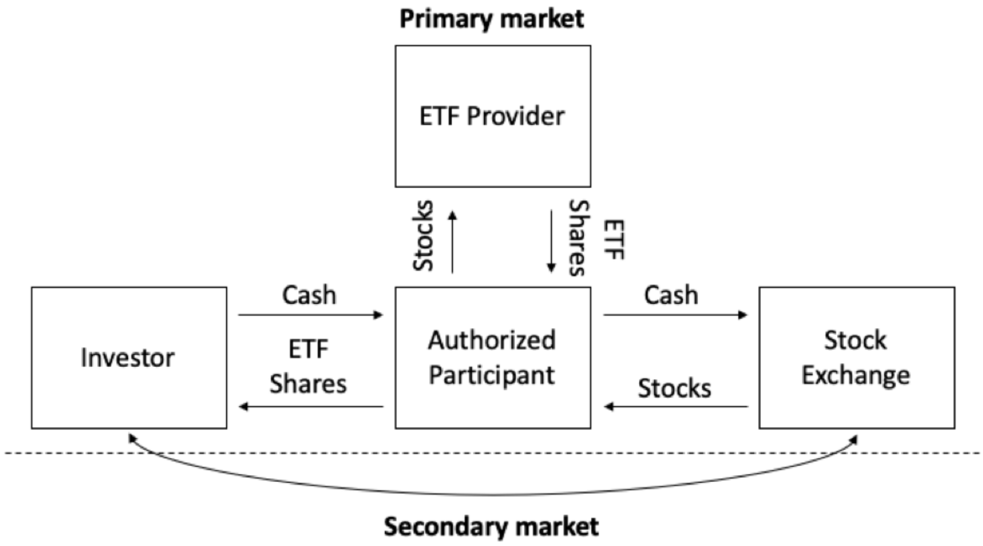


Figure 2.1: The proces of creation and redemption of Exchange Traded Funds happens in-kind.

For the purpose of trading in ETFs there exists a primary and secondary market. In the primary market, ETF shares are created by an authorized participant (AP) who deposits a portfolio of securities with the provider and receives an ETF share in return. These ETF shares are then sold either on the stock exchange or directly to large institutional clients. Figure 2.1 illustrates the process. The secondary market is most widely used amongst investors, totalling up to 90% of trading volume (Antoniewicz & Heinrichs, 2015). Only few are able to directly acquire ETFs in the primary market.

Trading on the stock exchange enables investors to buy and sell shares of ETFs at any given time a day. Therefore, naturally, prices of ETF shares are determined by the market forces of demand and supply. Meanwhile, tracking specific indices, ETF share prices should not deviate much from the net asset value (NAV) of its underlying assets. To that end, enhancing pricing efficiency, the concept of creating and redeeming a basket is critical (Elton, Gruber, Comer, & Li, 2002; Lin, Chan, & Hsu, 2006). Because, in the event an ETF trades above its NAV authorized participants will purchase the underlying associated securities and create new ETFs. Contrarily, if the ETF trades below its NAV APs will purchase ETF shares and sell them for its underlying securities. Engle and Sarkar (2006) have shown, as a result of this arbitrage, (domestic equity) ETFs tend to have smaller and less persistent premiums (discounts) than closed-end mutual funds (CEF). Moreover, Hughen and Mathew (2009) too find that ETF returns are closer to their

performance as the characteristics of the securities composing the index.

portfolio returns than those of CEFs.

There are several benefits distinguishing ETFs from mutual funds or closed-end funds, adding to their popularity. First, in general, ETFs enjoy lower expense ratios, making them a well-diversified low-cost product[2].

Second, ETFs allow intraday trading and so provide liquidity. In fact, Madhavan and Sobczyk (2015) find evidence that ETFs provide more liquidity than the underlying basket of securities[3].

Third, ETFs are tax efficient. In the event equity mutual funds sell appreciated shares, its investors are charged for their realized capital gains at the end of the year. In contrast, as ETFs, almost by default, enjoy lower turnover due to less rebalancing, they too enjoy lower capital gains, if applicable at all. But that is not all. Actually, realized capital gains within the fund tend to be nearly negligible. In case an authorized participant would like to sell a bucket of ETFs, its provider is then able to pay the respective AP in-kind, providing the underlying securities of the ETF, rather than using cash. As this transaction involves no sold securities, no capital gains have arised. In fact, if necessary, providers are able to cherrypick which shares to give the AP, singling out the ones with the lowest possible tax basis (Poterba & Shoven, 2002).

Fourth, ETFs offer greater transparency, as investors are able to daily monitor their fund's portfolio and compare products and the costs involved. This is particularly so for physical ones. Arguably transparency is lower for synthetic ETFs, as it requires a higher level of financial sophisticiation. Lastly, ETFs can provide access to specific markets that are otherwise difficult to attain. Unsurprisingly therefore, ETFs investing in emerging markets equity and bonds are among the most popular. Dathan and Davydenko (2018) support this theory and the desirability of liquidity by showing diminished liquidity in global bond markets sustains demand for bond ETFs.

2.2 Cost of ownership

In the context of this thesis it is important to understand which costs investors occur when investing in ETFs. The most salient costs are known as management fees, expense ratios and transaction costs. Management fees

[2]Expense ratio is defined as total expenses and fees divided by total net assets.

[3]As a result, some economists warn for a liquidity mismatch which may reduce market efficiency and cause stock comovement in the underlying constituents (Ben-David, Franzoni, & Moussawi, 2012; Da & Shive, 2018; Pan & Zeng, 2017; Shim, 2018). This becomes more pronounced by Ben-David, Franzoni, and Moussawi (2018) showing that ETF liquidity shocks increase nonfundamental volatility of stocks with high ETF ownership.

reflect the costs an investor pays for the services of the ETF provider, whilst expense ratios reflect all operating costs (including management fees) paid by investors. This thesis uses expense ratios as main variable of interest. Management fees can be used in robustness checks as they are not perfectly correlated with expense ratios. Transaction costs, including the bid-ask spread, charged by brokerages occur when purchasing or selling ETFs. However, as no ETF perfectly trails the index, implicit costs are disguised as tracking differences between investment funds and its corresponding indices[4].

Less obvious reasons, at least to unsophisticated investors, for funds to have trouble tracking the index are sampling, rebalancing and cash drag. Sampling refers to the act of holding a representative sample of an index instead of every constituent. Most of the time this saves costs as providers choose the most important and liquid constituents rather than investing in the entire underlying index (incurring all transaction costs involved). However, lacking securities might cause tracking differences. Rebalancing is the realigning of the ETF with the index. Guedj and Huang (2009) report an average number of 18 stocks entering or exiting an index per quarter. But some indices require more rebalancing than others, up to 60 stocks per quarter. As indices change instantaneously and ETFs do not, rebalancing generates tracking differences. In addition, some ETFs receive dividends of underlying assets and distribute these towards shareholders. But, this is not a real-time proces. Dividends are paid out periodically. Therefore, ETFs can reinvest or hold on to dividends, creating cash drag. In conclusion, total cost of ETF ownership may substantially deviate from expense ratios.

2.3 Market developments

This section uses the obtained data to provide some insight into ETF industry developments. In the sample, U.S. total net assets in ETFs amounted to \$13.6 billion in 1998 and around \$3.4 trillion in 2017, a cumulative annual growth rate of approximately 34%. Note that my data might differ slightly from alternative sources as I dropped all observations with negative total net assets, missing and negative expense ratios and observations lacking unique *Cusip8* codes[5]. After slow growth in the first years and a small noticeable

[4]Tracking differences are different from tracking error, referred to in section 3.1 on page 17. Basically, tracking error reflects the volatility in differences between a fund and its corresponding index. In this context, tracking difference is the difference in fund- and index performance at a given point in time. Note that tracking differences are not necessarily negative.

[5]Without dropping said observations total net assets deviates a few billion throughout the sample.

decline during the financial crisis in 2007, figure 2.2 shows the enormous influx of assets after the global credit crunch. It seems investors, at first, shun away from investing in new investment vehicles of which were only a few available. But many investors seem to have put more and more faith in ETFs instead of actively managed mutual funds after the financial crisis.

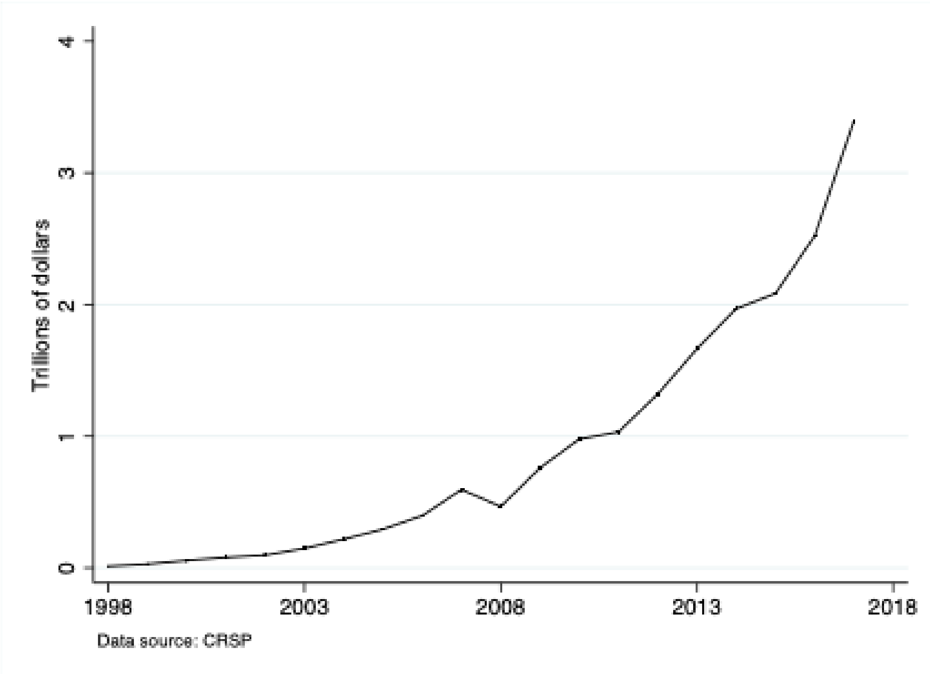


Figure 2.2: Time-series: total net assets of all U.S. ETFs from 1998 until 2017. Funds with a missing or negative expense ratio are excluded from the calculation.

Instead of looking at equal-weighted average expense ratios, allocating the same weight to every fund, figure 2.3 on the next page displays the asset-weighted expense ratio, giving more weight to funds most held by investors. The most obvious trend to spot is an industry-wide increasing amount of assets and decline of asset-weighted fees since the financial crisis. This could be due to two factors: more assets find themselves flowing to lower charging funds or fees are dropping overall (or both simultaneously). I find the equal-weighted expense ratio has stayed approximately constant around 50bps since the financial crisis. In contrast, the asset-weighted expense ratio has declined from around 30bps in 2007 to approximately 22bps in 2017. So, I contribute the decline chiefly to assets flowing to asset-rich low-cost funds[6]. Actually,

[6] Using the Morningstar sample, I document an industry-wide asset-weighted net expense ratio of approximately 20 basis points for January 2019, suggesting the asset-weighted expense ratio continued its decline. Yet, the equal-weighted expense ratio is still just short of 50bps.

Figure 2.3: Time-series: asset-weighted expense ratio for all U.S. ETFs from 1998 until 2017. Funds with zero expense ratio are excluded from the sample and the calculation of the mean.

in 2017, approximately 70% of all assets were managed by ETFs in the two lowest fee deciles, up from 60% in 2007. Table 1 on page 54 shows the distribution of assets over fee deciles over the years. Furthermore, table 2 on page 55 shows the distribution of assets over asset classes. With regards to number of funds, in 2017, approximately 77% of all funds were categorized as equity, of which little less than 50% was domestically orientated, and Fixed Income ETFs accounted for approximately 16%[7]. With regards to assets under management, domestic equity amounts to approximately 2 trillion, dwarfing all other investment objectives. Runner-up foreign equity manages around 750 billion. In stark contrast, all fixed income investment objectives combined only amounted to $247 billion in 2017. Also interesting from table 2 is the shown fund proliferation, from a total of 21 ETFs in year 2000 to 1618 in 2017.

Figure 2.4 on the following page shows the Herfindahl-Hirschman Index (HHI) over time, representing industry concentration (Hirschman, 1964). The index is widely accepted in the financial industry as a measure of market concentration and an indicator of competition (Bikker & Haaf, 2002;

[7]As of January 2019, the Morningstar sample categorizes 64% of all ETFs as equities, 18% as Fixed Income, 12% as Alternatives, 3% Commodities and 2% as Allocation.

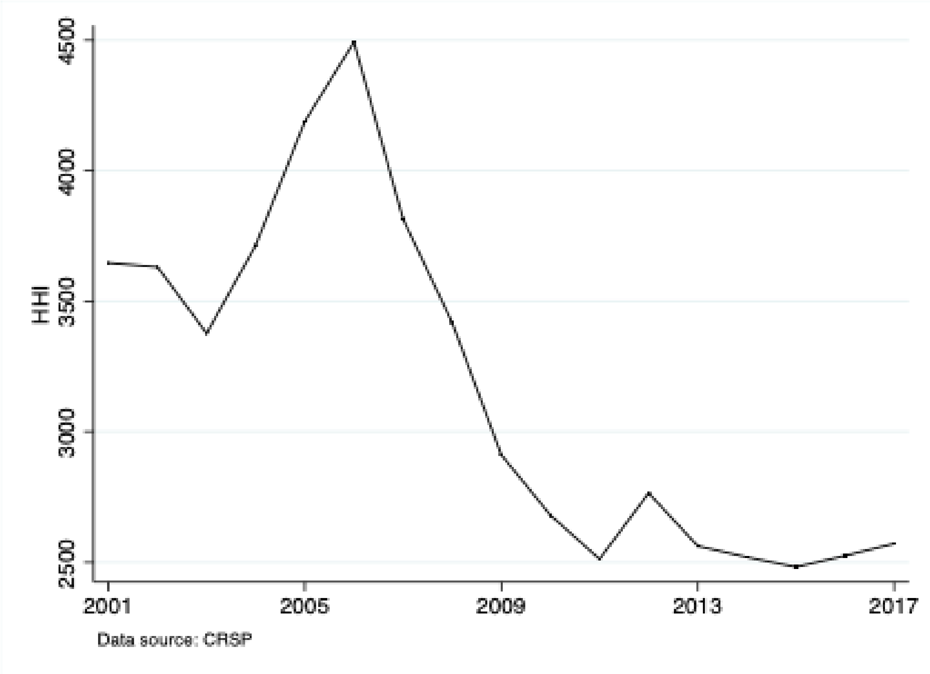


Figure 2.4: Time-series: Herfindahl-Hirschman Index. The Herfindahl-Hirschman Index is calculated as $HHI = \sum_{i=1}^{N} s_{i,t}^2$, in which s_i is the percentage market share of firm i in period t.

Rhoades, 1993). The U.S. Department of Justice classifies an industry as competitive if the HHI is below 1500. Between 1500 and 2500 they regard the industry to be moderately concentrated and above 2500 to be highly concentrated[8]. Following figure 2.4, HHI has declined since 2006 from a value of 4500 to around 2500. Thus, whilst assets have been increasing and asset-weighted fees have been on the decline, the ETF industry became less, although still highly, concentrated.

2.4 Constituents

Figure 2.1 on page 8 summarizes the industry constituents in the primary market and secondary market. In view of this, the role of the stock exchange is self explanatory. U.S. ETF providers, most notable investors and particularly authorized particpants maybe less so. APs are typically market makers or large regulated financial institutions with an ETF trading desk. They are not regulated in their capacity as an AP, however. Therefore, evidence on, for example, the number of APs per ETF is limited. Antoniewicz and

[8]Following the guidelines as described on the website of the U.S. Department of Justice. https://www.justice.gov/atr/herfindahl-hirschman-index

Heinrichs (2015) found, in an industry survey, ETFs enjoy an average of 34 AP agreements. The authors, too, documented an intuitive positive relation between size and number of APs. The best known authorized participants in the U.S. are large banks as Bank of America Merrill Linch, Goldman Sachs, JPMorgan Chase and Morgan Stanley. They are compensated by activity on the secondary market, by charging service fees for large investors on primary trades and from engaging in arbitrage (Antoniewicz & Heinrichs, 2014). One possibile arbitrage opportunity lies in the NAV spread and a second in the bid-ask spread.

