Abusing ETFs

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Abstract. Using data from a large German brokerage, we find that individuals investing in passive exchange-traded funds (ETFs) do not improve their portfolio performance, even before transaction costs. Further analysis suggests that this is because of poor ETF timing as well as poor ETF selection (relative to the choice of low-cost, well-diversified ETFs). An exploration of investor heterogeneity shows that though investors who trade more have worse ETF timing, no groups of investors benefit by using ETFs, and no groups will lose by investing in low-cost, well-diversified ETFs.

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JEL classification: D14, G11, G28

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1. Introduction

One of the most successful financial product innovations of the last twenty years is the exchange-traded fund (ETF).[1] The first ETF was launched in Canada in 1990. As of February 2016, 4,479 ETFs had been established, with approximately USD 2.7 trillion in assets under management (roughly the same size as the global hedge fund industry).[2]

In this paper, we investigate whether or not ETFs provide benefits to a sample of individual investors who include them in their portfolios.[3] Given the paucity of studies on the user effects of financial product innovations like ETFs, this is an important topic to analyze. Frame and White (2004, p 116) state: "Everybody talks about financial innovation, but (almost) nobody empirically tests hypotheses about it." It is important to test whether ETFs benefit individual investors because they attract a lot of them.[4] In addition, employers are actively

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[1] An ETF is an index-linked security. These instruments aim to replicate the movements of a particular market and therefore enable the investor to easily buy and sell a broadly-diversified portfolio of securities that mimic that market. Investors can buy and sell ETF shares in public markets any time during the trading day.

[2] ETFGI (Global ETF and ETP Directory, February 2016) and Hedge Fund Research (Global Hedge Fund Industry Report, Year End 2015).

[3] We examine only passive ETFs that aim to mimic an index. Active ETFs, which aim to outperform an index, are not examined. Amongst passive ETFs, we do not differentiate whether ETFs are synthetic or fully replicating, despite the fact that synthetic ETFs may entail additional risk (Ramaswamy, 2011). In unreported analyses, we also look at passive index funds and find results similar to those for passive ETFs.

[4] Charles Schwab, the largest U.S. discount brokerage, offers more than 200 commission-free ETFs to individual investors (Schwab ETF OneSource, http://www.schwab.com/public/schwab/investing/accounts_products/investment/etfs/schwab_etf_onesource).

seeking ways to include ETFs in 401(k) defined-contribution retirement plans[5] and numerous fin-tech startups promote standardized ETF portfolios to retail investors. Even some industry regulators are promoting ETFs to individual investors.[6]

Our null hypothesis is that individual investors benefit by using passive ETFs. Classical finance theory prescribes well-diversified and low-cost portfolios for investors.[7] However, many researchers document substantial portfolio underperformance by individual investors due to poor diversification and costly over-trading in single stocks.[8] Indeed, ETFs may help

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[5] "Are ETFs and 401(k) Plans a Bad Fit?" *The Wall Street Journal*, April 5, 2012.

[6] The Securities and Markets Stakeholder Group of the European Securities and Markets Authority (ESMA) states that "ETFs are a low cost and straightforward investment proposition for investors and, as such, ESMA should investigate how to make indexed ETFs more offered to individual investors." ESMA Report and Consultation paper – Guidelines on ETFs and other UCITS issues. July 25, 2012, http://www.esma.europa.eu/system/files/2012-474.pdf, p. 32.

[7] Markowitz (1952) suggests we diversify by buying optimal portfolios. Tobin (1958) suggests that we require only one optimal portfolio provided that a risk-free asset exists. Sharpe (1964) concludes that this optimal portfolio was the market portfolio.

[8] The portfolios of individual investors who participate in equity markets typically show suboptimal degrees of diversification (e.g., Blume and Friend, 1975; Kelly, 1995; Goetzmann and Kumar, 2008) and concentration on the home region ("home bias," e.g., French and Poterba, 1991; Cooper and Kaplanis, 1994; Lewis, 1999; Huberman, 2001; Zhu, 2002; Ahearne et al., 2004; Calvet et al, 2007). Individual investors are also shown to trade too much (Odean, 1999; Barber and Odean, 2000).

investors attain theoretically sound portfolios.[9] ETFs have other benefits, too. They trade in real time and they offer tax advantages (Poterba and Shoven, 2002).

However, there is some evidence that investors may not be using index-linked products wisely. Hortaçsu and Syverson (2004) find large fee dispersions among financially homogeneous funds and Elton et al. Busse (2004) show that investors irrationally prefer more expensive index funds.[10] Second, it is possible that some ETFs, because they are highly correlated with an index and are easy to trade, may enhance investors' temptation to time the underlying index.[11] Third, investors may be overwhelmed by the sheer number of ETF products and underlying market and sector indices (over 220 such indices in our sample alone) and end up purchasing costly ETFs linked to rather undiversified single sectors or industries.

The key contribution of this paper to the literature (to our knowledge, the first of its kind) is that we use the trading data of a large number of individual investors at a large German brokerage firm during the 2005 to 2010 period to test whether ETFs benefit those who use them.[12] First, we examine who uses ETFs. We find that, compared to non-users, ETF users

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[9] Boldin and Cici (2010) review the entire empirical literature on index-linked securities and discuss their benefits. French (2008) measures the benefits of passive investing and concluded, "the typical investor would increase his average annual return by 67 basis points over the 1980-2006 period if he switched to a passive market portfolio."

[10] Choi et al., (2010) confirmed this behavior in an experiment and found that more financially sophisticated investors pay lower fees.

[11] In Germany, by 2009, the turnover in ETFs (data obtained from Deutsche Börse 2010) had become about the same as the turnover in stocks (data obtained from the World Federation of Exchanges 2013).

[12] We test whether the portfolio performance of individual investors improves after they purchase ETFs. An ex

are younger, wealthier in terms of both portfolio value and overall wealth, and have a shorter relationship with the brokerage. Müller and Weber (2010), using a survey methodology, report comparable results.

Second, we compare the portfolio performance of ETF users with all non-users in a panel setting. We estimate the marginal contribution of ETFs to an individual's portfolio performance starting with the first month of ETF use. We examine raw returns as well as risk-adjusted returns using one, two, four, and five risk factors.[13] We use a panel setting with user fixed effects to control for any time-invariant differences between users and non-users of ETFs. We also control for observable demographics, lagged time-varying portfolio characteristics like prior portfolio performance, and year fixed effects. We find that portfolio performance, as measured by any of our measures using any benchmark index, does not increase with ETF use.

Third, and importantly, we examine why there is no performance improvement for ETF users and what the performance improvement would have been had investors used ETFs wisely. The basic idea is to compare actual portfolios with counterfactual portfolios. This approach allows for inferences at the individual investor level, mitigating issues of self-selection and endogeneity.

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ante test like the one proposed by Calvet et al. (2007) will fail to incorporate the dynamic effects of actual trading.

[13] For the market factor, we use a global index (MSCI All Country World Index "MSCI ACWI"), as well as the broadest local index (CDAX). The former benchmark is for global investors and the latter benchmark is for local investors. We use both indices for robustness. In our factor models that include a bond factor, we add the JP Morgan Global Bond to the MSCI ACWI as a fixed income benchmark for global investors and the RDAX Return Index to the CDAX Index as a fixed income benchmark for local investors.

We start with our first benchmark portfolio that is the non-ETF part of the portfolio. If we add all the actual ETF trades of an investor, we are back at the full portfolio. The return differential between the benchmark portfolio and the full portfolio is a statistically significant −1.16% per year. We then examine what would happen if the actual ETFs were only bought, but not sold, essentially emulating an ETF buy-and-hold strategy. This counterfactual portfolio allows one to extract the contribution coming from ETF timing ability. We find that poor ETF timing ability is responsible for -0.77 percentage points (statistically significant) of the total return differential (-1.16%). ETF selection ability is not statistically significant. Examining gross returns and risk-adjusted gross returns confirms that the actual portfolio returns of ETF users are mainly adversely affected by poor ETF timing, though trading costs matter as well. Focusing on portfolio efficiency alone, we find that the relative Sharpe ratio loss (RSRL)[14] increases significantly with ETF use. This rules out that investors use ETFs mainly for hedging or better diversification.