It is difficult to pinpoint the relative influence and share of retail and institutional investors in the ETF industry. But, there is a body of literature available concerning investor behavior. For example, Agapova (2011) finds no difference between reactions of institutional and retail investors to the availability of ETFs. The author does find a clientele effect for tax-sensitive investors (see tax properties in section 2.1 on page 7), suggesting they are more attracted to the industry. Other research concerns the performance of individual investors. Bhattacharya, Loos, Meyer, and Hackethal (2017) documented individual investors in ETFs might not improve their portfolio performance due to poor timing and selection ability. However, had they invested in a plain low-cost, well diversified ETF they would have had occured no losses.

Table 2.1 on the following page shows the top ten largest providers and funds within the U.S. industry. The industry mainly concentrates around iShares, Vanguard and State Street, of which iShares is the largest. In December 2016, Fichtner, Heemskerk, and Garcia-Bernardo (2017) documented a collective market share of 71% for BlackRock (iShares), Vanguard and State Street. Anadu et al. (2018) found that the ten largest ETF families accounted for 90 percent of market share since 2004. My research supports the above as, in January 2019, the market share of the big three has become approximately 82% of the ETF industry. Moreover, the top ten manages 95% of all assets.

Unsurprisingly nine out of ten of the largest funds are in equities of which the majority tracks the stock market in the United States. Accordingly, turnover in these funds is very low. The largest ETF (Ticker 'SPY') tracking the S&P 500, manages approximately 7 percent of all assets under management and enjoys the highest liquidity by far in terms of trading volume. The ten largest ETFs total up to approximately 28% of all AUM. It also follows from the table Vanguard charges the lowest net expense ratios, has the largest individual ETFs on average, the highest morningstar rating and the longest average ETF Age.

Table 2.1: Descriptive statistics: Top ten largest providers and ETFs. All data are from the Morningstar database per January 2019. *AUM* is the total assets under management in millions of dollars, *MktShr.* is the market share in percentages, *NER* is the (asset-weighted) net expense ratio in basis points, *Tenure* is the manager tenure in number of years, *Age* is the number of active years of the ETFs, *Liquidity* is the 3 month average daily volume in number of shares, *Turnover* is expressed as a ratio and represents the lesser of purchases and sales of securities in the past year divided by average monthly assets, *Rating* is the Morningstar rating from 1 to 5.

	AUM	**Mkt. Shr.**	**NER**	**ETF**	**Tenure**	**Age**	**Liquidity**	**Turnover**	**Rating**
iShares	$1,409,719	39.86	22	$4,364	4.7	10.7	1,822,523	31.0	3.32
Vanguard	$903,624	25.55	7	$12,909	5.0	11.4	1,707,189	24.2	3.72
State Street	$587,139	16.60	17	$4,482	4.5	10.4	3,580,925	41.2	3.34
Invesco	$167,113	4.73	32	$861	5.3	9.9	520,584	44.5	3.21
Schwab	$124,466	3.52	8	$5,658	3.2	8.0	1,272,217	18.7	3.71
First Trust	$65,038	1.84	62	$533	6.2	7.3	149,481	83.0	3.16
WisdomTree	$37,588	1.06	45	$515	6.7	8.3	154,613	43.9	3.40
VanEck	$35,668	1.01	47	$673	5.2	8.5	1,790,759	34.4	2.95
ProShares	$29,154	0.82	83	$254	4.4	9.1	1,349,440	31.9	2.88
JPMorgan	$19,181	0.54	20	$738	1.5	2.5	266,941	36.0	3.60
Total	$3,378,689	95.53	19						
	AUM	**Ticker**	**Asset class**	**NER**	**Tenure**	**Age**	**Liquidity**	**Turnover**	**Rating**
State Street	$243,429.48	SPY	Equity	9	26.0	26	119,710,492	3.0	4
iShares	$150,670.44	IVV	Equity	4	5.3	19	6,260,439	4.0	4
Vanguard	$101,178.17	VTI	Equity	4	13.4	8	4,971,540	3.0	4
Vanguard	$96,387.56	VOO	Equity	4	2.0	9	4,375,008	3.0	5
Vanguard	$68,388.30	VEA	Equity	7	3.5	12	23,613,798	3.0	3
iShares	$64,404.91	EFA	Equity	31	5.2	18	43,336,831	4.0	3
Invesco	$62,791.33	QQQ	Equity	20	19.8	20	58,428,538	4.9	5
Vanguard	$58,822.69	VWO	Equity	12	6.7	14	22,211,685	11.0	3
iShares	$57,153.22	AGG	Fixed Income	4	8.0	16	6,047,850	252.0	3
iShares	$56,007.53	IEMG	Equity	14	3.6	7	24,374,384	6.0	4
Total	$959,233.64			9.4					

*Source:*Morningstar

2.5 Applications

Exchange traded funds have developed themselves during the past decade. As table 2 on page 55 partly demonstrates, there is a multitude of asset classes, strategies, regions and markets. For example, ETFs focus on sectors, high dividend equities, alternatives, sustainability or are factor-based, either plain-vanilla, currency hedged or leveraged.

Smart-beta ETFs track certain investment strategies. The most common strategies they pursue are focusing on value and growth stocks. Other factors are for example dividend yield, momentum, high-minus-low or small-minus-big (Lettau & Madhavan, 2018). In fact, multifactor ETFs have started to arise providing simultaneous exposure to multiple factors (Braun, 2018). In addition hedge fund ETFs have arised providing retail investors access to hedge fund strategies, although Favreau, Kane, and Shelton (2018) conclude these ETFs underperform hedge fund benchmarks and a simple diversified portfolio.

Leveraged and traditional ETFs are different products, aside from the obvious. In contrast to traditional ETFs, leveraged ETFs create and redeem shares in-cash(Charupat & Miu, 2011). Moreover, drag on returns because of high transaction costs and tax inefficiency makes leveraged ETFs unsuitable for longer-term investors. Therefore, leveraged ETFs are primarily used by short-term traders, although it is winning popularity amongst individual investors according to Cheng and Madhavan (2009). Conform the earlier mentioned short-term horizon, Tsalikis and Papadopoulos (2019) find leveraged ETFs deliver the promised return in a holding period of up to one week. Other short-term traders joining the ETF landscape are liquidity traders.

Next, low transaction costs and the ability to short have fuelled ETF hedging activity. Tax arbitrage, market timing of a futures hedge on a long ETF portfolio and ETF pairs trading are of the most common strategies (Alexander & Barbosa, 2008). Moreover, shorting is not just potentially beneficial for investors but also an interesting proposition for ETF fund managers. Physical ETFs are able to lend securities at a premium to borrowers (short sellers) in exchange for cash. In fact, approximately 80% of all ETFs, active in 2019, lend securities. Following this, a fund's return equals the return of the underlying stock plus the income of lending securities (Blocher & Whaley, 2015).

Chapter 3

Literature Review

This chapter provides the academic context in which the thesis operates. Section 3.1 discusses previous relevant academic literature on mutual funds and ETFs.

3.1 Theoretical framework

The thesis revolves around the relationships between expense ratios, management fees, net flow, industry concentration and fund and manager market share. Thus, below, I discuss previous literature on ETF performance, economies of scale and costs.

Performance

Crane and Crotty (2018) document, in the popular field of research regarding active versus passive, risk-averse investors should choose a random index fund over random active mutual funds. In addition, contrary to their expectations, the authors provide evidence of managerial index fund skill. Moreover, the results of Harper, Madura, and Schnusenberg (2006) indicate utilizing a passive investment strategy, consisting of ETFs, may be favorable over an active investment strategy. Alkhatib and Harasheh (2018), for example, focus on ETF performance during the Brexit referendum and results from Rompotis (2011) reveal ETFs can beat the market.

As the abovementioned research indicates, previous literature on exchange traded funds has often focused on their performance, either defined in terms of share price, NAV or tracking error. Low tracking error, for instance, should signal investors the provider is capable of mimicking the index closely. Shin and Soydemir (2010) document tracking errors are negative and significantly different from zero, implying ETFs show persistence in underperforming their index. As one of the most important determinants of tracking error the authors identify changes in exchange rate, whereas Rompotis (2011) finds the fund's expense ratio, age and risk to explain persistence in tracking error. Additionally, Milonas and Rompotis (2006) provide evidence from the Swiss Stock Exchange on a positive relation between tracking error and management fees, possibly suggesting more expensive managers perform worse. Alternatively, it could indicate more complex products with higher management fees suffer from higher tracking error.

That aside, funds trading in the United States show the lowest level of tracking error compared to other regions. This is explained by Ackert and Tian (2008) by higher underlying market liquidity. This, in turn, corresponds with more market makers being involved in arbitrage, as outlined in section 2.4, enhancing pricing efficiency.

In more recent research, Anadu et al. (2018) focus on the impact of ETFs on financial stability. Doing so, the authors investigate the effect of lagged performance on fund flows. They find flows of ETFs, although less than for actively managed mutual funds, respond significantly positive to lagged returns. This finding is supported by Goetzmann and Massa (1999). Using daily flows for three major S&P 500 index funds the authors document a strong positive correlation between contemporaneous returns and net flow. Lower sensitivity to lagged returns for ETFs might find its explanation in research of Berk and Green (2004) showing that performance chasing flows try to navigate towards skilled active managers. It is remarkable therefore return-chasing behavior seems present with investing in passive investment strategies such as exchange traded funds at all.

Academic literature has further focused on the performance of index mutual funds versus exchange traded funds (Agapova, 2011; Gastineau, 2004). Regardless of those outcomes, the research suggests they may not be perfect substitutes. However, it does follow they are substitutes to a certain extent, as introductions of competing ETFs reduce net flow to incumbent ETFs as well as incumbent index funds (Svetina & Wahal, 2008). Thus, new entrants reduce market share and liquidity of incumbent ETFs, potentially indicating a highly effective and competitive industry. Although, section 2.3 on the Herfindahl-Hirschman Index and largest ETF providers has shown the industry is regarded as highly concentrated.

Economies of scale

Evidence on (dis)economies of scale and scope in the mutual fund industry is mixed. Some studies find mutual funds suffer from diseconomies of scale (Busse, Chordia, Jiang, & Tang, 2017; Edelen, Evans, & Kadlec, 2007). Others find fund size does not significantly affect fund performance (Phillips, Pukthuanthong, & Rau, 2018; Reuter & Zitzewitz, 2010). In contrast, Baumol, Goldfeld, Gordon, and Koehn (2012) do offer evidence of economies of scale in the U.S. mutual fund industry. The authors argue one should look for synergies and economies of scale at the fund family level instead of the fund-level. With regards to the importance of scale, Sirri and Tufano (1998) too find being part of a large fund complex is an important determinant of net flow. One of the plausible explanations the authors provide is that large fund families are able to lower search costs. Chen, Hong, Huang, and Kubik (2004) provide evidence a fund's return does not deteriorate with the size of its fund family.

With regards to exchange traded funds, I would argue, intuitively, scale should not negatively affect ETFs as they are passively managed and created and redeemed in-kind. In this field of research, Elton, Gruber, and de Souza (2018) find the major determinant of ETF performance to be the amount of passive funds in the same family, suggesting economies of scope. And Rompotis et al. (2012) reports expense ratios for German ETFs decrease with size, suggesting economies of scale. Both reinforcing the business case of the big asset managers. Instinctively, that makes sense, as the business case for ETF providers is based on accumulation of assets under management. Perhaps unsurprising therefore, concentration in the asset management industry has increased dramatically. Ben-David, Franzoni, Moussawi, and Sedunov (2016) show that, over a period of 35 years, stock ownership of the top ten largest asset managers has quadrupled. This also raises the question whether larger AUM offsets lower expense ratios. Although, bear in mind, profit maximizing (at the fund level) might not necessarily be the strategic objective of asset managers (in the short run).

Expense ratio

In the end, the main variables of interest of this thesis are expense ratio and net flow. With regards to mutual funds, Wilcox (2003) finds investors pay less attention to fees than to past performance. Although cost does become a greater concern when expected returns are more subdued, his results suggest a strong disregard exists for annual expense ratios. This is emphasized by S. Brown and Pomerantz (2017), who find investment management fees of mutual funds are immune to forces of competition. Mixed reactions regarding changes in expense ratios are found by Khorana and Servaes (2004). Providers lowering fees gain market share, provided the fees were above average to begin with. However, the authors also document low-cost families do not lose market share after raising fees.

Following this apparent inelasticity of management fees for mutual funds, this thesis focuses on ETFs. Traditional economic analysis argues, due to the passive nature of ETFs, fees should approximate marginal costs. Thus it seems plausible, cost is a key differentiator in choosing between ETFs (or index funds), not rewarded for active management. But, Choi, Laibson, and Madrian (2009) find evidence individual investors, consisting of harvard staff members and Wharton MBA students, fail to minimize expense ratios. The results showed investors seem to place emphasis on past performance, in casu annualized return since inception. In addition, Haslem, Baker, and Smith (2006) conclude there is a lack of price competition in the asset management industry after finding wide dispersion in net expense ratios across index funds. Not to mention, the introduction of new ETFs does not seem to put downward pressure on management fees (Box, Davis, & Fuller, 2018). Although interestingly, the authors also discover continuously picking the cheapest ETF renders 5 extra basispoints per year for investors.

Undoubtedly, the level of expense ratio is a critical impetus in picking ETFs. Likewise, it is certainly not the only factor at play. Similar research into ETF flow determinants documents investors chase returns with ETFs in the same way as with mutual funds (Clifford, Fulkerson, & Jordan, 2014). Moreover, the authors find fund and family size to be positively related to net flow. In their research, they incorporate expense ratio as a control variable. They find it negatively relates to ETF flows: higher expenses are associated with lower net flows. Note, however, all coefficients regarding the expense ratio should be taken with a grain of salt due to very little expense ratio time variation for a given fund.

Chapter 4

Data

In this chapter I present the data leveraged for this research. Section 4.1 explains how the sample is constructed and provides the datasource. Section 4.2 on page 23 discusses summary statistics of the data sample and recognizes its potential biases.

4.1 Sample contruction

Using the Survivor-Bias Free database from the Center for Research in Security Prices (CRSP), I obtain quarterly data on all, active and inactive, U.S. ETFs from 1998 to 2017. The CRSP sample is used for the main research of this thesis. Using Morningstar, I gather cross-sectional data on all active U.S. ETFs per January 2019[1]. These data are used in descriptive tables and in a robustness check.

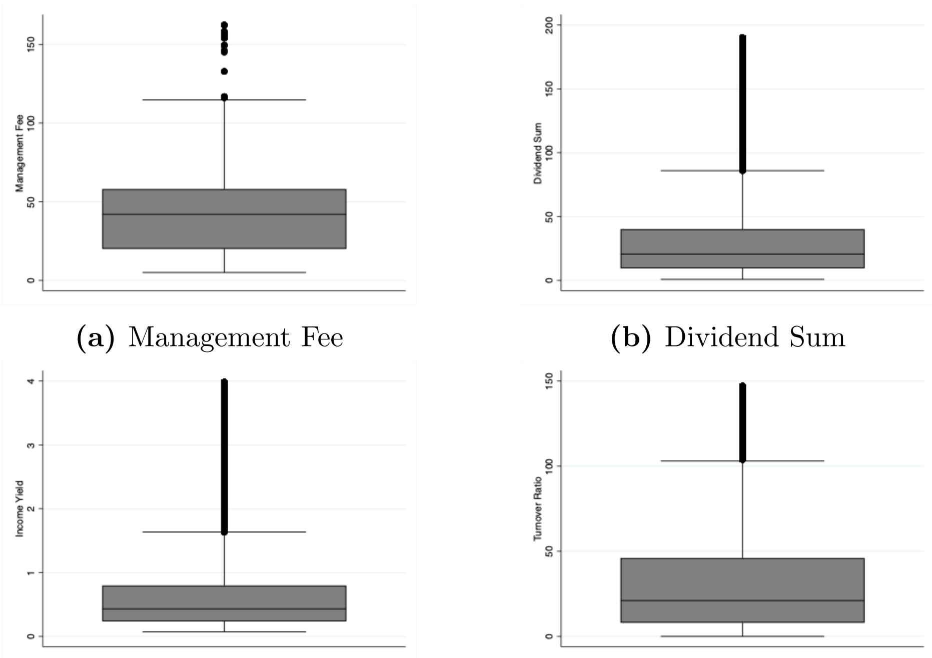
For the CRSP sample, I drop all observations without values, negative values and values above 200 basis points for expense ratios. In addition, I drop all observations with negative or blank values for total net assets. Following mutual fund literature on the incubation bias by Evans (2010), I filter all ETFs on a minimum fund age of one year. As idiosyncratic events like mergers of ETFs can result in extreme values of changes in assets, I winsorize all variables concerning the development of total net assets at the 1:99 level to correct for outliers. The variables, including the outliers, are shown in figure 2 on page 56. The winsorized variables are exhibited in figure 3 on page 56. All exclusions lead to a final sample of 44199 quarterly observations from 2495 distinct exchange traded funds.