Our second benchmark portfolio is a prescription: we prescribe the investor a buy-and-hold strategy in a low-cost ETF on the MSCI World Index. We find that investors are losing a statistically significant -1.69% p.a. in net portfolio returns by not using this prescribed portfolio. To decompose the above loss, we start with the actual portfolio of the investor. We then examine what happens if we replace all ETF trades with trades in a low-cost ETF on the MSCI World Index. This particular counterfactual portfolio isolates ETF selection (relative to choosing the MSCI). We find that most of that -1.69% loss (-1.28%, statistically significant) would have come from ETF selection (not choosing the low-cost ETF on the MSCI World

[14] We measure the relative Sharpe ratio loss as defined in Calvet et al. (2007).

Index) and little (-0.41%, not statistically significant) from not employing a buy-and-hold strategy. This result also holds for gross portfolio returns, gross risk-adjusted returns, and diversification. We conclude that the average investor could have benefited from using ETFs by following the guidelines of classical finance theory.

Finally, we explore investor heterogeneity in terms of overconfidence (proxied by portfolio turnover) and financial sophistication (proxied by portfolio value and portfolio diversification) to see if there are specific types of investors where our results are most relevant. Our conclusion from sorting investors by overconfidence and sophistication: though investors who trade more have worse ETF timing, no groups of investors benefit by using ETFs, no matter which measure (performance, timing, selection, or diversification) or sort (turnover, portfolio value, or diversification) we examine. We also find that no groups will lose by investing in the right MSCI ETF.

Our sorting exercise also yields one potential explanation. Investors from virtually all groups do not substantially adapt their trading behavior after ETF use. Those who traded more before ETF use continue to trade more after ETF use, both in the ETF part of the portfolio, as well as in the non-ETF part. Investors therefore appear to make the same mistakes when they trade ETFs that they have made in trading non-ETFs.

Our overall conclusion is that our sample of ETF users does not improve their actual portfolio performance after ETF use because they have both poor ETF timing as well as ETF selection (relative to choosing a low-cost well-diversified ETF like the MSCI). Thus, although passive ETFs are an important investment innovation, with an enormous potential to act as a low-cost vehicle for diversification, in practice they may not help individual investors enhance the efficiency of their portfolio, even before transaction costs. This would happen if individual investors get tempted to trade too much in the ever-expanding choices of high-liquidity ETFs based on narrow market indices. To conclude, more ETF choice may lead to abuse of ETFs.

We describe the data in Section 1 and examine which investors are most likely to purchase ETFs in Section 2. In Section 3, we investigate whether ETF users improve their portfolio performance compared with non-users. In Section 4, we examine why ETF users do not improve their relative portfolio performance. We conclude in Section 5.

2. Data

1.1 ETFS AND INDEX-LINKED SECURITIES IN GERMANY

Individuals in Germany, as in the United States, who want to invest in index-linked securities can choose ETFs and/or index mutual funds. Table I gives us a snapshot of both markets at the end of a year. Panel A of Table I provides the data for index-linked securities in Germany. Panel B provides this information for the U.S. Panel C provides the data for our German sample. As a result of data availability, the three panels represent a snapshot of the market at different times. For Germany and the U.S., the data for the end of 2011 are available, whereas these data for our sample are available only for the end of 2009.

[INSERT TABLE I ABOUT HERE]

The leftmost column in Panels A and B of Table I show that the total assets under management invested in index-linked securities relative to total active mutual fund investments, a ratio of about 20%, is comparable between Germany and the U.S. Panels A and B also show that the market in the U.S., as expected, is much larger as measured by both assets under management and the number of products. Interestingly, in terms of assets under management, the market is split almost evenly between passive ETFs and index mutual funds in the U.S., whereas in Germany, passive ETFs comprise 84% of the market.

When Panel A of Table I (Germany) is compared with Panel C (our sample), in terms of the proportion of assets under management in each security class, our sample seems to be representative of the entire German market.

1.2 ETFS IN OUR SAMPLE

In this paper, we focus only on ETFs rather than index funds for two reasons. First, as can be seen in Table I, ETFs are the predominant index-linked security in Germany, as well as in our sample. Second, as the construction and trading of index funds are different from ETFs, we do not bundle the two.[15]

Table II shows the rich diversity of ETFs in the portfolios in our sample. Panel A shows that our investors have exposure to many different indices. Although the top 10 benchmark indices constitute over 65% of the assets under management in ETFs, 224 other benchmark indices make up the remainder. Note that the popular indices are connected to Germany, Europe, and the world, which motivates us to select the local German index, CDAX, and a global index, MSCI ACWI, as our two benchmark indices.

[INSERT TABLE II ABOUT HERE]

In Panel B of Table II, we examine the regional allocations of these ETFs. Europe is the most popular, followed by Germany. Individual German investors, like individual investors all over the world, exhibit home bias.

In Panel C of Table II, we examine the asset class of ETFs. We find that ETFs that are

[15] The economic intuition of our paper, however, applies to both index funds and ETFs. Therefore, as mentioned in footnote 3, we replicate all our tests for passive index funds. We find results similar to those for passive ETFs.

based on equity indices dominate (90.5% of assets under management), which further justifies our use of equity indices like CDAX and MSCI ACWI as benchmarks. However, as there are a few bond- and commodity-based ETFs as well, we will sometimes use a bond benchmark.

Panel A of Table II shows that many ETFs in our sample are linked to narrow indices, so it is likely that they offer more choices for timing certain asset classes, sectors or countries, rather than opportunities for broad diversification. If so, their beta loadings with respect to our benchmarks, CDAX and MSCI ACWI, could be very different from 1. In Panel D of Table II, we show the beta loadings of all ETFs in our sample with respect to the CDAX and the MSCI ACWI. The mean beta loadings with respect to the CDAX and the MSCI ACWI are 0.72 and 0.88, respectively. Although these betas are statistically significantly different from 1, if we narrow our sample to equity ETFs, the mean beta loading with respect to the MSCI ACWI cannot be distinguished from 1, but the mean beta loading with respect to the CDAX is still below 1. Further, although many of these ETFs may not be tracking the CDAX or MSCI ACWI perfectly, Panel D of Table II shows that their alphas with respect to these indices are indistinguishable from zero.

1.3 INDIVIDUAL INVESTORS IN OUR SAMPLE

The brokerage that we work with was founded as a direct bank with a focus on offering brokerage services via telephone and the Internet. In 2009, to retain existing customers and attract new ones, the brokerage introduced a financial advisory service, which offered free financial advice to a random sample of about 8,000 investors. Approximately 96% of these individuals refused the financial advice and continued trading as before.[16] Our starting sample

[16] Bhattacharya et al. (2012) analyze the same sample with a focus on the 4% of individual investors who accepted

is these 7,761 investors. The knowledge that these investors refused financial advice assures us that our sample is composed of self-directed investors whose decisions are not distorted by a third party. As our focus is on ETFs, we keep investors who invest in all securities except index mutual funds. We additionally restrict our sample to investors who on average have at least €5,000 in their portfolios. We do so to avoid a bias introduced by small play money accounts. Our final sample has 6,949 investors in an unbalanced panel that begins in August 2005 and ends in March 2010. Of these 6,949 investors, 1,080 investors traded at least one ETF during this period — the "users" — and 5,869 investors who traded no ETFs during this period — the "non-users."