Size is defined as the natural logarithm of total net assets and *Return*

[1]The summary statistics for the Morningstar sample are presented in table 7 on page 63. The corresponding correlation matrix is presented in table 8 on page 64.

is computed as the quarterly increase or decrease in net asset value. Note this reflects the price development of the underlying assets and therefore not the development of the share price. Although, as explained in section 2.1 on page 7, share prices and NAV should not differ substantially. *Market Share* at the fund level is computed as total net assets divided by total assets under management of the respective asset class. *Market Share* at the fund family level is computed as the total assets under management relative to total industry assets. *Age* is the number of quarters the ETF has been active. *RATR*, short for Relative Average True Range, reflects the ETFs implied volatility by taking the difference between the NAV 52-week high and low, relative to its current net asset value. The proxy, normally used as a 14-day moving average, provides some insight in the ETF volatility of the past year, although its explanatory value is limited (Vervoort, 2009).

To control for outliers and inaccurate data (displayed in figure 4 on page 57), without dropping observations, I winsorize *Management Fee*, *Income Yield*, *Dividend Sum* and *Turnover Ratio* at the 7:100, 5:99, 1:99 and 10:95 percent levels, respectively. The winsorized variables, as a result, are shown in figure 4.1.



(a) Management Fee **(b)** Dividend Sum

(c) Income Yield **(d)** Turnover Ratio

Figure 4.1: Boxplot: winsorized independent variables

4.2 Sample characteristics

Table 4.1 on the following page shows the summary statistics per asset class for the CRSP sample. Within the sample, equity ETFs are largely dominant with 80% of all observations. 'Fixed Income', 'Mixed' and 'Other' make up approximately 14%, 3% and 2.5%, respectively. Equities too dominate the spectrum with regards to sheer size. The largest observation for fixed income, at $57 billion, is dwarfed by the $280 billion of equities. For this reason, I suspect results could be significantly skewed towards traits from equities. To that end, I perform a robustness check incorporating asset class fixed effects.

Equally-weighted average expense ratios are lowest, at 35bps, for 'Fixed Income' ETFs and highest, at 56bps, for mixed strategies. Naturally, management fees mark lower values than expense ratios and are, again, lowest for fixed income strategies.

The first observations of ETFs are included after one year and nine months. The oldest ETF, in 2017, is just short of 26 years. In section 2.1 the tax properties of ETFs led me to expect negligible capital gains. The near absence of observations is supportive of that and simultaneously the reason I do not include capital gains in the regression models.

In the sample there are fund families with 317 and 1 ETF(s) under management at some point. Moreover, the averages of expense ratio decreases are difficult to interpret. The largest noted increase in expense ratio for equities is 692% and the largest decrease 92.6%.

Several other characteristics of the dataset are unreported in table 4.1. For example, 4376 obsverations are labeled as a dead fund, all active ETFs are open to investors and none suffers from sales restrictions. To give a glimpse of its relative importance, the number of observations for index-based physical ETFs amount to 39368, of which 34701 hold virtually all securities and 4667 try to capture the best performers. In stark contrast, synthetics amount to just 2654 observations.

Table 3 on page 58 documents the correlation matrix of the CRSP sample. It very clearly shows a significant negative correlation of size and expense ratio and a significant positive correlation of size and fund age. Also of interest is the positive correlation of relative average true range and capital gains with total expense ratio. The high correlation of management fee and expense ratios was to be expected. Hence, its use for robustness checks is only limited.

Table 4.1: Summary statistics: CRSP. TNA refers to total net assets in millions of dollars, TER, total expense ratio in basis points, is defined as the ratio of total investment shareholders pay for the operating expenses, NAV is the net asset value, Age is the number of active quarters, $RATR$ refers to relative average true range (NAV 52-week high minus 52-week low / NAV) as a proxy for volatility, $Cap.Gain$ is the sum of capital gains year-to-date, $Inc.Yield$ is calculated as the ratio of income distributions and NAV, $Mgmt.Fee$, management fee in basis points, is defined as management fee divided by average net assets corrected for reimbursements, $Div.Sum$ refers to the sum of dividends year-to-date, $Turnover$ is the ratio of the minimum of aggregate sales and purchases of securities and total net assets.

	Equity				**Fixed Income**				**Mixed**				**Other**			
	Obs	Mean	Min	Max	Obs	Mean	Min	Max	Obs	Mean	Min	Max	Obs	Mean	Min	Max
TER	35510	53.6	1.0	190.0	6230	35.4	1.0	170.0	1316	56.4	1.0	190.0	1119	54.5	7.0	145.0
Mgmt. Fee	35510	42.9	5.0	162.3	6230	29.6	5.0	116.9	1316	41.2	5.0	157.5	1119	50.1	5.0	145.0
TNA	35510	1827.7	1.1	280334.1	6230	1894.1	1.2	56931.2	1316	288.7	1.2	5182.5	1119	820.4	1.2	12290.3
Age	35510	26.8	7.0	103.0	6230	20.6	7.0	65.0	1316	16.3	7.0	48.0	1119	21.3	7.0	52.0
RATR	35510	40.1	1.9	5639.1	6230	11.8	0.0	604.9	1316	26.4	1.7	1409.5	1119	18.6	0.5	1646.0
Cap. Gains	469	2.7	0.0	50.4	292	0.3	0.0	11.1	22	0.5	0.0	3.0	37	0.9	0.0	5.7
N0 of Funds	35510	109.1	1.0	317.0	6230	124.4	1.0	317.0	1316	72.9	1.0	317.0	1119	71.1	1.0	317.0
Inc. Yield	22481	0.7	0.1	4.0	5290	0.4	0.1	4.0	772	0.8	0.1	4.0	473	0.5	0.1	4.0
Div. Sum	22488	33.1	0.8	189.9	5292	21.0	0.8	189.9	772	29.3	0.8	189.9	475	16.4	0.8	189.9
Turnover	35510	33.8	0.0	147.0	6230	39.2	0.0	147.0	1316	46.3	0.0	147.0	1119	44.7	0.0	147.0
Mkt. Shr. C.	33494	1.1	-50.3	119.5	5844	2.5	-50.3	119.5	1169	-0.2	-50.3	119.5	1049	-1.1	-50.3	119.5
TER C.	35510	-0.3	-92.6	691.7	6230	-0.3	-72.7	266.7	1316	0.1	-83.3	800.0	1119	-0.2	-48.0	57.4
TER D.	35510	-0.5	-92.6	0.0	6230	-0.6	-72.7	0.0	1316	-0.8	-83.3	0.0	1119	-0.4	-48.0	0.0
Flow_{t+1}	33465	6.2	-48.6	130.6	5832	6.8	-48.6	130.6	1219	4.9	-48.6	130.6	1034	3.0	-48.6	130.6
Flow_{t+2}	31680	14.4	-59.6	252.4	5477	15.0	-59.6	252.4	1133	11.1	-59.6	252.4	963	7.1	-59.6	252.4
Flow_{t+3}	29970	23.6	-64.6	388.9	5134	24.1	-64.6	388.9	1057	16.7	-64.6	388.9	898	11.9	-64.6	388.9
Flow_{t+4}	28366	33.3	-67.0	515.5	4810	34.1	-67.0	515.5	986	22.6	-67.0	515.5	836	17.4	-67.0	515.5
Return_{t-1}	35510	0.9	-91.3	959.3	6230	-0.3	-75.7	104.1	1316	0.4	-92.7	83.9	1119	-0.7	-92.3	94.7
N	35510				6230				1316				1119			

Limitations

There are several limitations to this dataset. For one, quarterly observations may lack the nuance of short-term effects. This could cause me to forgo the impact of short term effects on quarterly flow, implying an omitted variable bias. Additionally, this research lacks stock exchange related data on potential explanatory variables, such as tracking error and trading volume.

Like in previous literature, there is large time invariation in expense ratios. Just 3259 changes are recorded. Following this, the specific effect of a change is not isolated in panel regressions. Thus, estimates of coefficients of expense ratio changes and decreases are difficult to interpret.

The raw data was prone to multiple extreme values in *Management Fee*, *Dividend Sum*, *Income Yield*, *Turnover Ratio* and *Flow*. Although winsorizing may improve statistical efficiency and robustness, it also introduces its own bias.

For certain descriptive tables and for a cross-sectional regression, I make use of the Morningstar sample. Contrary to the CRSP sample, the Morningstar database is subject to survivorship bias, as it solely comprises of active ETFs. *Ceteris paribus*, survival of ETFs depends on the performance of the underlying assets. Therefore, survivorship bias could induce spurious conclusions about fund characteristics and performance (S. J. Brown, Goetzmann, Ibbotson, & Ross, 1992; Rohleder, Scholz, & Wilkens, 2010). Regardless, descriptive tables should exhibit accurate contemporay data. Plus, considering the data is only used for a single robustness check of a very intuitive association, survivorship bias is not likely to affect any results in this thesis.

Chapter 5

Methodology

The main objectives of this chapter are providing the hypotheses and the used methodology. Section 5.1 documents the hypotheses and section 5.2 on the next page describes the . Furthermore, I motivate my choice of approach and weigh its advantages and limitations in section 5.3 on page 30.

5.1 Hypotheses

Hypothesis 1

H_0. *Average net flow is not higher for U.S. ETFs after a decrease in expense ratios than for those without a change.*

H_1. *Average net flow is higher for U.S. ETFs after a decrease in expense ratios than for those without a change.*

I expect to reject the null-hypothesis. I would argue investment decisions of individual investors are largely influenced by salient and attention-grabbing information, such as past performance and cost. Moreover, announcing a fee reduction might also provide additional attention and potentially attract capital.

Hypothesis 2

H_0. *There is no negative relation over time between decreasing expense ratios of U.S. ETFs and its subsequent net flow.*

H_1. *There is a negative relation over time between decreasing expense ratios of U.S. ETFs and its subsequent net flow.*

Most capital is currently managed by managers in the lowest fee deciles. I therefore expect to reject the null-hypothesis. ETFs lowering their expense ratios over time ought to increase assets under management, at least in the long run.

Hypothesis 3

H_0. *There is no negative relation over time between decreasing expense ratios of U.S. ETFs and the fund market share.*

H_1. *There is a negative relation over time between decreasing expense ratios of U.S. ETFs and the fund market share.*

Table 2 on page 55 shows an enormous fund proliferation over time. Hence, I do not predict fund market share to have grown over time or one off decreases to have a significant impact on fund market share.

Hypothesis 4

H_0. *An increase in net flow does not depend on the magnitude of a decrease in expense ratio.*

H_1. *An increase in net flow does depend on the magnitude of a decrease in expense ratio.*

Since for smaller ETFs changes in market share and total net assets are often relatively larger than for large ETFs, I expect larger decreases to have a larger impact, rejecting the null-hypothesis.

5.2 Model description

Hypothesis 1

I perform a two-sample t-test using a Welch approximation to account for the unequal variances and sample sizes, as Welch's t-test is more robust than a basic mean-comparison test. In using this test, I follow research from Gil-Bazo, Ruiz-Verdú, and Santos (2010) and Glassman and Riddick (2006) who use the Welch approximation to measure differences in fees, return and asset means, respectively. The t-statistic is calculated as follows.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}} \tag{5.1}$$

in which $\bar{X}_1$, s_1^2 and N_1 are the sample mean, variance and size, respectively. Further, the associated degrees of freedom are approximated using the Welch equation:

$$\nu \approx \frac{\left(\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}\right)^2}{\frac{s_1^4}{N_1^2 \nu_1} + \frac{s_2^4}{N_2^2 \nu_2}} \tag{5.2}$$

in which $\nu_1 = N_1 - 1$ represents the degrees of freedom of the variance of the first sample.

Hypothesis 2

I test Hypothesis 2 using panel data analysis. I run a linear fixed effects regression with robust standard errors, controlling for fund and quarterly time effects. The temporal component corrects for any cross-sectional correlation due to differences in average flows across quarterly observations. The dependent variable, Y_{it}, is defined as

$$NetFlow_{i,t+1} = \frac{TNA_{i,t+1} - TNA_{i,t}}{TNA_{i,t}}$$

where $TNA_{i,t}$ is fund i's total net assets in period t. Net flow reflects the percentage growth and/or decline of a fund. I use percentual change, instead of an absolute dollar amount, as dependent variable because of a strong postive correlation of fund size and subsequent dollar flow (0.20). The model can be defined as follows.

$$Y_{it} = \alpha_0 + \beta_1 X_{1,it} + ... + \beta_k X_{k,it} + Y_2 A_2 + ... + Y_n A_n + \delta_2 T_2 + ... + \delta_t T_t + \varepsilon_{it} \tag{5.3}$$

in which $X_{k,it}$ represents all independent variables, A_n represents dummy variables of the asset class, T_t represents dummy variables of time and ε_{it} is the error term. As both A_n as T_t are dummy variables, the model includes $n-1$ and $t-1$ entities, respectively.

This definition of fund flow assumes fund flow takes place at the end of the quarter. Additionally, the analysis also assumes changes in expense ratios occur at the end of the quarter. If, for instance, a change in expense ratio occured in 1Q2012, 2Q2012 is the first period which could possibly be affected. Regardless, I run the regression for both $t = 0$ and $t = 1$. The regression for $t = 1$ should yield more relevant results and is therefore shown in the main text. But, as the exact moment of a change in expense ratio is uncertain, I perform the same regression for $t = 0$.

I do not account for turnover in the regression as the turnover variable comprises of yearly values. Management fees, as an other datasource of costs, are used as a robustness check.

Hypothesis 3

Except for altering the dependent variable Y_{it}, I replicate the analysis of Hypothesis 2, as displayed in equation (5.2) on the preceding page. Following similar research of Khorana and Servaes (2004) in which the authors study manager market share, I compute $MarketShare_{it}$ at the end of each quarter as the total assets under management of ETF i divided by all assets under management of the asset class in period t. Hence, the dependent variable is defined as

$$MarketShareChange_{i,t} = \frac{MarketShare_{i,t+1} - MarketShare_{i,t}}{MarketShare_{i,t}}$$

where $MarketShare_{i,t}$ is fund i's market share in period t.