Figure 1 shows the share of ETFs in the portfolio of an average individual investor in our sample. It shows that after investors have switched to ETFs, their weight in the portfolio hardly exceeds 20%. Figure 1 also shows the growing popularity of ETFs in our sample. The sharp increase in ETF share in December 2008 is likely related to a tax change in Germany. From 2009 onwards, all capital gains and losses, irrespective of the holding period, are subject to taxation. Gains and losses from securities purchased before the end of 2008, if held for longer than one year, are tax exempt. Thus, it is possible that some investors switched to ETFs in December 2008 to ensure a tax advantage.

[INSERT FIGURE 1 ABOUT HERE]

The German brokerage provided us with investor demographics and account characteristics for both ETF users and non-users for the sample period. Investor demographics

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the offer.

include gender, age, and micro-geographic status. The micro-geographic status variable measures the average wealth level of individuals who inhabit a given micro area (street-level address). The variable has nine categories, with category one comprising the poorest individuals and category nine the wealthiest individuals. This information is provided to the German brokerage by a specialized data service that uses several factors (such as house type and size, dominant car brands, rent per square meter, and the unemployment rate) to construct it.

The account characteristics are primarily comprised of monthly position statements, daily transaction data, and account transfers for the August 2005 to March 2010 period. We use the transaction records to calculate portfolio turnover and number of trades per month, as in Barber and Odean (2002). To compute daily position statements and portfolio values, we proceed as follows. We multiply the beginning-of-month value of each security holding by the corresponding daily price return (excluding dividends but considering any capital actions) for that security to obtain its end-of-day holding value. These values are then adjusted for any sales, purchases, and/or account transfers that occurred on that day to yield the position statements for the beginning of the second day in the month. We repeat this procedure for each trading day in a given month. The computed holdings on the last day of each month are then reconciled with the true holdings in our dataset.

Daily portfolio returns are calculated as the weighted average return of all securities held, purchased, and sold by the investor on that day. For securities held, we use *total* daily return data from Datastream (they take into account dividend payments). For securities that are either purchased or sold on that day, we compute daily returns based on exact transaction prices. Our weighting factors for securities held or sold are closing prices of the previous day times the number of securities held or sold. The weighting factors for securities purchased are the corresponding transaction prices multiplied by the number of securities purchased. Since we also obtained transaction costs, commissions, and fees from the bank, we are able to calculate daily security and portfolio returns both on a gross (before transaction cost) and on a net (after transaction cost) basis.

The account characteristics provided by the brokerage also include account opening date and cash account balances at the beginning of the sample period and at the end of the sample period. The account opening date gives us the length of the client relationship with the brokerage, and the cash account balances enable us to calculate the share of risky securities in the account with the brokerage (portfolio value plus cash value) for at least two dates.

Table III gives the sources of all the data described above, as well as of data obtained from other sources. Finally, as we find that the typical investor in our sample only trades about twice a month, we aggregate all daily returns and other statistics to the monthly level.

[INSERT TABLE III ABOUT HERE]

3. Who Uses ETFs?

Table IV provides summary statistics about the users and non-users of ETFs in the sample. In this univariate setting, ETF users seem to be slightly younger and wealthier than non-users. Moreover, they also have a shorter relationship with this brokerage, a higher share of their portfolio in risky securities at the end of the sample period, a higher average portfolio value during the sample period, more securities in their portfolio, and they trade more often during the sample period. We also find a small difference in alpha over the entire sample period, suggesting that ETF users appear to be more skilled investors than the non-users.

[INSERT TABLE IV ABOUT HERE]

Table V provides the results of a multivariate probit model to confirm the above univariate results. The dependent variable is set to one if an investor opted to use ETFs at least once in our sample period and is set to zero otherwise. The independent variables are the time-invariant variables that we know at the start of our sample or on the first day an investor enters the sample. The results in Table V confirm that younger and wealthier (in terms of portfolio value) investors are more likely to use ETFs. This echoes the survey results in Müller and Weber (2010) and is consistent with findings in the marketing literature (e.g., Dickerson and Gentry 1983) that document early adopters to be younger and wealthier.

[INSERT TABLE V ABOUT HERE]

4. Do Individual Investors Benefit by Using ETFs?

We now examine whether individual investors benefit by using ETFs. We use data from all ETF users and non-users in our sample. This allows us to exploit all of the information in our panel dataset. We thus estimate the following model:

$$r_{i,t} = \propto + \beta_1 * First\ Use\ of\ ETFs_{i,t} + \beta_2 * User\ fixed\ effect_{\ i} + \beta_3 * \boldsymbol{MF_t} + \beta_4 * \boldsymbol{TF_t} + \beta_5 * \boldsymbol{DC_i} + \beta_6 * \boldsymbol{IC_{i,(t-7\ to\ t-1)}} + \varepsilon_j, \tag{1}$$

where $r_{i,t}$ is the excess net return (excess over the 3-month Euribor rate and net of all transaction cost) on investor *i*'s portfolio in month *t*, *α* denotes the constant, $First\ Use\ of\ ETFs_{i,t}$ is a dummy variable set to 1 in every month *t* after investor *i* has invested in ETFs for the first time, *User fixed effect* is a dummy variable set to 1 if an investor holds an ETF at any point in time during our observation period, and $\boldsymbol{MF_t}$ is a vector representing the return of factors like the market factor in month *t*. Depending on the specification, this vector may contain no factors, a market factor (CDAX or MSCI ACWI) or additional factors like SMB (small-minus-big), HML (high-minus-low), MOM (Momentum) or a bond factor. $\boldsymbol{TF_t}$ represents year fixed effects, which means that there is one year dummy for each year. $\boldsymbol{DC_i}$ is a demographic control vector for investor i. This vector contains gender, age, dummies for low and high wealth, and length of relationship. $\boldsymbol{IC_{i,(t-7\ to\ t-1)}}$ is a vector of time-varying characteristics (log of the portfolio value, alpha, turnover, and number of trades) of the portfolio of investor i over the rolling window t-7 (months) to t-1. All these time-varying portfolio characteristics of the investor are rolling moving averages calculated on a monthly basis at t over the prior six months from t-7 to t-1 (*6 months MA*).

The use of year fixed effects is important in our context. These control for any events in a given calendar year that change the propensity to purchase ETFs, such as the financial crisis years of 2007-2009 or years in which the tax policy on investment profits changed. In our sample, this is particularly important since a tax law change took place in Germany at the end of 2008. From 2009 onwards, all capital gains and losses, irrespective of the holding period, are subject to taxation. Gains and losses from securities purchased before the end of 2008, if held for longer than one year, are tax exempt. Because some investors may have purchased ETFs to ensure a tax advantage in 2009 (see Figure 1), a year with above average stock returns, the effect of buying ETFs for tax reasons in this year would indicate a spurious benefit of ETF use.

Although the user fixed effects control for all time-invariant differences in characteristics of users and non-users of ETFs, the criticism remains that the choice of using an ETF may still be endogenous because we have not controlled for time-varying variables. To mitigate this concern, we control for the following time-varying portfolio characteristics of the investor that we can observe: log portfolio value, past performance as measured by a one-factor Jensen (1968) alpha with the CDAX as the benchmark, and trading behavior measured by number of trades and portfolio turnover. We use the rolling moving average of the previous six trading months to calculate these four variables**.**

Finally, when running these panel regressions, we cluster standard errors by month in all the regressions to address potential issues with cross-sectional correlation (Seasholes and Zhu, 2010) and to be as conservative as possible. This level of clustering leads to lower *t*-stats than a two-way cluster on investor and month, as suggested by Petersen (2009). If we had not clustered standard errors by month, and would therefore have assumed independence of returns between investors, the *t*-statistics would have been on average five times higher.