Hypothesis 4

I use an inverse probability weighted regression adjustment treatment-effects estimator to estimate the causal effect of a treatment on net flow and change in market share. In this case the treatment is a dummy variable taking the value of 1 if expense ratios decrease. Moreover, I split the treatment variable into quartiles, dependent on the value of the relative decrease of the expense ratio (shown in table 6.4 on page 37). Essentially, IPWRA estimators first use a probit model to predict the treatment status. Thus, whether the binary variable takes the value of 1 or 0. In order to know which variables to include in the probit treatment and outcome model, I perform several probit regressions[1]. Second, the IPWRA estimator uses a linear model to predict the estimates of both the treatment- and outcome model. The entire set of sample estimating functions of the IPWRA can be defined as follows. Here $\hat{\theta}' = (\hat{\alpha}', \hat{\beta}', \hat{\gamma}')$.

$$s_{ipwra,i}(X_i, \hat{\theta})' = s_{ra,e,i}(X_i, \hat{\alpha}, \hat{\beta})', s_{ml,om,i}\left\{X_i, w_i(t), \hat{\beta}\right\}', s_{tm,i}(z_i, \hat{\gamma})' \quad (5.4)$$

The elements for the regression adjustment parameters are given by:

$$s_{ra,e,i}(X_i, \hat{\alpha}, \hat{\beta})' = \mu(x_i, t, \hat{\beta}_t) - \hat{\alpha}_t \quad (5.5)$$

The parameters for the linear outcome model are estimated by:

$$s_{ml,om,i}\left\{X_i, w_i(t), \hat{\beta}\right\}' = w_i(t)t_i(t)(y_i - x_i\hat{\beta}_t{}')x_i' \quad (5.6)$$

[1]The log-likehood function for the probit model is defined as follows.

$$lnL = \sum_{j\in s} w_j ln\Phi(X_j\beta) + \sum_{j\notin s} w_j ln\left\{1 - \Phi(X_j\beta)\right\}$$

where lnL is maximized, Φ is the cumulative normal and w_j denotes the optional weights.

And, lastly, the parameters for the probit treatment model are given by:

$$s_{tm,i}(z_i,\hat{\gamma})' = \left[\frac{g(z_i\hat{\gamma}')\left\{t_i - G(z_i\hat{\gamma}')\right\}}{G(z_i\hat{\gamma}')\left\{1 - G(z_i\hat{\gamma}')\right\}}\right] z_i \tag{5.7}$$

It follows the process of estimating treatment effects uses a three-step approach. First, it computes inverse-probability weights and estimates the parameters of the treatment model. Second, it fits the weighted regression outcome model for each treatment level (0 or 1), using the inverse-probability weights. Third, the adjusted outcome-regression parameters are used to calculate averages of both the treated and untreated sample.

One of the key benefits of the IPWRA estimator is the treatment is assumed to be independent of the outcome variable after conditioning on the covariates.

5.3 Limitations

I refrain from excluding the possibility of reverse causality within the longitudinal data regressions, regarding both the relation between performance and scale on expense ratios. The effect is not properly isolated using these tests.

Past performance could be the major determinant of net flow. Research of Elton, Gruber, and Blake (1996) is particularly revelant here. They argue 'smart money' chases past performance in anticipation of performance persistence. According to the authors relevant lag length to include in the regression is 12 months or more. I include a 3-month, 6-month, 9-month and 12-month lag of past return.

Another major issue in panel data studies is the possiblity of cross-sectional dependence between observations. However, if a model is correctly specified, cross-sectional dependence should not be present in the error term.

The IPWRA estimator lacks nuance in relative terms of expense ratio decrease. Absolute decreases ought to be more informative. For this reason, I generated four categories of a treatment. But, dividing the variable in four relative categories of decreases is still not ideal.

Chapter 6

Empirical Research

This chapter shows the results of the empirical research outlined in chapter 5 on page 26. Section 6.1 documents the (regession) results for all tests using the sample from the Center for Research in Security Prices, section 6.2 on page 41 discusses the robustness of the results and section 6.3 on page 42 acknowledges its limitations and biases.

6.1 Results

Section 6.1 is divided in four different subsections. Every subsection covers the tests used to answer the respective hypotheses. Subsection 6.1.1 answers Hypothesis 1 using two-sample t-tests with a Welch approximation. In subsection 6.1.2 on page 34 the results of cross-sectional time-series regressions are documented which provide evidence for Hypothesis 2 and 3. Subsection 6.1.3 on page 36 provides necessary insights on which factors significantly influence the probability of an ETF lowering its expense ratio. These factors are incorporated in treatment-effect estimators in subsection 6.1.4 on page 40 that allow formulating an answer on Hypothesis 4. Additionally, subsection 6.1.4 sheds a different light on Hypothesis 2 and 3.

6.1.1 Welch approximation

First, solely focusing on the development of total assets and expense ratios, I identify all quarterly changes in expense ratios. Across the sample there have been 3259 changes of which 2282 negative and 977 positive. Table 6.1 on the next page shows the summary statistics of the quarterly net flows after a decrease in expense ratio, compared to the observations in which no change occured.

Table 6.1: Summary statistics: net flow in percentages. The sample size for *NoChange* decreases per time period as only observations with consecutive periods without a change are included. All values, barring number of observations, are expressed as percentages.

Net flow	Observation	Mean	Std. Dev.	Min	Max
Fee decrease 1Q	2,282	7.01	25.23	-50.37	122.85
No change 1Q	35,258	6.21	26.78	-48.65	135.71
Fee decrease 2Q	2,107	17.24	46.52	-61.48	245.45
No change 2Q	30,381	14.35	46.59	-59.09	260.84
Fee decrease 3Q	1,992	29.84	81.51	-67.62	523.75
No change 3Q	25,958	23.26	66.75	-63.79	393.75
Fee decrease 4Q	1,913	38.33	105.06	-69.37	704.09
No change 4Q	23,237	32.56	86.32	-66.17	513.65

Seemingly, subsequent average net flow for ETFs with decreasing expense ratios are substantially higher than for those without a change for all periods. For instance, after two periods net flow of ETFs which experienced a fee decrease amounted to 17.24%, whilst the rest of the sample witnessed an increase in assets of 14.35%. Yet, these summary statistics provide little evidence on whether the means are statistically sigficantly different from one another. To check for statistical significance, I conduct two-sample t-tests separately for all periods. An extract of the output is shown in table 6.2. The full tests are displayed in table 4 on page 59.

Table 6.2: Extract of a two-sample t-test using Welch approximation. *Difference* refers to the differences between the net flows as expressed in table 6.1. *Mean* is the average difference in percentages. *d.o.f.* refers to Welch degrees of freedom.

Difference	Mean	T-statistic	d.o.f	P-value		
				$T < t$	$\|T\| > \|t\|$	$T > t$
Difference 1Q	.80	1.4466	2616	0.9259	0.1481	0.0741
Difference 2Q	2.89	2.7585	2409	0.9971	0.0059	0.0029
Difference 3Q	6.59	3.5171	2201	0.9998	0.0004	0.0002
Difference 4Q	5.77	2.3361	2130	0.9902	0.0196	0.0098

For the six, nine and twelve month periods after a fee decrease, I reject the null-hypothesis of equal means at the 99%, 99% and 95% significance level, respectively. In fact, the means of net flows for the decreasing subsample are significantly larger at the 90% and 99% significance level for the first and other periods, respectively. For the first period, the means are not significantly different from eachother, potentially suggesting a certain effect becomes present after a period of time. As on average, net flow is higher for ETFs decreasing their expense ratios in $t+2$, $t+3$ and $t+4$, I reject the null-hypothesis of Hypothesis 1 for those periods, in line with expectations.

The abovementioned tests exclude observations with increasing expense ratios. Potentially, although unlikely, this could bias results. Hence, table 5 on page 60 explores the differences between the effect of increasing and decreasing costs on net flow and documents the results.

I find the means for fee cuts to be significantly larger at the 99%, 90% and 90% significance level during the second, third and fourth subsequent quarters, respectively. I cannot reject the null-hypothesis of equal means for the first period. These results might indicate how changes in expense ratios relate to each other and to net flows. On average, decreasing fees, relative to no changes, experience higher net flow in $t+2$, $t+3$ and $t+4$. Increasing fees yield statistically and economically significantly lower net flows than decreasing ones. For example, whereas ETFs decreasing their expenses, on average, after six months, experienced a net flow of 17.23%, ETFs increasing their fees saw an asset growth of 12.71%.

Figure 6.1 exhibits net flow prior to changing expense ratios. In unreported analysis, I find assets flowing to ETFs prior to changing expense ratios in period t do not differ significantly in $t-1$ and $t-2$ from ETFs about to make no changes.

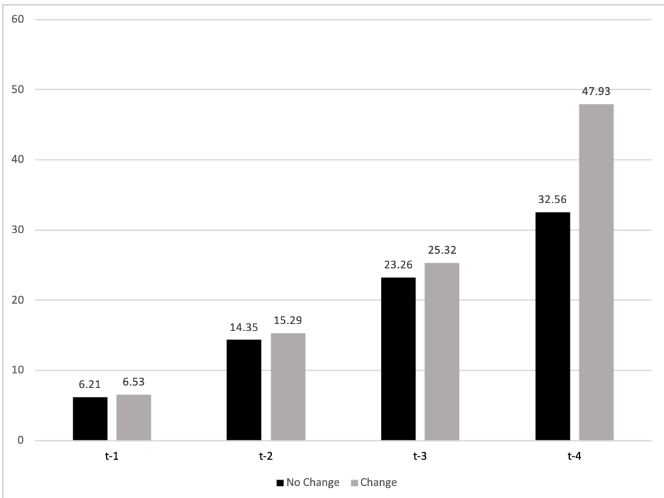


Figure 6.1: Descriptive: average prior flow. The figure shows the average net flow for all observations not occuring any changes and those experiencing expense ratio decreases. The difference of the means is statistically larger at the 99% significance level for $t-4$.

Oppositely, in $t-3$ and $t-4$ net flow is higher for changing ETFs at the 90% and 99% significance level. Still, on the basis of these statistics, it is impossible to exclude reverse causality or endogeneity, whether lower expense ratios cause higher flow or whether higher flow leads to lower expense ratios or both.

Also, note a two-sample t-test does not take into account any other factors of potential interest. Thus, the tests contribute little to exploring the explanatory power of lowering fees on asset flows. To that end, the following subsection sets out cross-sectional time-series regressions.

6.1.2 Panel regression

The yearly distribution of assets over fee deciles documented in table 1 on page 54, suggests an intuitive negative relation between size and expense ratios. Table 6 on page 61 quantifies this effect by estimating the coeffients using a cross-sectional time-series regression with robust standard errors. The table makes a distinction between asset classes and switches between expense ratio and management fee as independent variable of main interest. Control variables stay the same throughout. All models correct for fund and time fixed effects. The coefficients of the Equity and Fixed Income model show an increase of the expense ratio of 1 basis point is associated with a 1.7% and 2.8% lower fund size respectively, significant at the 99% significance level. The coefficients for mixed and other investment objectives show a 1bps increase is associated with a 2.6% increase and 13.8% decrease in fund assets, respectively, statistically significant at the 95% level. But, only the models for the equity sample are overall significant. Thus, capital rich funds are associated with lower costs and vice versa. The regression does not provide any evidence on potential causality.

Worth mentioning, too, is the significance of prior performance of the underlying assets for the equity sample. A 1% higher return in $t-1$ is associated with a 0.7% increase in assets, significant at the 99% significance level. The coefficients for the other periods are substiantially similar. Finally, the age coefficient is economically and statistically significant. It shows a three month older equity ETF is associated with 4.4% percent more assets. Similarly, an increase in dividend of one percent, is associated with 0.2% larger assets under management. Essentially, table 1 confirms a positive relation for past performance and a negative relation for expenses, conform previous literature.

Now, instead of using the natural logarithm of total net assets as dependent variable, I look at the relative growth and/or decline of an ETF, defined as the percentual change in TNA and fund market share. Table 6.3 on the following page shows the results of this panel data regression. The model incorporates two independent variables, either taking the value of changes in expense ratios ($TERC.$) or only the percentual decreases in expense ratios ($TERD.$). Naturally, if no changes occurred the variables will take the value of zero. The same logic applies to the management fee variables.

Table 6.3: Cross-sectional time-series: Net Flow and Market Share $t = 1$. The dependent variables are lead net flow and change fund market share. The independent variables are all leads of the same variables as described in table 4.1 on page 24. $TERC.$ takes the value of the change in TER or 0 if non-existent, $TERD.$ takes the value of the percentual decrease in TER or 0 if non-existent.The table shows coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

	Net Flow		Mkt. Shr. Change	
	TER	Mgmt. Fee	TER	Mgmt. Fee
TER_{t+1}	-0.117*		-0.115**	
	0.046		0.043	
TER C.	0.023**		0.023**	
	0.009		0.008	
TER D.	-0.043		-0.047	
	0.035		0.034	
Mgmt. Fee_{t+1}		-0.312***		-0.302***
		0.045		0.043
Mgmt. Fee. C.		-0.002		-0.001
		0.008		0.007
Mgmt. Fee. D.		-0.007		-0.012
		0.030		0.031
RATR_{t+1}	0.169***	0.167***	0.160***	0.158***
	0.021	0.021	0.021	0.021
Age_{t+1}	-0.332*	-0.274*	0.156	0.215
	0.140	0.137	0.146	0.143
Inc. Yield_{t+1}	-3.505***	-3.672***	-3.296***	-3.459***
	0.679	0.668	0.649	0.638
Div. Sum_{t+1}	-0.011	-0.008	-0.011	-0.008
	0.012	0.012	0.012	0.012
Return_{t-1}	1.209***	1.201***	1.177***	1.169***
	0.058	0.058	0.057	0.057
Return_{t-2}	0.478***	0.471***	0.450***	0.443***
	0.035	0.035	0.034	0.033
Return_{t-3}	0.206***	0.198***	0.197***	0.189***
	0.032	0.031	0.031	0.031
Return_{t-4}	0.171***	0.171***	0.167***	0.167***
	0.028	0.028	0.027	0.027
Fund FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Adj. R^2	0.272	0.276	0.201	0.205
AIC	198351	198242	196393	196281
BIC	198954	198844	196995	196884

Continued on next page

Table 6.3 – Continued from previous page

	Net Flow		Mkt. Shr. Change	
	TER	Mgmt. Fee	TER	Mgmt. Fee
P-value	0.000	0.000	0.000	0.000
N	22846	22846	22846	22846

Most importantly, it follows from the table that decreasing expense ratios exhibit no significant relation with subsequent net flow and fund market share. In contrast, also comprising of expense ratio increases, $TERC.$ is significant at the 99% level, suggesting a 1% higher change in expense ratio is associated with 0.02% higher subsequent net flow. However, this hardly seems economically significant and interpreting these coefficients is difficult due to large time invariation.

Again, the results show a trend of assets flowing to lower charging ETFs. Managing an ETF with a 1bps lower expense ratio is associated with a 0.12% increase in assets and a 0.12% increase in fund market share. Basically, the results reinforce the idea of low-cost ETFs accumlating more assets and gaining market share. A decrease in fees itself does not generate a significant negative effect. Therefore, I cannot reject the null-hypothesis of Hypothesis 2 and 3. There is no negative relation over time between decreasing expense ratios of U.S. ETFs and its subsequent net flow and fund market share. Lastly, table 6.3 documents higher past performance is associated with higher subsequent net flow. Higher past performance in $t-1$ of 1% is associated with 1.21% higher subsequent net flow.

The effect of a change in cost in $t = 0$ on net flow and the development of fund market share in $t = 0$ is documented in table 9 on page 66. In general, it renders the same conclusions as the table 6.3 on the preceding page, although $TERC.$ lost its significance and $TERD.$ now has a statistically significant, at the 95% level, positive relation with net flow and fund market share. This coefficient too is difficult to interpret as both occur during the same period and the exact date is unknown.

As I expect the large time invariation of changes in expense ratios to distort the results, I further regard the decrease of expense ratios and management fees as a treatment variable. The following subsection considers the determinants of the treatment variables.

6.1.3 Probit regression

Undoubtedly, there are factors determining whether or not an ETF provider is able to decrease the expense ratio of an ETF. Larger funds and providers might be better positioned to lower expense ratios due to economies of scale. In the same line of thought, I hypothesize the probability of undergoing a treatment increases with time. Accordingly, I suspect the fund's prior performance and net flow to have an effect. To find out which factors are significantly associated with the probability of the treatment variable taking the value of 1, I perform a probit regression. Table 6.5 on the next page presents the results of the cross-sectional time-series probit regression. Dependent variables are all binary values which take the value of 1 if a decrease in expense ratio occurs. Independent variables are the same for all regressions. To gain better understanding of the impact of relative decreases, the treatment variable has been split up in quartiles of magnitudes of decreases, the 1^{st} quartile being the lowest and the 4^{th} the highest. The summary statistics and the distribution of these quartiles are shown in table 6.4 and figure 6.2, respectively.

Table 6.4: Summary statistics: Quartiles. All values, barring the number of observations, are expressed in percentages.

Quartile	Obs	Mean	Std. Dev.	Min	Max
1	470	-1.89	1.00	-10.64	-0.59
2	534	-3.67	1.58	-18.57	-2.04
3	542	-8.51	4.10	-26.92	-3.57
4	558	-24.27	12.82	-92.63	-3.57

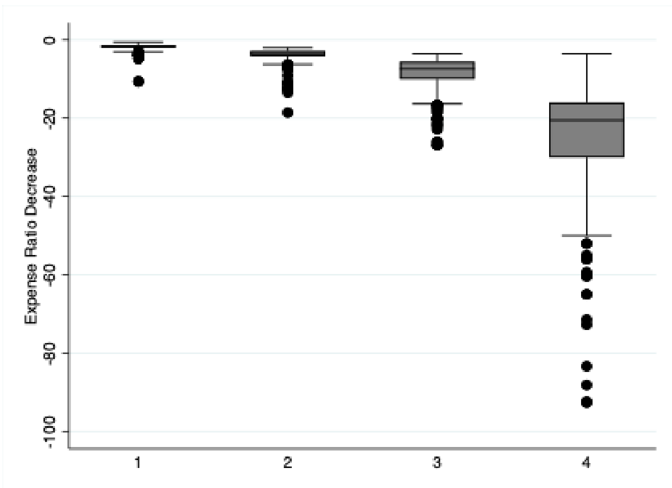


Figure 6.2: Boxplot of the quartiles of expense ratio decreases.

Probit coefficients are challenging to interpret. To do so requires to look at the marginal effects of the regressors, *ceteris paribus*. However, to this research, the sign and significance of the coefficients is of main interest. For all decreases, I find past net flow to be significantly positive in $t-4$. Meaning an increase in net flow during the quarter in $t-4$ increases the probability of decreasing expense ratios in period t. This is consistent with the findings in figure 6.1 on page 33, which saw higher flow, in $t-4$, for ETFs about to change their expense ratios. Moreover, performance too is significantly positive in $t-4$. Additionally, age, size and manager market share all have a significant positive effect on the probability of a treatment, whilst the number of funds is negatively associated. Notwithstanding different results across the scale of decrease, the tendency seems to be older and larger ETFs from bigger providers with high return and flow in $t-4$ have higher probability of lowering their expense ratios.

Table 6.5: Probit cross-sectional time-series: Treatment. The dependent variables are binary values which take the value of 1 if an observation experienced a decrease in expense ratio. *Size* is an one period lag of the natural logarithm of total net assets. $N0.ofFunds$ is the number of funds the ETF provider manages at that time. *F.Mkt.Shr.*, *M.Mkt.Shr.* and *Gr.Mkt.Shr.* are the fund, manager and two period growth market share, respectively. $Return^2$ is the squared return over the past year. *Return* and *Flow* show the past return and past net flow over the respective period. The regression accounts for fund fixed effects. The table presents coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

		Lowest	Quartile		Highest
	All	(1)	(2)	(3)	(4)
Age	0.006***	0.005**	0.006***	0.007***	0.002
	0.001	0.002	0.002	0.002	0.002
Size_{t-1}	0.045***	-0.007	0.021	0.063***	0.060***
	0.009	0.013	0.013	0.015	0.014
N0. of Funds	-0.001***	0.000	0.000	-0.002***	-0.003***
	0.000	0.000	0.000	0.000	0.000
F. Mkt. Shr.	-0.027	-0.039	-0.029	-0.114*	-0.001
	0.020	0.045	0.032	0.055	0.023
M. Mkt. Shr.	0.005***	-0.001	0.004*	0.008***	0.008***
	0.001	0.002	0.002	0.002	0.002
Gr. Mkt. Shr.	0.000*	0.000*	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
Return^2_{t-4}	-0.000	0.000	-0.000**	-0.000*	0.000
	0.000	0.000	0.000	0.000	0.000
Return_{t-1}	-0.000	0.001	0.001	-0.002	-0.002
	0.001	0.001	0.001	0.002	0.002
Return_{t-2}	-0.003*	-0.000	-0.003	-0.005*	0.000
	0.001	0.002	0.002	0.002	0.002
Return_{t-3}	0.001	-0.001	0.006**	0.005*	-0.003
	0.001	0.002	0.002	0.002	0.002
Return_{t-4}	0.002	0.005*	0.006*	0.002	-0.003

Continued on next page

Table 6.5 – Continued from previous page

		Lowest	Quartile		Highest
	All	(1)	(2)	(3)	(4)
	0.001	0.002	0.003	0.002	0.002
Flow_{t-1}	-0.000	-0.002*	-0.001	0.001	0.002
	0.001	0.001	0.001	0.001	0.001
Flow_{t-2}	0.001*	-0.000	0.000	0.002*	0.002*
	0.001	0.001	0.001	0.001	0.001
Flow_{t-3}	0.000	-0.003***	-0.001	0.001	0.002*
	0.001	0.001	0.001	0.001	0.001
Flow_{t-4}	0.003***	0.001	0.000	0.003***	0.004***
	0.000	0.001	0.001	0.001	0.001
P-value	0.000	0.000	0.000	0.000	0.000
N	35022	35022	35022	35022	35022

Intuitively, quarterly changes are relatively larger for smaller funds. Additionally, one might expect relative expense ratio decreases to be higher for already low values. As expected, figure 6 on page 65 clearly demonstrates this. Figure 6a confirms larger funds experience lower relative expense ratio decreases and figure 6b shows decreases are relatively larger for low-cost ETFs. Figure 6c and figure 6d both also show relative quarterly changes are smaller for larger funds. Thus, results might be biased towards effects of size. For this reason, I perform the same probit regression in which expense ratios and size are now categorized in quintiles, shown in table 10 on page 67 and table 11 on page 68 respectively.

Most interestingly, for ETFs in the lower size quintiles the probability of decreasing expense ratios increase with manager market share. Whilst, for ETFs in the upper size quintiles manager market share is not statistically significant. Contrarily, for the upper size quintiles net flow in $t-4$ is statistically and economically very significant. Thus, the probability of very large ETFs decreasing expense ratios increases significantly with higher past asset accumulation. In contrast, net flow in $t-4$ is not significant for the lower quintiles. This can be interpreted as economies of scale.

Moreover, the coefficient of $N0.OfFunds$ is significantly negatively related to the probability of decreasing expense ratios for the two lower quintiles. This can be interpreted as economies of scope. Proliferation of funds for a small ETF provider decreases its probability to lower fees, whilst the coefficient renders insignificant for the upper quintiles.

The following subsection documents the results of treatment-effects estimators, in which the probit regressions are included in the last panels.

6.1.4 Treatment-effects

Table 6.6 documents an extract of the results of the IPWRA treatments-effects estimator for the subsequent quarter after a fee change. In the first panel, the table documents an overall larger net flow during the subsequent quarter for the treated sample. Funds without treatment grew on average 5.54% and funds with treatment 7.28%.

The first and second quartile yield significantly lower subsequent net flow at the 95% and 99% level, respectively. In stark constrast, relatively large expense ratio decreases are associated with significantly higher subsequent net flow. Flow in the third quartile shows an average higher flow of 5.57% and the largest relative decreases show an higher average flow of 3.53%. Thus, the results suggest relative decreases in the top 50% are associated with subsequent higher inflow of assets. This table suggests a sweet spot for decreasing the expense ratio with approximately 8.5% (see table 6.4 on page 37.).

Table 6.6: Treatment Effect: New Flow t=1. The treatment variable is change in expense ratio. The table shows coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

		Lowest	Quartile		Highest
	All	(1)	(2)	(3)	(4)
No Change	5.539***	5.696***	5.698***	5.595***	5.628***
	0.155	0.153	0.153	0.153	0.154
Change	7.276***	2.945*	5.018***	11.460***	9.153***
	0.650	1.381	0.940	1.726	1.491
N	22637	22637	22637	22637	22637

All regression adjustments and probit results are presented in table 12 on page 69. In this table, the second and third panel display the regression adjustment coefficients for the untreated and treated groups, respectively. Conform results in the cross-sectional time-series regression in table 9 on page 66, all coefficients but turnover are highly significant for the untreated groups. However for the treated subsample, the coefficients only show significance for Age_{t+1}, $Return_{t-1}$ and $Inc.Yield_{t+1}$. The fourth panel shows the coefficients for the treatment probit model. The probit model should diminish the potential influence of endogeneity.

An extract of the results of another IPWRA treatment-effects estimator are presented in table 6.7 on the following page. Now, the dependent variable is growth or decline of fund market share. The treatment variable, again, is a binary value dependent on a change in expense ratio and its relative value.

Overall, subsequent growth of 2.2% in fund market share is significantly higher at the 99% level than the untreated average of 0.91%. The higher growth is fully driven by the top two quartiles. The effect of decreasing expense ratios seems to have the same impact on subsequent fund market share as on net flow. All results are shown in table 13 on page 70.

Table 6.7: Treatment Effect: Market Share Change t=1. The treatment variable is change in expense ratio. The table shows coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

		Lowest	Quartile		Highest
	All	(1)	(2)	(3)	(4)
No Change	0.905***	1.049***	1.006***	0.914***	0.944***
	0.144	0.141	0.142	0.141	0.141
Change	2.208***	-4.269**	0.499	7.311***	3.374*
	0.644	1.301	1.004	1.727	1.415
N	22637	22637	22637	22637	22637

In conclusion, an increase in net flow and market share does depend on the magnitude of a decrease in expense ratio. Hence, I reject the null-hypothesis of Hypothesis 4. Larger changes in expense ratio coincide with larger consequent net flow and fund market share.

6.2 Robustness

Welch approximation

I perform unreported two-sample t-tests without a Welch approximation and unequal variances. The results are substantially identical.

Panel regression

I perform several robustness checks with regards to the panel regression section. First, using the morningstar sample I reproduce the cross-sectional regression with a focus on the relationship between fund market share and expense ratio. Table 14 on page 71 documents the results for all ETFs active in 2019. Although the sample lacks time-series data, the regression can be used to confirm the instinctive relation between fund market share and expense ratios. In the CRSP sample, I found low-cost funds to be associated with larger size. The findings, reported in table 14, render the same conclusions. A decrease in expense ratio of 1bps is associated with an increase in fund market share of 0.004% in the equity sample. Backwards, a 1% increase in fund market share is associated with a 8.5bps lower expense ratio for the equity sample.

Second, in unreported analysis, I add *Number of Funds* to table 6.3. Doing this, I follow Ferreira and Ramos (2009) who found fund proliferation to be negatively related to expense ratios and positively to firm competition. Additionally, Massa (1998), too, interprets the growing number of funds as a competive strategy to limit competition. The coefficients, however, did not add to the model and did not prove to be statistically significant.

Third, again replicating table 6.3, I include asset class fixed effects as interaction terms with time fixed effects, following Del Guercio and Tkac (2002). Including the style component adjusts for differences amongst average flows of, for instance, equity and fixed income. The estimates are documented in table 15 on page 72. It follows, apart from having a marginal effect on several coefficients, the initial results are robust to including effects of investment objectives.

Treatment effects

In the same line of thought as the earlier elaboration on the effect of size on relative changes in subsection 6.1.3 on page 36, one could argue size is not incorporated in the regression adjustment of the treatment-effects estimator. To that end, in unreported analysis, I find adding size to the regression adjustment panel does not yield significant estimates. Moreover, it does not significantly influence the level of subsequent net flow as reported in this thesis.

6.3 Limitations and biases

Several factors could potentially bias the results. Four particular concerns arise from possible sample selection bias, the measurement of prior performance and relative average true range, the temporal relation and the measurement of costs. Below I dicuss these concerns.

First, although the ETF industry concentrates around the United States, the research makes use of a restricted sample. It is therefore unsure whether research on worldwide, Asian or European ETFs would yield the same results. Moreover, strategic decisions of ETF providers are most likely dependent on actions of global rivals. Since some large European competitors are excluded from the analysis, certain external factors are unaccounted for. Secondly, the research incorporates all possible ETFs, known to CRSP. No exclusions have been made on the basis of, for instance, strategy or leverage.

Second, with regards to measuring performance, it is unsure, a priori, how and over which timeframe investors appraise performance. I calculate performance on a quarterly basis and the results assume net flows are an ex-post decision. In contrast, investors could anticipate future returns. Thus future research could extend this analysis by including market timing models.

Third, constrained by a lack of data on expense ratios, the sample is on quarterly temporal basis. Unfortunately, this does not facilitate the measurement of net flow and changes in expense ratios as of the exact moment. Although I follow Barber et al. (2005) and Sirri and Tufano (1998) on the chosen methodology of measuring flows at a quarterly interval, short-term investment behavior is ignored. Admittedly, this is less than perfect.

In this thesis costs are represented by expense ratios. Yet, as explained in section 2.2 on page 9, the total cost of ownership comprises of more than just the expense ratio. In the models, I have corrected for effects of dividend sums and turnover. However, I failed to account for transaction and sampling costs.

Chapter 7

Conclusion

The past decade can be characterized by a surge in assets flowing to exchange traded funds. Meanwhile, approximately since the global financial crisis, asset-weighted expense ratios have been on the decline. This thesis studies the effect of a decreasing expense ratio, of an ETF trading in the United States, on subsequent net flow and fund market share. First, I test whether average quarterly net flow is significantly higher after a decrease in expense ratio than for constant expenses. The results from a two-sample t-test show flows in $t + 2$, $t + 3$ and $t + 4$ are on average 2.89%, 6.59% and 5.77% higher, respectively. The result for $t + 1$ is not statistically significant. For this reason I reject the null-hypothesis of Hypothesis 1 for abovementioned respective periods. Average net flow of U.S. ETFs is higher for those lowering their expense ratio than for those who do not.

Second, using a cross-sectional time-series regression controlling for fund and time fixed effects, I test whether there is a negative relation between decreasing expense ratios and subsequent net flow and fund market share. The results do confirm an intuitive negative relationship between expense ratio and total fund assets, either expressed as its natural logarithm or as quarterly growth. The coefficient of decreasing expense ratios, however, does not render significant. Paradoxically, even, the coefficient of all expense ratio decreases (thus including increases in costs) shows a positive relation, suggesting an increase in expense ratio is associated with a higher relative increase in net flow and fund market share. This result cannot be explained by a size effect, as scatterplots show a tendency of decreasing percentual changes in expense ratio, net flow and market share with size. Hence, I cannot reject the null-hypothesis of Hypothesis 2 and 3. There is no negative relation over time between decreasing expense ratios and its subsequent net flow and fund market share. I can confirm assets are concentrated in low-cost funds and low-cost funds are associated with higher flow. I suspect large time invariation of expense ratio coefficients to distort results in the time-series regression. To circumvent this problem, I consider lowering expense ratios to be a treatment expressed as a binary variable.

Lastly, I hypothesize the level of net flow and market share depends on the magnitude of a decrease in expense ratios. To that end, I categorize expense ratio decreases in quartiles, dependent on its relative value and the time period. Before turning to treatment-effects estimators, I perform probit regressions to determine potential endogeneous variables increasing the probability of receiving a treatment. In particular, the results indicate a significant effect of past performance, past flows and manager market share on the probability of an ETF receiving a treatment. Using these variables in an inverse probability weighting regression adjustment treatment-effects estimator, I find net flow of ETFs experiencing an expense ratio decrease to be economically and statistically higher on average for the overall sample. No change generated an average flow of 5.5%, whilst change yielded 7.3%. The results are completely driven by the highest quartiles of expense ratio decreases. Thus, large decreases in expense ratios are associated with higher subsequent net flow. The same applies to changes in market share. Consequently, I reject the null-hypothesis of Hypothesis 4. An increase in net flow and market share, on average, does depend on the magnitude of a decrease in expense ratio.

In short, I find evidence investors in United States exchange traded funds are fee-senstive. First, low cost funds accumulate more assets. Second, on average, funds can expect to see higher subsequent net flow after large relative expense ratio decreases. This study reinforces the business case of ETF providers, accumulating assets and gaining scale. Policy makers should be aware of an highly concentrated industry which could become even more concentrated.