The independent variable of interest is *First Use of ETFs*. It is set to 0 on months before ETFs were used, and switched to 1 after the first use of ETFs no matter whether investors held any ETFs in subsequent periods. This allows us to compare portfolios of users before and after the use of ETFs. So β_1 measures the change in portfolio performance after an investor uses ETFs for the first time. If we run Equation (1) without $\boldsymbol{MF}_t$, the coefficient β_1 measures the change in portfolio performance without risk adjusting, whereas if we run the equation with $\boldsymbol{MF}_t$, the coefficient measures the change in portfolio performance after risk adjustment. The β_3 coefficients are the corresponding betas or factor sensitivities. The variable *User fixed effect*, which is set to 1 if an investor holds an ETF at any point in time during our observation period, allows us to compare ETF users with non-users. Their differential portfolio performance is measured by β_2. The β_4 coefficients are the fixed effects of a given year, which we do not show in Table VI for the sake of brevity. The β_5 coefficients are the effects of the investor's time-constant demographic characteristics. The β_6 coefficients are the effects of the investor's time-varying portfolio characteristics.

Although the above specification seems like a classic difference-in-difference research design, it is not in our context. The reason is that it is not clear what the exact treatment and control groups are. Certainly, investors who have never held an ETF in our sample are unequivocally non-users and belong to the control group and investors who purchase ETFs for the first time and then keep ETFs in their portfolio over the remaining sample period clearly belong to the treatment group. However, if an investor held an ETF in the past but does not hold an ETF in month *t*, should she be assigned to the control group of non-users or the treatment group of users for month *t*? Questions like these are important, and it is for this reason that we run Equation (1) in many ways.[17] However, given the lack of an exogenous shock, the myriad possible ways of running our panel regressions or doing a propensity score matching, will still not give us a clean identification. Recognizing this limitation, and noting that the results we obtain from our various tests are qualitatively similar, we show the results

[17] We re-run regression (1) by restricting our sample only to users, and we define *First Use of ETFs* only for investors who hold ETFs every month after first use or define *First Use of ETFs* only for investors who hold ETFs sometimes after first use. Results are similar. Results are qualitatively unaltered if we add non-users to the sample and re-run the above two tests. Results are qualitatively unaltered if we allow the factor exposures to be different for ETF users and non-users. The logic is that ETFs, being a basket of well-diversified securities, may tend to move the beta of the portfolios towards 1. Our results are qualitatively similar if we use the continuous fraction of an investor's portfolio value that is invested in ETFs instead of the dummy specification. Results are similar if, instead of using the user fixed effect and demographic control variables as in Table VI, we use investor fixed effects. We get the same qualitative result using a propensity scoring methodology. All results are available from the authors upon request.

of just one of our tests in Table VI.

Column (1) in Table VI gives the results for raw net returns, whereas the other columns give the results for risk-adjusted net returns. We risk adjust using the one-factor MSCI ACWI, the MSCI ACWI factor and a world bond factor, the one-factor CDAX, the CDAX factor and a German bond factor, the four-factor model that uses the CDAX factors, and the five-factor model that uses the CDAX factors and a German bond factor, and present the results in columns (2)-(7), respectively.

The most important result in Table VI is the observation that the portfolio performance of ETF users does not improve after they start using ETFs; the coefficient on the *First Use of ETFs* is negative in five models and positive in two models, but statistically insignificant in all seven models. Table VI also shows that ETF users do no worse than non-users over the whole sample; the coefficient on the *User fixed effect* is positive but insignificant in each of the seven models. We interpret both these results to mean that although ETF users are insignificantly better investors than non-users, ETFs do not improve their portfolio performance after use.

[INSERT TABLE VI ABOUT HERE]

We cannot completely control for unobserved heterogeneity. This is because we do not have an exogenous shock (even the "exogenous" tax law change in Germany towards the latter part of our sample period may affect ETF users differently in unpredictable ways) or good instrumental variables to further refine our testing. We can rule out, however, one usual suspect — investors using ETFs use all products sub-optimally, not just ETFs — from the results in both Table IV (alphas are higher for ETF users) and Table VI (ETF users do no worse than non-users in their portfolio performance as seen in the non-negative coefficient of the user fixed effect).

5. Why Individual Investors Do Not Benefit by Using ETFs?

4.1 COUNTERFACTUAL PORTFOLIOS

We have shown above that individual investors do not benefit when they hold ETFs in their portfolios. In this section, we use counterfactual portfolio analysis to determine why.

The basic idea is to compare the performance of actual portfolios with hypothetical portfolios where we let the investor use a buy-and-hold ETF strategy (in this counterfactual portfolio, we switch off ETF timing) or we let the investor replace all his ETF buys and sells at time *t* with buys and sells in a MSCI World Index ETF at that same time *t* (in this counterfactual portfolio, we switch off security selection), or we let the investor use a buy-and-hold MSCI World Index ETF strategy (in this counterfactual portfolio, we switch off market timing and security selection). These counterfactual portfolios can be constructed because we know for each trade of each investor, the ISIN, the date, the value, and the associated fees of that trade.

The counterfactual approach allows for inferences at the individual investor level, mitigating issues of self-selection and endogeneity. This is because we look at the portfolio performance changes for the same investor at the same point in time. Thereby, we can directly draw conclusions on how a change in trading strategy or a different ETF selection changes individual performance. In contrast to other approaches, we do not have to rely on a single return series at the portfolio level to decompose portfolio returns into the components of security selection and market timing.[18] In comparison to Odean (1999), who uses individual

[18] See Treynor and Mazuy (1966), Jensen (1968), Henriksson and Merton (1981), Pesaran and Timmermann

investors' trading records to decompose the holding period returns of security purchases and sales into market timing and security selection abilities, our counterfactual portfolio approach does not require any assumptions on the weighting of trades or the lengths of holding periods. Risk adjustment is also possible.[19]

These counterfactual portfolios, most importantly, allow us to test whether portfolio performance changes because an investor trades the "right" ETF at the "wrong" point in time, or because an investor trades the "wrong" ETF at the "right" point in time, or both. The wrong point in time is when an investor buys high and sells low. The right ETF is difficult to determine. As the ETF offerings are many, and are often based on narrow indices (see Panels A, B, and C of Table II), a wrong ETF is one that promises suboptimal expected Sharpe ratios. From an ex ante perspective, a single ETF (or alternatively, a basket of ETFs) that replicates the market portfolio best would be the right ETF. Therefore, any ETF that tracks only a tiny sub-market or has too large a tracking error with the market index is a wrong ETF. Given these criteria, it seems that a sensible proxy for the right ETF in our context is an ETF on the MSCI World Index.[20]

(1994), Gruber (1996), and Carhart (1997) for "top-down" approaches that use return series. See Jiang, Yao, and Yu (2007), Kaplan and Sensoy (2008), and Elton et al. (2011, 2012) for "bottom-up" approaches that use changes in returns in response to changes in portfolio holdings.

[19] Odean (1999) weights trades equally, has different holding period lengths, and cannot risk-adjust in his framework, whereas in counterfactual portfolios we retain the weighting of the original trade and can risk-adjust.

[20] Calvet et al. (2007) also use the MSCI World Index as the market benchmark for Swedish investors holding portfolios containing stocks, funds, bonds, and other marketable securities. The MSCI World Index is a

We start our analysis with the non-ETF part of an investor's portfolio. This is called the "benchmark" portfolio (*BM*) because we want to see how the performance of an investor's portfolio changes when ETFs are added to it. We then examine what would happen if ETFs were added to this benchmark portfolio, but were just bought-and-held. So this first counterfactual portfolio is an investor's full portfolio that includes all non-ETFs and ETFs ever bought where we assume that the investor buys and holds but never sells any ETF actually purchased.[21] This is called the buy-and-hold ETF portfolio (*B&H*). As it is a buy-and-hold portfolio, it has no ETF timing. We then allow the ETFs to be traded, which is the actual full portfolio (*FULL*) of the investor. By doing this, we introduce ETF timing.

It is apparent from the above construction of the portfolios that the difference in returns between the full portfolio, *FULL*, and the non-ETF part portfolio, *BM*, is the change in returns from adding ETFs to an investor's portfolio. So *FULL* minus *BM* is the ETFs impact on portfolio performance. The important task is to decompose this differential return into the

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theoretically efficient choice from an ex ante perspective. This is because the MSCI World Index, as a proxy of the market portfolio, promises the highest expected Sharpe ratio, assuming that investors do not have private information and that capital markets are semi-strong form efficient. We choose the Vanguard Global Stock Index Fund that tracks the MSCI World Index. We choose this fund for many reasons. First, this fund is well known and would have been available at an expense ratio of 0.5% p.a. to our investors throughout our entire observation period. Alternatives like a value-weighted portfolio of all assets held by all investors are not available as an ETF. Other well-known funds have inception dates that do not cover our entire observation period. Note that all results hold qualitatively if we use an investable ETF on the German DAX index instead of the MSCI World Index.

[21] Results remain qualitatively unchanged if we create this first counterfactual portfolio using all non-ETFs and only the first ETF ever bought. This means we disregard all purchases and sales of ETFs after the initial purchase.

contribution that is coming from ETF timing and the contribution that is coming from ETF selection.

FULL minus *BM*, the ETF impact on portfolio performance, can be decomposed into *FULL* minus *B&H* and *B&H* minus *BM*. As *FULL* is the actual full portfolio with actual ETF buys and sells at different points in time, and *B&H* is the counterfactual full portfolio with a buy-and-hold strategy for ETFs that switches off timing, it is clear that *FULL* minus *B&H* is the contribution that is coming from an investor's ETF timing ability. So we measure an investor's ETF timing ability using *FULL* minus *B&H*. *B&H* minus *BM* must then be the contribution that is coming from ETF selection ability of the investor because it has no timing in it. So we measure the ETF selection ability (relative to not choosing any ETFs) of an investor using *B&H* minus *BM*.

The above decomposition, as it ignores what would happen if the investor who bought a low-cost, well-diversified ETF — the strategy that is prescribed in classical finance theory — is unable to analyze the opportunity loss by not doing so. It is for this reason that we do an additional decomposition.

Using our full portfolio (*FULL*), we examine what would happen if we replace all ETF trades with trades in a low-cost ETF on the MSCI World Index. This second counterfactual portfolio is, therefore, the investor's full portfolio where we replace all ETF buys and sells with buy and sell trades in a Vanguard ETF that tracks the MSCI World Index. This is called the Trade MSCI World (*MSCI*) portfolio. In this counterfactual portfolio, we get rid of selection, because only investments in the ETF on the MSCI World Index are included.

We then examine what would happen to the *MSCI* counterfactual portfolio if we allow the low-cost ETF on the MSCI World Index to be just bought-and-held instead of being traded.

This third counterfactual portfolio is, therefore, an investor's full portfolio where we replace all ETF purchases of an investor with purchases of a Vanguard ETF that tracks the MSCI World Index, and where we disregard all ETF sales, emulating a pure buy-and-hold strategy of the market portfolio. This is called the "market benchmark" (*MBM*) because we want to see what happens when an investor buys and holds the ETF on the MSCI World Index (i.e. the "right" ETF). This counterfactual portfolio has neither ETF timing nor selection in its ETF part. Table VII provides an overview of the counterfactual portfolios.

[INSERT TABLE VII ABOUT HERE]

It is apparent from our discussion of the hypothetical portfolios that *FULL* minus *MBM* is the "opportunity loss" that the investor incurs by deviating his actual full portfolio from a theoretically sound full portfolio. *FULL* minus *MBM*, the opportunity loss, can be decomposed into *MSCI* minus *MBM* and *FULL* minus *MSCI.* As the *MSCI* is the counterfactual full portfolio with MSCI World Index buys and sells and the *MBM* is the counterfactual portfolio with MSCI World Index buy-and-hold only, *MSCI* minus *MBM* is the change in returns caused by trading instead of holding the MSCI World Index ETF. As the MSCI World Index is our proxy for the market, this is the classical way to measure the impact of market timing on portfolio performance, and following this tradition we call this measure "market timing." Note again that *MSCI* minus *MBM* is market timing (trading the MSCI ETF minus buying-and-holding the MSCI ETF) and should not be confused with the previous ETF timing ability (*FULL* minus *B&H,* i.e., trading selected ETFs minus buying-and-holding selected ETFs). As *FULL* is the actual full portfolio with actual ETF buys and sells at different points in time, and *MSCI* is the counterfactual full portfolio with MSCI World Index ETF buys and sells at the same points in time, it is clear that *FULL* minus *MSCI* is the performance contribution that is coming from choosing these particular ETFs instead of the MSCI World Index ETF. *FULL* minus *MSCI*, therefore, might be considered the classical way (cf. e.g., Brinson et al., 1986) to measure the impact of security selection on portfolio performance. So we call this measure ETF selection ability (relative to choosing MSCI).

We notice above that there are many ways of decomposing our returns. These could be confusing. To simplify, though we show all our decompositions in Tables VIII through XI, we focus on mostly interpreting two of our most important decompositions: *FULL* minus *B&H*, which measures an investor's ETF timing ability, and *FULL* minus *MSCI,* which measures an investor's ETF selection ability relative to passive indices. Note that *FULL* minus *MSCI* measures the impact of choosing a particular ETF instead of the "right" MSCI ETF; it should not be confused with the previous *B&H* minus *BM* ETF selection, which measures ETF selection ability with respect to not choosing any ETFs.

We use several metrics to compare portfolio performance: the mean of the return, the standard deviation of returns, the RSRL[22] (1 minus the quotient of the Sharpe ratio of an investor's portfolio over the Sharpe ratio of the MSCI World ACWI) over the sample period in which ETFs are held, Jensen's (1968) alpha, and the unsystematic variance share (average of the ratio of idiosyncratic variance divided by the total variance of the portfolio return). To compute Jensen's alpha and the unsystematic variance share, we use the MSCI ACWI as the benchmark. All measures are computed per investor and then averaged over the cross-section of investors to make comparisons easier. Note that there are no qualitative differences if we first average across investor per time period and then use the average over the different time

[22] Calvet et al. (2007, 2009) suggest using the RSRL to measure the under-diversification in a household's risky portfolio.

periods.

A question that naturally arises is how to compute returns for the ETF part of the portfolio during months in which a previous ETF user does not hold any ETFs. As we construct the counterfactual portfolios based on the non-ETF part of the portfolio plus different strategies in the ETF part, the ETF share in the counterfactual portfolios is zero in these months, while the return on the total counterfactual portfolio is equal to the return of the non-ETF part. This is equivalent to the assumption that when the investor sells ETFs, the cash goes toward purchasing non-ETF risky securities. We use this option in all our tables with one notable exception: computing the return on the ETF part of the portfolio. When we analyze only the ETF part of the portfolio, another option becomes viable. We could assume that when the investor bought (sold) ETFs, the cash came from (went to) the cash account. So we should use zero as return, instead of the non-ETF return, for the ETF part of the portfolio in months without ETF holdings. The two options give us different results for the ETF part of the portfolio. We discuss these differences later.

4.2 RESULTS FROM COUNTERFACTUAL ANALYSIS

Table VIII shows the results of our portfolio return decomposition. Panel A shows the results net of transaction costs and Panel B shows the results for gross returns. To compute the net returns for the counterfactual portfolios that use the Vanguard MSCI World ETF, we retain the costs of the original transactions. The transaction costs on the Vanguard MSCI World ETF are likely to be lower.[23]

[23] As all our qualitative results hold also for gross returns, this assumption is not critical.