Future research could extend this study using data with higher temporal frequency. For instance, it could zoom in on short-term creation and redemption behavior. Furthermore, future research could improve the explanatory power of the models by including stock exchange related control variables comprising the full cost of ownership.

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Appendices

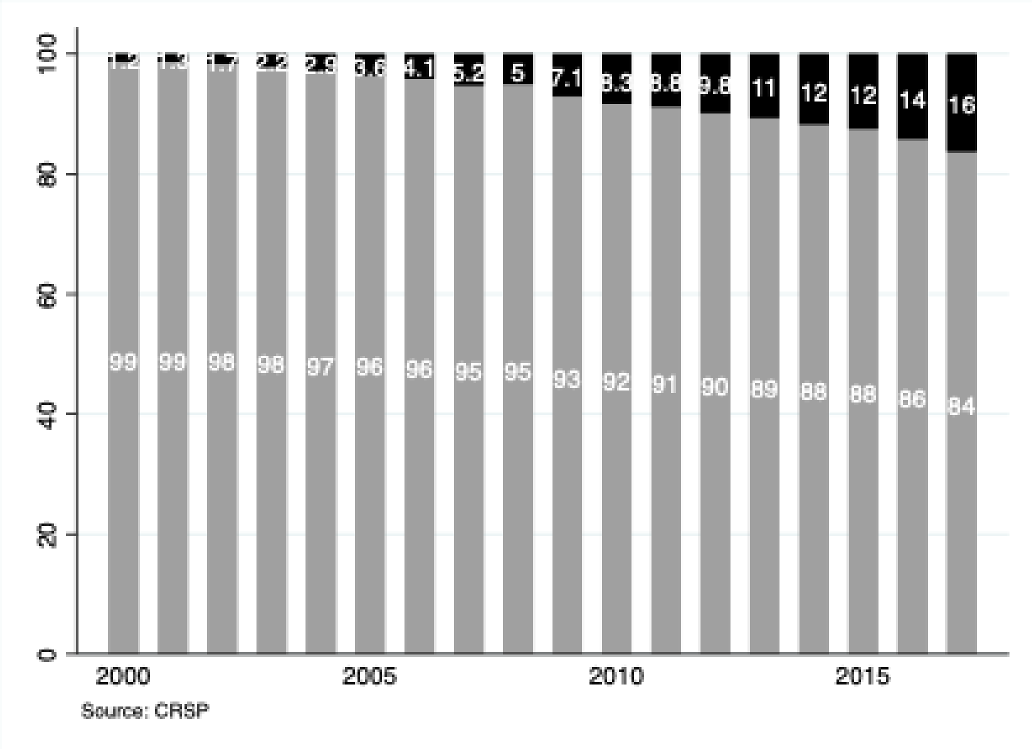


Figure 1: This image shows the distribution of all assets under management, known to CRSP, between mutual funds and exchange traded funds. All values are expressed as percentages.

Table 1: Descriptive statistics: total net assets per fee decile. All values below are expressed as percentages. Missing values in the first few years are due to a lack of observations. The deciles rank from low to high expense ratios.

	Low				Decile					High
Year	1	2	3	4	5	6	7	8	9	10
1998	89.1					10.9				
1999	92.0							8.0		
2000	90.2	8.1	0.8		0.4	0.2	0.1	0.1	0.1	0.0
2001	77.0	7.3	8.8		4.4	0.2	2.0			0.3
2002	79.5	0.1	9.2	2.4	3.5	0.9	2.2	1.8		0.3
2003	46.9	26.8	9.3	4.3	4.2	1.6	2.7	3.4		0.9
2004	43.0	21.9	9.8	4.1	0.8	9.2	3.4	3.3	3.0	1.6
2005	36.3	19.7	11.0	3.1		8.8	11.5	0.3	3.1	6.1
2006	32.8	19.2	12.4	0.4	11.0	5.1	6.8	3.6	0.8	7.8
2007	47.3	12.2	10.0	8.8	2.3	5.2	1.8	4.4	6.4	1.6
2008	55.2	11.0	10.6	4.9	3.8	2.7	0.9	6.2	4.6	0.0
2009	44.0	13.0	9.0	8.9	6.6	2.0	3.1	7.8	5.5	0.1
2010	45.1	11.2	7.1	11.9	6.2	4.7	1.7	7.5	4.5	0.1
2011	30.4	28.2	6.1	14.0	5.6	4.9	5.0	1.6	4.0	0.2
2012	30.8	29.5	6.2	12.5	7.3	3.0	6.5	1.3	2.8	0.1
2013	38.0	26.2	6.9	9.9	4.2	4.7	5.3	1.6	2.7	0.4
2014	49.3	17.8	6.5	7.3	7.2	3.1	2.4	3.4	2.8	0.2
2015	40.8	27.4	7.4	6.0	6.2	4.4	3.0	2.1	2.5	0.2
2016	43.0	28.3	6.5	5.4	5.5	4.1	2.7	2.0	2.3	0.1
2017	44.8	24.6	8.0	6.5	4.0	4.5	2.9	2.4	2.0	0.4

Source: CRSP

Table 2: Descriptive statistics: total net assets per asset class in billions of dollars. The CRSP Style Code consists of up to four characters, following an increasing level of granularity. I only include the first two characters in the table below. The first character (E,I,M,O) stands for *Equity*, *FixedIncome*, *MixedFI&Equity* and *Other* respectively. The second character, within equity, represents *Domestic*(*D*) and *Foreign*(*F*). Fixed Income makes distinctions between *Corporate*(*C*), *Foreign*(*F*), *Government*(*G*) and *MoneyMarket*(*U*). Other can be placed in *MortgageBacked*(*M*) and *Currency*(*C*).

	Equity		**Fixed Income**					**Other**			
	Domestic	Foreign	Corporate	Foreign	Government	MoneyMarket	Mixed	Other	Currency	Mortgage Backed	Funds
1998											2
1999											4
2000		1.65									21
2001	76.95	1.80					0.98				64
2002	91.76	2.59					1.05				92
2003	129.27	12.79	2.31		2.00		2.15				110
2004	175.76	32.49	2.52		3.47		2.98				131
2005	211.71	63.75	2.42		9.69		3.43				154
2006	263.47	106.62	2.72		12.88		5.15				203
2007	380.17	166.47	3.32		18.83		16.75				387
2008	303.43	102.40	8.80	0.98	22.88	1.05	5.03			0.86	552
2009	446.37	198.29	17.72	4.12	32.90	5.53	12.03			1.76	683
2010	578.09	258.68	21.94	5.48	37.58	6.90	1.70		5.01	2.29	803
2011	612.58	222.48	19.90	9.69	52.67	8.17	2.25		6.13	4.42	951
2012	759.48	303.92	29.77	16.55	53.83	11.71	2.82	0.12	3.55	8.43	1,112
2013	1017.48	377.65	18.48	12.24	43.51	10.65	5.18	8.74	3.29	12.50	1,181
2014	1243.26	397.36	23.63	15.73	54.96	14.05	7.33	11.15	2.63	14.82	1,257
2015	1246.45	458.93	28.85	16.75	66.50	18.17	12.13	9.69	2.78	15.31	1,374
2016	1571.56	476.45	54.11	24.19	77.92	23.66	11.77	12.79	2.49	27.59	1,539
2017	2033.20	757.02	81.07	36.26	100.47	29.50	14.57	14.84	1.86	37.09	1,618

Source: CRSP

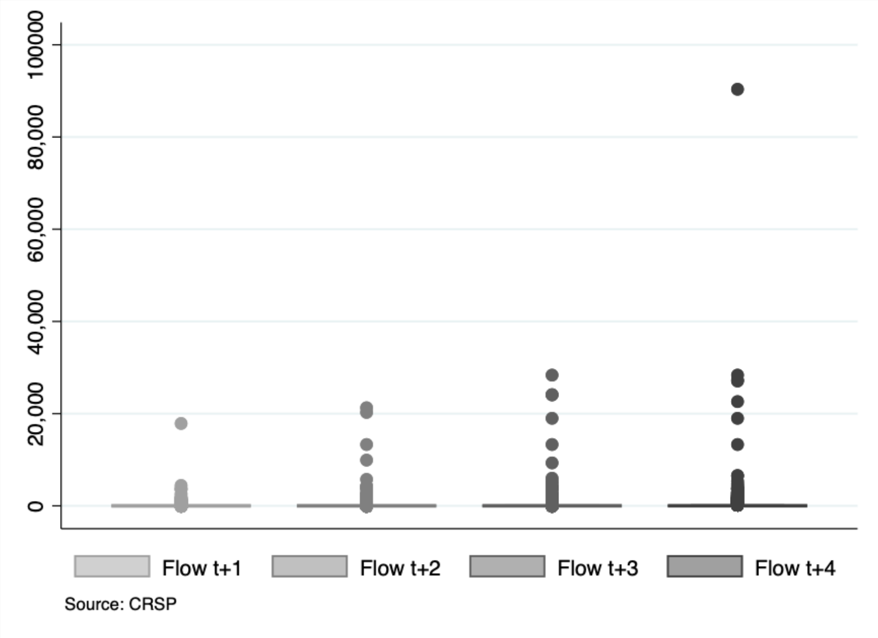


Figure 2: Boxplot: Net Flow. This figure displays boxplots of the original Net Flow variable.

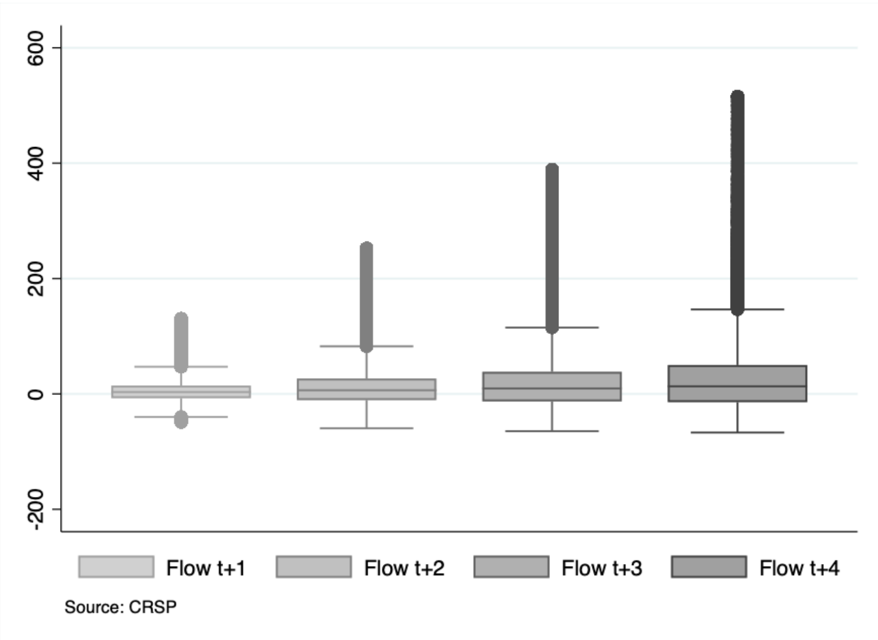
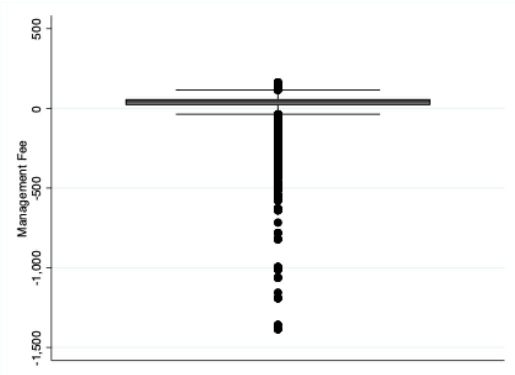
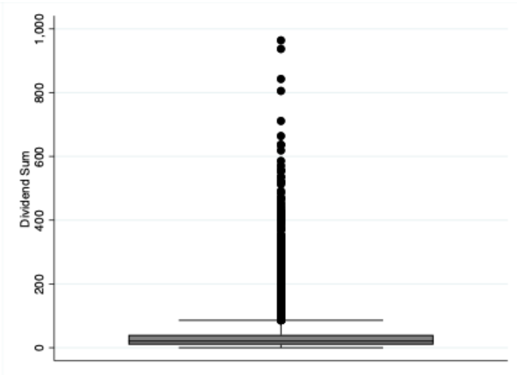


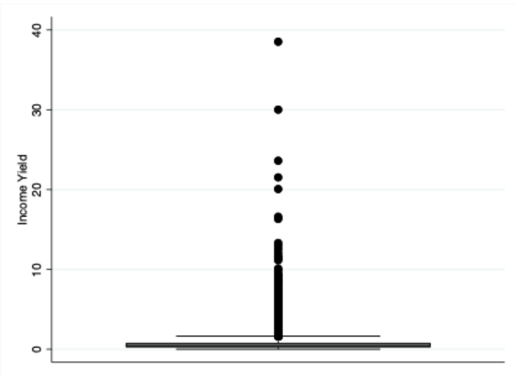
Figure 3: Boxplot: Net Flow Winsorized. This figure displays boxplots of the Net Flow variable, winsorized at the 1:99 level.



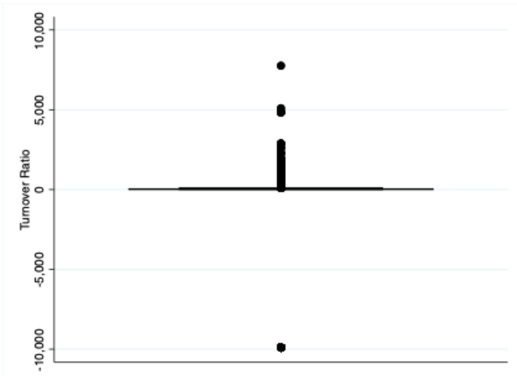
(a) Management Fee



(b) Dividend Sum



(c) Income Yield



(d) Turnover Ratio

Figure 4: Boxplot: independent variables. The image displays boxplots of several independent variables. Panel (a) shows management fee, panel (b) shows dividend sum, panel (c) shows income yield and panel (d) concludes with turnover ratio. The winsorized variables are shown in figure 4.1 on page 22.

Table 3: Correlation matrix: CRSP sample.

	TNA	TER	Mgmt.Fee	Age	RATR	Cap.G.	N0.F	Inc.Y	Div.S	Turn.	TER.C	TER.D	Mkt.Shr.C.	Flow	Ret.
TNA	1														
TER	-0.23	1													
Mgmt. Fee	-0.18	0.77	1												
Age	0.33	-0.23	-0.16	1											
RATR	-0.12	0.43	0.33	-0.05	1										
Cap. Gains	-0.07	0.37	0.27	-0.11	0.56	1									
N0. of Funds	0.15	-0.29	-0.08	0.35	-0.07	-0.06	1								
Inc. Yield	-0.07	0.11	0.15	-0.01	0.08	-0.11	0.03	1							
Div. Sum.	0.08	-0.07	-0.02	0.13	0.03	-0.07	0.08	0.80	1						
Turnover	0.13	0.04	-0.12	0.02	-0.12	-0.16	-0.03	-0.04	0.01	1					
TER C.	-0.08	0.04	0.00	-0.06	0.11	-0.01	0.08	-0.02	-0.02	0.08	1				
TER D.	-0.19	0.03	0.12	-0.04	-0.01	0.05	0.07	0.04	0.01	-0.12	0.31	1			
Mkt.Shr.C.	-0.08	0.03	0.05	-0.06	0.09	0.05	-0.02	0.07	0.05	-0.08	0.00	0.04	1		
Flow_{t+1}	-0.07	-0.03	-0.01	-0.06	0.03	-0.04	-0.02	0.09	0.06	-0.05	0.00	0.00	0.98	1	
Return_{t-1}	0.01	-0.02	-0.08	-0.05	-0.39	-0.35	-0.06	-0.07	0.03	0.06	0.07	0.04	-0.03	0.00	1

Table 4: The table shows the results of a two-sample t-test using a Welch approximation. The variables of interest are net flow after decreasing fees and net flow without change. The table shows summary statistics, t-statistics and P-values.