[INSERT TABLE VIII ABOUT HERE]

Panel A of Table VIII, which displays net returns, shows that an ETF investor decreases the net return of his portfolio from 3.91% (*BM*) to 2.74% (*FULL*) per year. This drop of -1.16% (*FULL* minus *BM*)[24] is statistically significant at the 10% level. However, if this investor had just bought and held ETFs instead of trading in them, the increase in return would be 0.77%. So the investor's ETF timing ability is -0.77% (*FULL* minus *B&H*), which is statistically significant at the 10% level. As the drop of 0.77% is the only part that is significant in the overall drop of 1.16%, we conclude that it is mainly the investor's poor ETF timing ability that is adversely affecting portfolio's return. If we adjust for risk and consider alphas, we find that it is also the investor's poor ETF timing ability that is adversely affecting the risk-adjusted return of the portfolio [ETF timing ability expressed in alpha is -1.11% (*FULL* minus *B&H*), which is statistically significant]. If we consider diversification and look at RSRL, we find that most of the diversification loss of 9.15% is again coming from poor ETF selection (6.33%) and both are statistically significant at 1% level.

We also examine what would happen if the investor chooses a MSCI World Index ETF. The results are given at the bottom of Panel A of Table VIII. An investor would have improved portfolio returns if all ETF trades had been replaced by a buy-and-hold strategy in a low-cost, diversified ETF like the Vanguard MSCI World ETF. The opportunity loss for doing this is a statistically significant -1.69% (*FULL* minus *MBM*). Most of this opportunity loss, -1.28% (*FULL* minus *MSCI*), comes from ETF selection (relative to choosing MSCI), and this number is statistically significant at the 5% level. If we adjust for risk and examine the alphas, we find

[24] *FULL* minus *BM* has a rounding error.

an opportunity loss of -1.79% (*FULL* minus *MBM*). Most of this opportunity loss, -1.12% (*FULL* minus *MSCI*), again comes from ETF selection (relative to choosing MSCI) and this number is statistically significant at the 1% level. If we consider portfolio diversification and look at RSRL, we also find that most of the 18.01% diversification loss is coming from ETF selection (relative to choosing MSCI) (16.91%), and both are statistically significant at the 1% level.

Panel B of Table VIII gives the results of the counterfactual analysis before transaction costs (i.e., gross returns). An investor who uses ETFs decreases their gross portfolio returns from 5.51% (*BM*) to 4.18% (*FULL*). This decline of -1.33% (*FULL* minus *BM*) is statistically significant. However, if decomposed, none of the decomposed parts are statistically significant. If we adjust for risk and consider the alphas, poor ETF timing seems to be responsible for the decline.

When we examine opportunity loss at the bottom of Panel B in Table VIII, we find that an investor would have higher portfolio returns if they had employed a buy-and-hold strategy in a low-cost, diversified ETF like the Vanguard MSCI World ETF instead of conducting ETF trades. The opportunity loss they incur by trading ETFs in terms of gross returns is a statistically significant -1.23% (*FULL* minus *MBM*). Most of this opportunity loss, -1.29% (*FULL* minus *MSCI*), comes from ETF selection (relative to choosing MSCI) and is statistically significant. If we adjust for risk and examine the alphas, we also find an opportunity loss of -1.29% (*FULL* minus *MBM*). Most of this opportunity loss, -1.12% (*FULL* minus *MSCI*), again comes from poor ETF selection (relative to choosing MSCI) and is statistically significant. If we consider portfolio diversification and look at RSRL, we find that most of the 16.43% diversification loss is coming from poor ETF selection (relative to choosing MSCI) (16.62%) and both are statistically significant.

To summarize, there are four major findings from Table VIII. First, an investor is hurting his overall portfolio performance mostly by poor ETF timing. Second, the cost from poor market timing cannot all be due to extra costs from excessive ETF trading because we see the same result for gross returns. Third, if an investor had added a MSCI World Index ETF to their portfolios and applied a buy-and-hold strategy, their net and gross returns would have improved significantly. Most of that improvement would have come from replacing the ETFs actually traded by the MSCI World Index ETF (security selection), rather than by implementing a buy-and-hold strategy in the MSCI World Index ETF (market timing). Fourth, the results for risk-adjusted returns (alphas) and portfolio diversification (RSRL) are qualitatively similar to those for raw returns. Note that despite the fact that ETFs make up only a fraction of 15% of the average investor's full portfolio (see Figure 1), we do find that the investor's unwise use adversely and significantly affects the return of the full portfolio most of the time.

4.3 DISCUSSION OF ALTERNATIVE EXPLANATIONS

The results in Table VIII allow us to rule out three alternative hypotheses as explanations for our results. The first alternative hypothesis is that the non-ETF part of an ETF investor's portfolio is responsible for the lack of improvement of portfolio performance after ETF use rather than the ETF part. The net return on the ETF part is -0.55% if we assume that purchases (and sales) of ETFs are financed from the non-ETF part, as is the maintained assumption in this table. This number changes to -1.46% (unreported result) if we assume that purchases (and sales) of ETFs are financed from (finance) the cash account, the second option we discuss above. Whether it is -0.55% or -1.46%, the net return on the ETF part of the portfolio is lower than the net return on the non-ETF part (3.91%). Further tests show that they are statistically significantly lower. This rules out that the non-ETF part is responsible for the lack of improvement in portfolio performance after ETF use.

The second alternative hypothesis is that investors sacrifice returns by using ETFs as hedges and benefit from substantial diversification effects. If ETFs were used for hedging, the RSRL of the full portfolio should be smaller for the *FULL* portfolio than for the *BM* portfolio. Note that the net RSRL is higher for the *FULL* portfolio (54.64) than it is for the *BM* benchmark non-ETF portfolio (45.49).

The third alternative hypothesis is that investors simply trade more in ETFs than in other securities and that extra trading costs are the main cause of deterioration in net returns. If we assume that buys (and sells) of ETFs are financed from the non-ETF portion of the portfolio, as is the assumption for Table VIII, the return net of transaction costs is –0.55% for the ETF part of the portfolio (*ETF*) and 3.91% for the non-ETF part of the portfolio (*BM*). The return before transaction costs is 1.02% for the ETF part of the portfolio (*ETF*) and 5.51% (*BM*) for the non-ETF part of the portfolio. Although the drop in returns due to transactions is marginally larger for the ETF part than for the non-ETF part, the important insight is that the performance difference already exists for gross returns. Therefore, the costs that investors incur in trading ETFs are not the only reason why the ETF part of the portfolio under-performs the non-ETF part.[25]

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[25] We obtain the same conclusion if we assume that purchases (and sales) of ETFs are financed from (finance) the cash part of the portfolio (results not tabulated). Then the *after* transaction costs return is -1.46% for the ETF part of the portfolio and -2.10% for the non-ETF part of the portfolio; the return *before* transaction costs is -0.715% for the ETF part and -0.722% for the non-ETF part.

4.4 IMPACT OF INVESTOR HETEROGENEITY

In this section, we explore the role of investor heterogeneity in the use of ETFs. Specifically, we examine whether overconfident investors and/or financially unsophisticated investors trade ETFs unwisely. The research design is to check whether there is a difference in trading behavior and portfolio performance amongst ETF users sorted into quintiles along these two dimensions.

Overconfident investors have higher portfolio turnover (e.g., Barber and Odean, 2000), so we use turnover as our first sorting variable. Financially unsophisticated investors have lower portfolio values, and are typically under-diversified (e.g., Goetzmann and Kumar, 2008). We measure under-diversification using the RSRL. We use portfolio value and portfolio diversification as our second and third sorting variables.

We use several metrics as measures of the trading behavior of ETF users. We first use the portfolio turnover in ETF users' portfolios before and after using ETFs. Then we decompose the turnover after ETF use into turnover in the ETF part and turnover in the non-ETF part of the portfolio. To measure the impact of portfolio performance, we use the same return differentials as in Table VIII, but we focus our attention to ETF timing ability (FULL minus B&H) and ETF selection (relative to choosing MSCI) (FULL minus MSCI). To check for a portfolio diversification impact, we again resort to the change in RSRL.