Variable	Observation	Mean	Std. Error	Std. Deviation	95% Confidence Interval	
Fee decrease 1Q	2,282	7.009168	.5343532	25.5262	5.961299	8.057037
No fee change 1Q	35,258	6.209139	.1426025	26.77664	5.929633	6.48864
	Diff = mean(Fee decrease 1Q) - mean(No fee change 1Q) t = 1.4466					
H0: Diff = 0					Welch's degrees of freedom = 2617	
	$Ha : diff < 0$		$Ha : diff \neq 0$		$Ha : diff > 0$	
	$Pr(T < t) = 0.9259$		$Pr(\lvert T\rvert > \lvert t\rvert) = 0.1481$		$Pr(T > t) = 0.0741$	
Fee decrease 2Q	2,107	17.23699	1.013372	46.51589	15.24968	19.22431
No fee change 2Q	30,381	14.346	.2673155	46.59349	13.82205	14.86995
	Diff = mean(Fee decrease 2Q) - mean(No fee change 2Q) t = 2.7585					
H0: Diff = 0					Welch's degrees of freedom = 2409	
	$Ha : diff < 0$		$Ha : diff \neq 0$		$Ha : diff > 0$	
	$Pr(T < t) = 0.9971$		$Pr(\lvert T\rvert > \lvert t\rvert) = 0.0059$		$Pr(T > t) = 0.0029$	
Fee decrease 3Q	1,992	29.84273	1.826247	81.50875	26.26117	33.42428
No fee change 3Q	25,958	23.25643	.4143288	66.75453	22.44432	24.06853
	Diff = mean(Fee decrease 3Q) - mean(No fee change 3Q) t = 3.5171					
H0: Diff = 0					Welch's degrees of freedom = 2201	
	$Ha : diff < 0$		$Ha : diff \neq 0$		$Ha : diff > 0$	
	$Pr(T < t) = 0.9998$		$Pr(\lvert T\rvert > \lvert t\rvert) = 0.0004$		$Pr(T > t) = 0.0002$	
Fee decrease 4Q	1,913	38.32699	2.40215	105.0649	33.61588	43.0381
No fee change 4Q	23,237	32.56145	.5662818	86.32222	31.4515	33.6714
	Diff = mean(Fee decrease 4Q) - mean(No fee change 4Q) t = 2.3361					
H0: Diff = 0					Welch's degrees of freedom = 2130	
	$Ha : diff < 0$		$Ha : diff \neq 0$		$Ha : diff > 0$	
	$Pr(T < t) = 0.9902$		$Pr(\lvert T\rvert > \lvert t\rvert) = 0.0196$		$Pr(T > t) = 0.0098$	

Table 5: The table shows the results of a two-sample t-test using a Welch approximation. The variables of interest are net flow after decreasing and increasing fees, respectively. The table shows summary statistics, t-statistics and P-values.

Variable	**Observation**	**Mean**	**Std. Error**	**Std. Deviation**	**95% Confidence Interval**	
Fee decrease 1Q	2,282	7.009168	.5343532	25.5262	5.961299	8.057037
Fee increase 1Q	977	6.320179	..8958317	28.00101	4.562201	8.078157
	Diff = mean(Fee decrease 1Q) - mean(Fee increase 1Q) t = 0.6605					
H0: Diff = 0					Welch's degrees of freedom = 2703	
	$Ha : diff < 0$		$Ha : diff \neq 0$		$Ha : diff > 0$	
	$Pr(T < t) = 0.7455$		$Pr(\lvert T \rvert > \lvert t \rvert) = 0.5090$		$Pr(T > t) = 0.2545$	
Fee decrease 2Q	2,107	17.23699	1.013372	46.51589	15.24968	19.22431
Fee increase 2Q	911	12.71365	1.467483	44.29272	9.833607	15.5937
	Diff = mean(Fee decrease 2Q) - mean(Fee increase 2Q) t = 2.5364					
H0: Diff = 0					Welch's degrees of freedom = 1809	
	$Ha : diff < 0$		$Ha : diff \neq 0$		$Ha : diff > 0$	
	$Pr(T < t) = 0.9944$		$Pr(\lvert T \rvert > \lvert t \rvert) = 0.0113$		$Pr(T > t) = 0.0056$	
Fee decrease 3Q	1,992	29.84273	1.826247	81.50875	26.26117	33.42428
Fee increase 3Q	894	25.54734	2.692474	80.50453	20.26302	30.83165
	Diff = mean(Fee decrease 3Q) - mean(Fee increase 3Q) t = 1.3203					
H0: Diff = 0					Welch's degrees of freedom = 1740	
	$Ha : diff < 0$		$Ha : diff \neq 0$		$Ha : diff > 0$	
	$Pr(T < t) = 0.9065$		$Pr(\lvert T \rvert > \lvert t \rvert) = 0.1869$		$Pr(T > t) = 0.0935$	
Fee decrease 4Q	1,913	38.32699	2.40215	105.0649	33.61588	43.0381
Fee increase 4Q	853	32.99373	3.56742	104.1907	25.99176	39.99569
	Diff = mean(Fee decrease 4Q) - mean(Fee increase 4Q) t = 1.2401					
H0: Diff = 0					Welch's degrees of freedom = 1650	
	$Ha : diff < 0$		$Ha : diff \neq 0$		$Ha : diff > 0$	
	$Pr(T < t) = 0.8924$		$Pr(\lvert T \rvert > \lvert t \rvert) = 0.2151$		$Pr(T > t) = 0.1076$	

Table 6: Cross-sectional time-series regression with fund and time fixed effects. The dependent variable for all columns is the natural logarithm of total net assets. The independent variables are in the same format as described in table 4.1 on page 24. $Return^2_{t-4}$ is the squared return of the past twelve months. $Return_{t-x}$ is the performance of the ETF during period $t-x$. The table shows coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

	Equity		Fixed Income		Mixed		Other	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
TER	-0.017***		-0.028***		0.026*		-0.119*	
	0.004		0.008		0.012		0.048	
Mgmt. Fee		0.008*		-0.007		0.015**		-0.034*
		0.004		0.008		0.006		0.015
RATR	0.003***	0.003***	0.001	0.001	0.015*	0.014*	-0.019	-0.012
	0.000	0.000	0.001	0.001	0.006	0.006	0.015	0.016
Age	0.044***	0.053***	0.039***	0.040***	-0.035	0.016	0.048***	0.056***
	0.003	0.002	0.007	0.007	0.050	0.056	0.007	0.009
Turnover	-0.001	-0.001	-0.002*	-0.002*	0.001	-0.000	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
Inc. Yield	-0.188***	-0.187***	0.017	0.026	0.099	0.082	-0.231	-0.182
	0.027	0.027	0.081	0.080	0.089	0.079	0.440	0.494
Div. Sum	0.002***	0.003***	-0.001	-0.001	-0.000	-0.001	0.012	0.013
	0.001	0.001	0.002	0.002	0.002	0.001	0.013	0.017
Return^2_{t-4}	0.000	0.000	0.000	0.000	0.001***	0.001***	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Return_{t-1}	0.007***	0.007***	0.002	0.002	0.017**	0.016**	0.004	0.005
	0.001	0.001	0.002	0.002	0.006	0.006	0.011	0.011
Return_{t-2}	0.008***	0.008***	0.002	0.002	0.007	0.009	-0.001	-0.001
	0.001	0.001	0.002	0.002	0.005	0.004	0.009	0.010
Return_{t-3}	0.007***	0.007***	-0.001	-0.001	0.008	0.008	0.001	-0.002
	0.001	0.001	0.002	0.002	0.005	0.005	0.010	0.011
Return_{t-4}	0.006***	0.006***	0.002	0.002	0.007	0.009*	0.002	0.005

Continued on next page

Table 6 – Continued from previous page

	Equity		Fixed Income		Mixed		Other	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
	0.001	0.001	0.002	0.002	0.005	0.004	0.009	0.010
Fund FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Adj. R^2	0.479	0.473	0.446	0.430	0.619	0.639	0.351	0.265
AIC	22230	22423	2750	2848	-107	-133	327	364
BIC	22802	22987	3051	3150	85	55	423	460
P-value	0.000	0.000	.	.	.	.	.	.
N	16796	16796	3468	3468	438	438	298	298

Table 7: Summary statistics: Morningstar. *Rating* refers to the rating given by Morningstar, *Tenure* refers to the average number of years of a manager on the job, TNA is total net assets, *SharesOut* is the number of shares outstanding in millions, *Return* is the annualized return per period of time, *Premium* refers to the premium(disount) relative to NAV, NER is the net expense ratio, *Turnover* is the turnover ratio, *Volume* refers to the 3-month average daily volume in millions of shares, *Age* is the number of active years and *FundMkt.Shr.* is the market share of ETFs in percentages.

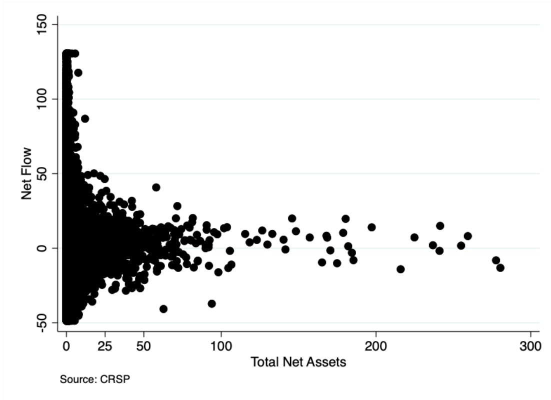
	Equity				Fixed Income				Other			
	Obs	Mean	Min	Max	Obs	Mean	Min	Max	Obs	Mean	Min	Max
Rating	798	3.3	1.0	5.0	215	3.0	1.0	5.0	65	3.1	1.0	5.0
Tenure	1165	4.2	0.1	26.1	293	4.3	0.0	11.2	310	4.8	0.3	14.2
TNA	1170	2453.1	1.2	256910.4	293	2317.2	4.6	57765.2	354	327.9	1.0	33984.3
Shares Out	1169	33.5	0.0	1714.7	292	39.7	0.1	538.2	354	11.3	0.0	1003.3
Return YTD	1170	11.5	-16.1	43.0	293	2.3	-3.7	8.9	354	5.4	-49.8	77.9
Return 1Y	1170	-1.8	-43.6	28.2	293	2.3	-13.8	7.3	354	-6.7	-57.9	120.8
Return 2Y	1033	7.0	-26.5	40.8	251	2.5	-3.6	5.3	319	-3.3	-66.5	114.7
Return 3Y	900	13.1	-8.8	43.5	216	3.4	-7.0	12.4	302	-0.2	-87.0	89.8
Return 5Y	692	5.9	-28.8	23.1	166	2.4	-3.8	8.1	258	-7.0	-80.5	46.6
Premium	1170	0.0	-2.2	5.3	293	0.0	-0.9	0.7	354	0.1	-20.4	19.7
NER	1170	44.3	1.0	152.0	293	30.9	1.0	170.0	354	83.0	1.0	190.0
Turnover	1170	281.0	0.0	271677.0	289	61.7	0.0	834.0	288	336.9	0.0	77384.0
Volume	1163	1.0	0.0	112.7	290	0.7	0.0	25.2	353	0.9	0.0	37.7
Age	1170	8.3	2	26	293	6.5	2	17	354	8.4	2	15
Fund Mkt. Shr.	1170	0.1	0.0	9.0	293	0.3	0.0	8.5	354	0.3	0.0	29.3
N	1170				293				354			

Table 8: Correlation Matrix: Morningstar.

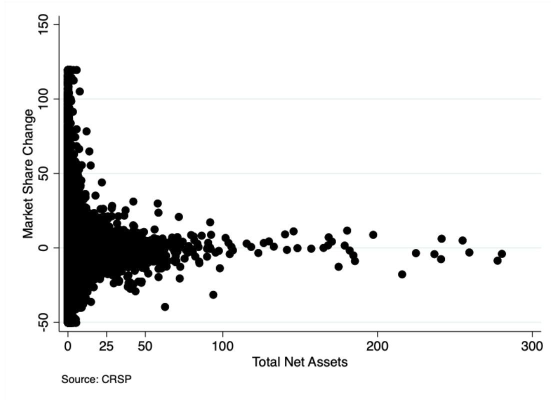
					Return										
	Rat.	Ten.	TNA	Shrs.	YTD	1Y	2Y	3Y	5Y	Prem.	NER	Turn.	Vol.	Age	Mkt.Shr
Rating	1														
Tenure	0.01	1													
TNA	0.12	0.23	1												
Shares Out	0.10	0.08	0.71	1											
Return YTD	0.13	0.01	0.00	-0.05	1										
Return 1Y	0.36	0.09	0.07	0.00	0.11	1									
Return 2Y	0.40	0.08	0.10	0.02	0.24	0.48	1								
Return 3Y	0.32	0.00	0.04	-0.02	0.65	0.16	0.67	1							
Return 5Y	0.48	0.05	0.10	0.01	0.24	0.49	0.81	0.61	1						
Premium	0.13	0.07	0.03	0.04	0.03	0.17	0.12	0.04	0.16	1					
NER	-0.28	0.03	-0.26	-0.25	0.03	-0.32	-0.13	0.04	-0.20	-0.18	1				
Turnover	-0.11	0.03	-0.06	-0.08	-0.08	-0.03	-0.08	-0.12	-0.07	0.01	0.22	1			
Volume	0.01	0.17	0.63	0.64	0.01	-0.02	0.01	0.04	0.01	0.02	-0.09	-0.06	1		
Age	0.07	0.33	0.30	0.21	0.25	0.13	0.21	0.22	0.23	0.01	-0.18	-0.13	0.28	1	
F. MktShr.	0.06	0.23	0.81	0.64	-0.17	0.10	-0.01	-0.14	-0.01	0.06	-0.28	0.01	0.47	0.23	1

(a) Decrease vs. Size

(b) Decrease vs. Exp Ratio



(c) Net Flow



(d) Market Share Change

Figure 6: The figure displays two-way scatterplots of distributions of dependent variables, relative to size or expense ratio. Panel (a) shows the decrease of expense ratios relative to size, panel (b) again shows the decrease of expense ratios relative to its base rate, panel (c) shows net flow in $t+1$ relative to size and panel (d) concludes with changes in market share in $t+1$ relative to total assets.

Table 9: Regression: quarterly growth. The dependent variables are net flow and change fund market share. The independent variables are in the same format as described in table 4.1 on page 24. $TERC.$ takes the value of the change in TER or 0 if non-existent, $TERD.$ takes the value of the percentual decrease in TER or 0 if non-existent. The same logic applies to the management fee variables. The table shows coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

	Net Flow		Mkt. Shr. Change	
	(1)	(2)	(1)	(2)
TER	-0.129**		-0.128**	
	0.047		0.044	
TER C.	-0.007		-0.007	
	0.006		0.006	
TER D.	0.079*		0.078*	
	0.038		0.036	
Mgmt. Fee		-0.303***		-0.295***
		0.042		0.041
Mgmt. Fee C.		0.018		0.017
		0.012		0.012
Mgmt. Fee D.		0.015		0.019
		0.036		0.035
RATR	0.170***	0.168***	0.161***	0.159***
	0.021	0.021	0.020	0.020
Age	-0.147*	-0.004	0.467***	0.608***
	0.068	0.073	0.058	0.061
Inc. Yield	-4.049***	-4.240***	-3.766***	-3.952***
	0.685	0.671	0.654	0.641
Div. Sum.	0.001	0.003	-0.001	0.002
	0.012	0.012	0.012	0.012
Return_{t-1}	1.172***	1.164***	1.141***	1.133***
	0.073	0.073	0.071	0.071
Return_{t-2}	0.490***	0.481***	0.460***	0.452***
	0.033	0.033	0.032	0.032
Return_{t-3}	0.196***	0.187***	0.188***	0.180***
	0.031	0.030	0.030	0.030
Return_{t-4}	0.158***	0.155***	0.156***	0.153***
	0.028	0.027	0.026	0.026
Fund FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Adj. R^2	0.270	0.273	0.196	0.199
AIC	208479	208372	20640	206291
BIC	209085	208978	207006	206897
P-value	0.000	0.000	0.000	0.000
N	23932	23932	23932	23932

Table 10: Probit cross-sectional time-series: Treatment. The dependent variable is the treatment variable, which takes the value of 1 if an observation experienced a decrease in expense ratio. The dependent variable is categorized in quintiles of the height of expense ratio. *LagSize* is the one period lag of the natural logarithm of total net assets, $N0.OfFunds$ is the number of funds the ETF provider manages. *F.Mkt.Shr.*, *M.Mkt.Shr.* and *Gr.Mkt.Shr.* are the fund, manager and two period growth market share, respectively. $Return^2$ is the squared return over the past year. *Return* and *Flow* show the past return and past net flow over the respective period. The regression accounts for fund fixed effects. The table presents coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

	Lowest		Quintile		Highest
	(1)	(2)	(3)	(4)	(5)
Age	-0.000	0.011***	0.009***	0.007**	0.011*
	0.002	0.003	0.002	0.002	0.004
Size_{t-1}	0.079***	-0.050*	-0.020	0.080***	0.115***
	0.021	0.022	0.016	0.018	0.023
N0. of Funds	0.000	-0.002**	-0.001**	-0.001	-0.005***
	0.001	0.001	0.000	0.000	0.001
F. Mkt. Shr.	0.007	-0.012	-0.002	-0.021	-0.038
	0.023	0.092	0.059	0.079	0.117
M. Mkt. Shr.	-0.021***	0.005*	0.008***	0.008***	0.013***
	0.003	0.003	0.002	0.002	0.003
Gr. Mkt. Shr.	0.000	-0.000	0.000	0.000*	0.001***
	0.001	0.000	0.000	0.000	0.000
Return^2_{t-4}	0.000***	0.000	-0.001***	-0.000*	-0.000
	0.000	0.000	0.000	0.000	0.000
Return_{t-1}	0.001	0.002	-0.004	-0.001	0.001
	0.003	0.003	0.003	0.003	0.001
Return_{t-2}	-0.001	0.003	-0.001	-0.007*	-0.004
	0.003	0.004	0.003	0.003	0.002
Return_{t-3}	-0.006*	0.004	0.003	-0.000	0.005
	0.003	0.003	0.003	0.003	0.002
Return_{t-4}	0.007	0.007*	0.006	0.001	0.003
	0.004	0.003	0.004	0.003	0.002
Flow_{t-1}	-0.002	0.001	-0.001	-0.001	0.002
	0.001	0.001	0.001	0.001	0.001
Flow_{t-2}	0.003*	0.002	-0.001	0.003*	-0.000
	0.001	0.001	0.001	0.001	0.001
Flow_{t-3}	0.001	0.002	-0.002	0.000	-0.002
	0.001	0.001	0.001	0.001	0.001
Flow_{t-4}	0.004**	0.002	0.003**	0.003**	0.002
	0.001	0.001	0.001	0.001	0.001
P-value	0.000	0.000	0.000	0.000	0.000
N	7908	7423	6831	6987	5873

Table 11: Probit cross-sectional time-series: Treatment. The dependent variable is the treatment variable, which takes the value of 1 if an observation experienced a decrease in expense ratio. The dependent variable is categorized in quintiles of total net assets. *LagSize* is the one period lag of the natural logarithm of total net assets, $N0.OfFunds$ is the number of funds the ETF provider manages. *F.Mkt.Shr.*, *M.Mkt.Shr.* and *Gr.Mkt.Shr.* are the fund, manager and two period growth market share, respectively. $Return^2$ is the squared return over the past year. *Return* and *Flow* show the past return and past net flow over the respective period. The regression accounts for fund fixed effects. The table presents coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

	Lowest		Quintile		Highest
	(1)	(2)	(3)	(4)	(5)
Age	0.011**	0.008**	0.010***	0.009***	0.005**
	0.004	0.003	0.002	0.002	0.002
Size_{t-1}	-0.064	0.092	0.071	0.127*	0.005
	0.049	0.072	0.073	0.061	0.031
N0. of Funds	-0.006***	-0.002**	-0.001*	-0.001	-0.000
	0.001	0.001	0.001	0.000	0.000
F. Mkt. Shr.	-14.333*	-2.742	1.475	-0.424	0.011
	6.883	2.022	0.821	0.328	0.020
M. Mkt. Shr.	0.031***	0.013***	0.005*	0.002	-0.005*
	0.004	0.003	0.003	0.002	0.002
Gr. Mkt. Shr.	0.000	0.000	0.000	-0.000	0.000
	0.000	0.000	0.000	0.000	0.000
Return^2_{t-4}	-0.000	-0.000	-0.000	-0.000	-0.000
	0.000	0.000	0.000	0.000	0.000
Return_{t-1}	-0.002	-0.003	0.001	0.002	-0.002
	0.003	0.003	0.003	0.002	0.003
Return_{t-2}	-0.004	-0.004	-0.002	-0.004	0.000
	0.004	0.003	0.003	0.002	0.003
Return_{t-3}	0.006	0.006	-0.004	0.004	-0.004
	0.004	0.003	0.003	0.003	0.003
Return_{t-4}	0.007	0.004	-0.002	0.001	0.002
	0.004	0.003	0.003	0.003	0.003
Flow_{t-1}	-0.003	0.000	0.000	0.000	0.000
	0.002	0.001	0.001	0.001	0.002
Flow_{t-2}	0.000	0.002*	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001
Flow_{t-3}	-0.001	-0.000	0.001	0.000	-0.000
	0.001	0.001	0.001	0.001	0.001
Flow_{t-4}	0.000	0.001	0.003**	0.004***	0.007***
	0.001	0.001	0.001	0.001	0.001
P-value	0.000	0.000	0.000	0.000	0.000
N	5576	6589	7100	7570	8187

Table 12: Treatment Effect: New Flow t=1. The treatment variable is change in expense ratio. The table shows coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

	All	1st Q	2nd Q	3rd Q	4th Q
No Change	5.539***	5.696***	5.698***	5.595***	5.628***
	0.155	0.153	0.153	0.153	0.154
Change	7.276***	2.945*	5.018***	11.460***	9.153***
	0.650	1.381	0.940	1.726	1.491
Age_{t+1}	-0.134***	-0.131***	-0.131***	-0.135***	-0.135***
	0.010	0.009	0.009	0.009	0.009
Return_{t-1}	0.702***	0.718***	0.718***	0.713***	0.721***
	0.139	0.140	0.140	0.139	0.141
Inc. Yield_{t+1}	-3.944***	-3.589***	-3.644***	-3.854***	-3.574***
	0.484	0.466	0.460	0.465	0.467
Turnover_{t+1}	-0.003	-0.004	-0.003	-0.004	-0.004
	0.005	0.004	0.004	0.004	0.004
RATR_{t+1}	0.027*	0.026*	0.027*	0.027*	0.027*
	0.011	0.012	0.012	0.011	0.012
Div. Sum_{t+1}	0.043***	0.038***	0.039***	0.043***	0.040***
	0.007	0.006	0.006	0.006	0.006
Age_{t+1}	-0.163***	-0.152	-0.172**	-0.257**	-0.066
	0.037	0.084	0.059	0.098	0.093
Return_{t-1}	1.225***	1.303***	1.261***	1.454***	0.710***
	0.101	0.183	0.131	0.185	0.184
Inc. Yield_{t+1}	-2.150*	-3.300*	1.251	0.657	-6.188**
	0.985	1.511	2.051	2.213	2.274
Turnover_{t+1}	-0.008	0.030	-0.067*	0.020	-0.013
	0.022	0.046	0.029	0.054	0.049
RATR_{t+1}	0.061	0.178	0.023	0.090	0.086
	0.031	0.091	0.028	0.069	0.067
Div. Sum_{t+1}	0.036	0.109**	0.005	-0.039	0.057
	0.020	0.040	0.036	0.053	0.030
Age	0.011***	0.008***	0.008***	0.011***	0.005**
	0.001	0.002	0.002	0.002	0.002
Size_{t-1}	0.005	-0.053***	-0.006	0.014	0.045***
	0.008	0.014	0.012	0.014	0.013
N0. of Funds	-0.002***	0.000	0.001*	-0.003***	-0.003***
	0.000	0.000	0.000	0.000	0.000
M. Mkt. Shr.	0.009***	0.002	0.005***	0.011***	0.007***
	0.001	0.002	0.002	0.001	0.001
Return_{t-4}	0.002	0.005	0.009***	0.003	-0.005*
	0.002	0.003	0.002	0.002	0.002
Flow_{t-4}	0.004***	0.001	-0.000	0.004***	0.005***
	0.001	0.001	0.001	0.001	0.001
N	22637	22637	22637	22637	22637

Table 13: Treatment Effect: Market Share Change t=1. The treatment variable is change in expense ratio. The table shows coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

	All	1st Q	2nd Q	3rd Q	4th Q
No Change	0.905***	1.049***	1.006***	0.914***	0.944***
	0.144	0.141	0.142	0.141	0.141
Change	2.208***	-4.269**	0.499	7.311***	3.374*
	0.644	1.301	1.004	1.727	1.415
Age_{t+1}	-0.092***	-0.092***	-0.092***	-0.094***	-0.095***
	0.009	0.009	0.009	0.009	0.009
Return_{t-1}	0.420***	0.429***	0.429***	0.424***	0.431***
	0.079	0.080	0.080	0.079	0.080
Inc. Yield_{t+1}	-3.567***	-3.454***	-3.502***	-3.643***	-3.446***
	0.359	0.345	0.342	0.343	0.345
Turnover_{t+1}	-0.002	-0.003	-0.001	-0.003	-0.003
	0.004	0.004	0.004	0.004	0.004
RATR_{t+1}	0.014	0.014	0.014	0.014	0.014
	0.008	0.008	0.008	0.008	0.008
Div. Sum_{t+1}	0.021***	0.020***	0.021***	0.023***	0.021***
	0.006	0.006	0.006	0.006	0.006
Age_{t+1}	-0.120**	-0.084	-0.145*	-0.268**	-0.020
	0.037	0.082	0.064	0.101	0.085
Return_{t-1}	0.621***	0.766***	0.583***	0.781***	0.277
	0.093	0.164	0.155	0.211	0.151
Inc. Yield_{t+1}	-3.456***	-3.219*	-2.610	0.489	-6.915***
	0.993	1.358	1.970	2.812	2.061
Turnover_{t+1}	0.007	0.067	-0.067*	0.031	0.003
	0.022	0.045	0.028	0.056	0.046
RATR_{t+1}	0.026	0.062	0.015	0.093	0.016
	0.028	0.071	0.033	0.071	0.065
Div. Sum_{t+1}	0.039	0.100**	0.032	-0.054	0.046
	0.021	0.036	0.036	0.062	0.029
Age	0.011***	0.008***	0.008***	0.011***	0.005**
	0.001	0.002	0.002	0.002	0.002
Size_{t-1}	0.005	-0.053***	-0.006	0.014	0.045***
	0.008	0.014	0.012	0.014	0.013
N0. of Funds	-0.002***	0.000	0.001*	-0.003***	-0.003***
	0.000	0.000	0.000	0.000	0.000
M. Mkt. Shr.	0.009***	0.002	0.005***	0.011***	0.007***
	0.001	0.002	0.002	0.001	0.001
Return_{t-4}	0.002	0.005	0.009***	0.003	-0.005*
	0.002	0.003	0.002	0.002	0.002
Flow_{t-4}	0.004***	0.001	-0.000	0.004***	0.005***
	0.001	0.001	0.001	0.001	0.001
N	22637	22637	22637	22637	22637

Table 14: Cross-sectional regression: Morningstar. All data in the table are from active ETFs per January 2019. *TER* is the total expense ratio, *F.Mkt.Shr.* is expressed the funds market share in its respective asset class in percentages, *Liquidity* is the daily 3-month average Liquidity in millions of shares, *Premium* is the 12-month average premium, *Tenure* is the number of active years on the job for the manager, *Age* is the number of active years of the fund, *Turnover* is the turnover ratio, *Return* is the return over the past year and *Strat.Beta* is a dummy variable signalling a strategic beta ETF. The table accounts for firm fixed effects. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

	Fund Market Share			Expense Ratio		
	Equity	FixedI	Other	Equity	FixedI	Other
TER	-0.004***	-0.003	0.001			
	0.000	0.273	0.906			
F. Mkt. Shr.				-8.557***	-1.546	0.091
				0.000	0.273	0.906
Liquidity	0.041***	0.150***	0.212***	0.122	1.557**	-0.513
	0.000	0.000	0.000	0.221	0.001	0.271
Premium	0.000	-0.207	0.607	-2.634	-6.253	-2.518
	0.996	0.472	0.416	0.116	0.319	0.759
Tenure	0.028***	-0.048	0.209***	0.403	1.594**	0.673
	0.000	0.087	0.001	0.076	0.009	0.330
Age	0.001	0.114***	0.041	0.482***	-1.197*	1.319*
	0.814	0.000	0.430	0.000	0.015	0.021
Turnover	-0.000	0.001*	0.000	-0.000	-0.001	-0.000
	0.953	0.018	0.875	0.816	0.945	0.991
Return	0.000	0.007	0.001	-0.473***	-1.467***	-0.271**
	0.879	0.674	0.874	0.000	0.000	0.002
Strat. Beta	0.001	-0.042	-1.426*	-2.116	-1.124	-1.314
	0.972	0.830	0.033	0.053	0.793	0.859
Cons.	0.079*	-0.271	-1.088	39.274***	34.409***	70.173***
	0.024	0.087	0.061	0.000	0.000	0.000
Firm FE	Y	Y	Y	Y	Y	Y
Adj. R^2	0.457	0.425	0.259	0.604	0.543	0.618
AIC	438	544	933	9454	2307	2103
BIC	483	577	965	9500	2340	2134
P-value	0.000	0.000	0.000	0.000	0.000	0.006
N	1159	286	244	1159	286	244

Table 15: Cross-sectional time-series: Net Flow and Market Share $t = 1$. The dependent variables are net flow and in change in fund market share. The independent variables are all leads of the same variables as described in table 4.1 on page 24. $TERC.$ takes the value of the change in TER or 0 if non-existent, $TERD.$ takes the value of the percentual decrease in TER or 0 if non-existent. The same logic applies to management fees. This table accounts for fund, time and asset class fixed effects. The table shows coefficients and standard errors. ***, ** and * indicate statistical significance at the 0.001, 0.01 and 0.05 level, respectively.

	Net Flow		Mkt. Shr. Change	
	TER	Mgmt. Fee	TER	Mgmt. Fee
TER_{t+1}	-0.110*		-0.109*	
	0.046		0.043	
TER C.	0.022**		0.022**	
	0.008		0.008	
TER D.	-0.042		-0.046	
	0.035		0.034	
Mgmt. Fee_{t+1}		-0.309***		-0.300***
		0.045		0.044
Mgmt. Fee C.		-0.002		-0.001
		0.008		0.007
Mgmt. Fee. D.		-0.006		-0.012
		0.030		0.031
RATR_{t+1}	0.169***	0.167***	0.160***	0.158***
	0.021	0.021	0.021	0.021
Age_{t+1}	-0.328*	-0.273*	0.160	0.216
	0.140	0.137	0.146	0.143
Inc. Yield_{t+1}	-3.452***	-3.641***	-3.255***	-3.439***
	0.681	0.672	0.651	0.642
Div. Sum_{t+1}	-0.013	-0.010	-0.012	-0.009
	0.012	0.012	0.012	0.012
Return_{t-1}	1.209***	1.201***	1.177***	1.169***
	0.058	0.058	0.057	0.057
Return_{t-2}	0.478***	0.471***	0.449***	0.443***
	0.035	0.035	0.034	0.033
Return_{t-3}	0.206***	0.199***	0.197***	0.189***
	0.032	0.031	0.031	0.031
Return_{t-4}	0.171***	0.171***	0.167***	0.167***
	0.028	0.028	0.027	0.027
Fund FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Asset Class FE	Y	Y	Y	Y
Adj. R^2	0.272	0.276	0.201	0.205
AIC	198308	198201	196351	196242
BIC	198935	198828	196978	196869
P-value	0.000	0.000	0.000	0.000
N	22841	22841	22841	22841