In Table IX, ETF users are grouped into quintiles depending on their average portfolio turnover before they start using ETFs. Quintile 1 has the lowest turnover whereas quintile 5 has the highest.

[INSERT TABLE IX ABOUT HERE]

ETF users, who trade more than other users before ETF use, also trade more than their peers after ETF use. This holds for both the ETF part and for the non-ETF part of their portfolio. Within each turnover quintile, ETF turnover is higher than the non-ETF turnover after ETF use. Taken together, this suggests that the availability of ETFs induces the active traders to remain active, but to shift some of their active trading from non-ETFs to ETFs.

Are there differences in performance, timing and selection abilities, or portfolio diversification between the investor quintiles? Table IX shows some systematic relations.

First, no quintiles have statistically significant gains by trading ETFs (*FULL* minus *BM*). However, overconfident investors, as measured by high portfolio turnover, have much worse ETF timing abilities (*FULL* minus *B&H*), but actually have better ETF selection abilities. Third, in terms of opportunity loss, almost all quintiles significantly lose by not buying and holding the MSCI World Index ETF. However, turnover does not seem to be related to ETF selection. Fourth, almost all quintiles worsen their portfolio diversification as measured by RSRL.

Table X is analogous to Table IX except that ETF users are grouped into five quintiles according to their average portfolio value before they start using ETFs. Quintile 1 has the lowest portfolio value whereas quintile 5 has the highest. We find a negative relation between investor sophistication as measured by portfolio value and trading before ETF use, but not after ETF use. As in Table IX the level of turnover across all quintiles after ETF use is higher for the ETF portion of the portfolio than for the non-ETF part.

[INSERT TABLE X ABOUT HERE]

We next examine whether wealth differences between users, as measured by portfolio value, affect portfolio performance, timing and selection abilities, and portfolio diversification.

The results in Table X indicate no systematic relation. Nevertheless, we again find that there is no distinct investor group that significantly benefits from ETF use or that experiences significant increases in diversification (as measured by RSRL).

Table XI is analogous to Table X except that ETF users are grouped into five quintiles depending on their RSRL before they start using ETFs. Quintile 1 has the lowest RSRL (highest portfolio diversification), whereas quintile 5 has the highest RSRL (lowest portfolio diversification). We find that with increasing RSRL, the portfolio turnover of ETF users' increases. This positive relation exists before and after ETF use and is driven by trading in the non-ETF part of the portfolio. Again, as in Table IX the level of portfolio turnover across all quintiles after ETF use is much higher for the ETF portion of the portfolio than for the non-ETF part.

[INSERT TABLE XI ABOUT HERE]

We next examine whether RSRL differences are related to performance, timing, and selection abilities. The results in Table XI indicate no systematic relation. Though we find that there is no quintile in which investors benefit from ETF use, and almost all quintiles lose (sometimes significantly) by not buying and holding the MSCI World Index ETF, we do not see significant cross-sectional differences across the quintiles in terms of performance, timing, and selection abilities.

To summarize our exploration of investor heterogeneity, there is no distinct group of investors whose portfolio performance is positively affected by the use of ETFs, no matter which measure (performance, timing, selection, or RSRL) or sort (turnover, portfolio value, or RSRL) we examine. We also find that no groups will lose by investing in the right MSCI ETF. Our sorting exercise also yields one potential explanation. Investors from virtually all groups do not substantially adapt their trading behavior after ETF use. Those who traded more before ETF use continue to trade more after ETF use, both in the ETF portion of the portfolio, as well as in the non-ETF part. Investors therefore appear to make the same mistakes when they trade ETFs that they have made in trading non-ETFs.

6. Conclusion

In this paper, we investigate whether a sample of individual investors in Germany benefit from using ETFs in the period 2005 to 2010. We find that the portfolio performance of ETF users relative to non-users does not improve after ETF use. This is primarily due to buying ETFs at the "wrong" time. There is also an opportunity loss that results mostly from not choosing ETFs that are low-cost and well-diversified. Therefore, for the individual investors in our sample, buying and holding well-diversified, low-cost ETFs would have been a wise strategy. This strategy, of course, also saves transaction costs.

The innovation of passive ETFs, with its enormous potential to act as a low-cost and liquid investment vehicle for diversification, may not help individual investors to enhance their portfolio performance. Problems arise when they actively abuse passive ETFs by buying and selling them at the "wrong" time or trading the "wrong" ETFs (buying and selling ETFs that are linked to narrow indices). Ironically, the growth in the number of ETFs that track single industries or countries seems to encourage this damaging behavior.

Our findings will make policymakers, regulators, consumer protection agencies, companies with 401(k) plans, financial planners, and financial economists more cautious when recommending ETF use. From a policy perspective, therefore, programs promoting savings in well-diversified, low-cost ETFs that simultaneously limit the potential to actively trade in them might be beneficial to individual investors.

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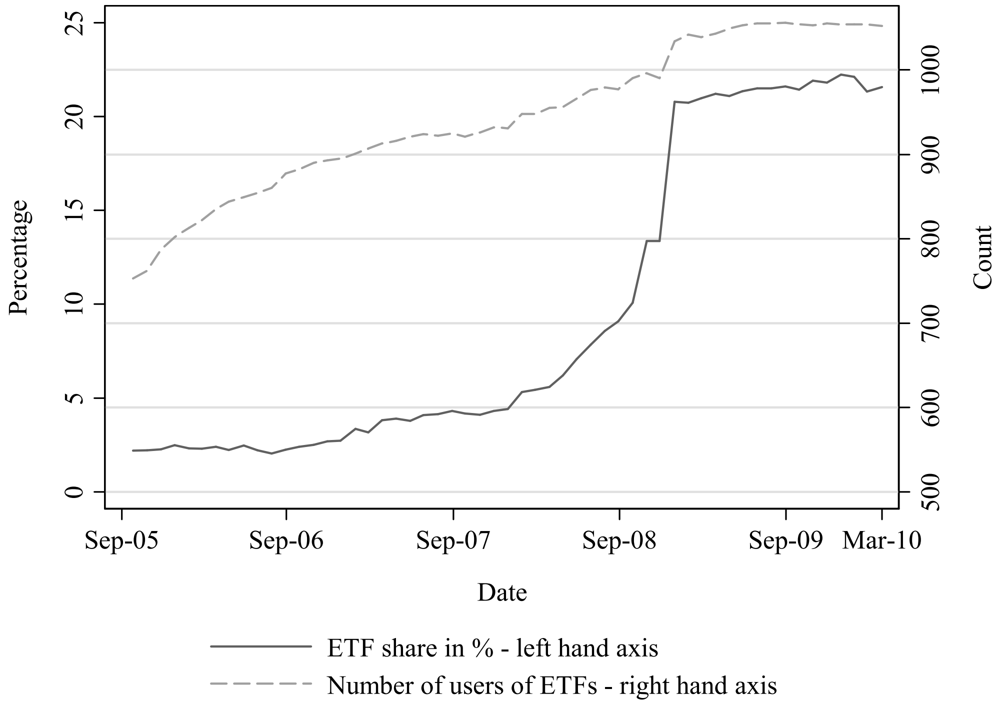

Figure 1. ETF Use in Our Sample. The figure presents the usage of ETFs over time. The solid line shows the average percentage share of ETFs in terms of euros in the portfolios of users (*ETF share in %*) and the dashed line shows the cumulative number of users (*Number of users of ETFs*).

Table I. Usage of Index-linked Securities: An Overview

This table provides an overview of the markets for ETFs and index funds in Germany (Panel A), the U.S. (Panel B), and within our sample (Panel C). For all panels, the latest available year-end data are used. We report the number of products, as well as assets under management (AUM), in absolute numbers and in percentages. The last two columns show the ETFs and index funds with active mutual funds in terms of the number of available products and assets under management (AUM).

	Index-linked securities				As % of active mutual funds	
	# of products	%	AUM in € m	%	# of products	AUM
Panel A: Index-linked securities in Germany[1]						
Passive ETFs	826	86%	99,311	84%		
Index mutual funds	135	14%	18,353	16%		
Total	961	100%	117,664	100%	17%	20%
Panel B: Index-linked securities in the US[2]						
Passive ETFs	1,028	73%	934,216	46%		
Index mutual funds	383	27%	1,094,296	54%		
Total	1,411	100%	2,028,512	100%	23%	21%
Panel C: Index-linked securities held by our investors[3]						
Passive ETFs	279	90%	17	95%		
Index mutual funds	30	10%	1	5%		
Total	309	100%	18	100%	17%	16%

[1] As of December 31, 2011. Source: BVI, Deutsche Börse.

[2] As of December 31, 2011. Source: Investment Company Institute Factbook 2012.

[3] As of December 31, 2009.

Table II. The Kind of ETFs Investors in the Sample Buy

Panel A: This panel shows the average amount of euros invested per month in a passive ETF on a benchmark index as a percentage of the total average amount of euros invested per month in all passive ETFs.

Benchmark index	Share in %
DAX	25.0%
STOXX Europe 50	11.2%
STOXX Europe Select Dividend	5.7%
LevDAX	4.2%
MDAX	3.7%
TecDAX TRI	3.7%
MSCI World	3.3%
EONIA	3.2%
MSCI Emerging Markets	3.0%
STOXX Europe 600	2.5%
Other (224 indices)	34.4%
Total	100.0%

Panel B: This panel shows the average amount of euros invested per month in a region using passive ETFs as a percentage of the total average amount of euros invested per month in all passive ETFs.

Country / region	Share in %
Europe	42.1%
Germany	35.6%
Emerging markets	6.2%
World	3.5%
Japan	3.2%
U.S.	2.6%
China	1.8%
Brazil	1.2%
India	0.9%
Asia	0.8%
Other	2.2%
Total	100.0%

Panel C: This panel shows the average amount of euros invested per month in an asset class using passive ETFs as a percentage of the total average amount of euros invested per month in all passive ETFs.

Asset class	Share in %
Equity	90.5%
Bonds	6.5%
Commodities	3.0%
Other	0.1%
Total	100.0%

Panel D: This panel shows the distribution of beta, alpha, and tracking error of all ETFs (top panel) and ETFs based on equity indices (bottom panel) that investors in our sample use. Beta, alpha, and tracking error (RMSE) result from a regression of ETF returns on the MSCI ACWI or the German benchmark index CDAX and are estimated separately for each ETF. p-values result from a t-test of betas and alphas against 1 and 0, respectively. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	All ETFs							
Metric	*N*	Mean	*p*-value	Median	10%	25%	75%	90%
Benchmark: MSCI World All Country								
Beta	353	0.88	.002***	1.03	-0.04	0.61	1.29	1.59
Alpha in % p.a.	353	0.84	.237	0.25	-12.27	-4.36	5.17	12.99
Tracking Error in % p.a.	353	3.63		3.16	1.27	2.16	4.70	6.21
Benchmark: CDAX								
Beta	353	0.72	.000***	0.83	-0.07	0.44	1.09	1.37
Alpha in % p.a.	353	0.11	.237	-0.36	-13.11	-6.30	5.66	13.41
Tracking Error in % p.a.	353	3.55		3.09	1.13	2.11	4.59	6.34

	ETFs on Equity Indices							
Metric	*N*	Mean	*p*-value	Median	10%	25%	75%	90%
Benchmark: MSCI World All Country								
Beta	284	1.05	.238	1.11	0.60	0.91	1.35	1.66
Alpha in % p.a.	284	0.67	.439	-0.07	-13.06	-4.84	5.45	14.21
Tracking Error in % p.a.	284	3.90		3.31	1.81	2.41	4.81	6.34
Benchmark: CDAX								
Beta	284	0.87	.000***	0.93	0.44	0.69	1.15	1.40
Alpha in % p.a.	284	-0.17	.837	-2.03	-13.86	-6.67	5.95	13.91
Tracking Error in % p.a.	284	3.79		3.26	1.70	2.40	4.72	6.38

Table III. Data Collected

The data are summarized in this table.

Type of data	Data	Frequency	Source of data
Client demographics	Gender	Time-invariant	Bank
	Date of birth (measure of age)	Time-invariant	Bank
	Microgeographic status (measure of wealth)	Time-invariant	Bank
Portfolio characteristics	Actual position statements	Monthly	Bank
	Actual transactions and transfers	Daily	Bank
	Cash	On start and end of dataset	Bank
	Account opening date (measure of length of relationship)	Time invariant	Bank
Market data	German Fama and French (1993) & Carhart (1997) factors	Monthly	Datastream / own calculation
	MSCI World All Country	Monthly	Datastream
	CDAX	Monthly	Datastream
	RDAX	Monthly	Datastream
	JP Morgan Global Bond	Monthly	Datastream
	Individual security prices	Monthly	Datastream
	Individual security properties	Time-invariant	Bank / Deutsche Börse

Table IV. Summary Statistics

This table reports summary statistics on investor demographics, investor characteristics, and portfolio characteristics. Investor demographics are comprised of statistics on the share of male investors (*Gender*), the age of investors (*Age*), and the wealth of an investor measured by the micro-geographic status rating, one through nine, assessed by an external agency (*Wealth*). Investor characteristics are comprised of statistics on the number of years the investor has been with the bank (*Length of relation*) and the proportion of risky assets (*Risky share*) held with this brokerage at the beginning (08/2005) and at the end (03/2010) of our sample period. Portfolio characteristics are comprised of the following statistics: the average risky portfolio value (*Average risky portfolio value*) of the customer, the average number of securities in the portfolio at the end of each month (*Average number of securities*), the average number of trades per month (*Average number of trades*), the average portfolio turnover per month (*Average portfolio turnover*), and alphas net of transaction costs for the MSCI ACWI and the CDAX (*alpha*). ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

		ETF users			ETF non-users			*t*-test (users vs. non-users)
Metric	Measurement units	Mean	Median	*N*	Mean	Median	*N*	*p*-value
Client demographics								
Gender	Dummy = 1 if male	80.9	100.0	1,080	82.0	100.0	5,869	.405
Age (08/2005)	Years	47.8	45.0	1,080	49.8	48.0	5,869	.000***
Wealth (08/2005)	Microgeographic status	6.5	7.0	952	6.3	6.0	5,164	.015**
Investor characteristics								
Length of relationship with the bank (03/2010)	Years since account opening	7.2	8.1	1,080	7.6	8.9	5,869	.000***
Risky share (08/2005)	%	81.6	85.5	754	95.5	86.1	4,418	.653
Risky share (03/2010)	%	78.0	86.7	1,043	73.4	82.2	5,381	.000***
Portfolio characteristics								
Average risky portfolio value (08/2005 - 03/2010)	€ thousands	60.3	42.8	1,080	51.0	34.6	5,869	.000***
Average number of securities (08/2005 - 03/2010)	Count	12.0	9.7	1,080	10.9	8.5	5,869	.001***
Average number of trades (08/2005 - 03/2010)	Trades per month	2.1	1.4	1,080	1.6	0.9	5,869	.000***
Average portfolio turnover (08/2005 - 03/2010)	%, monthly	7.4	4.4	1,080	6.5	3.5	5,869	.001***
Alpha (net) MSCI World All Country (08/2005 - 03/2010)	%, yearly	-0.9	0.0	1,080	-2.1	0.4	5,869	.091*
Alpha (net) CDAX (08/2005 - 03/2010)	%, yearly	-3.2	-2.3	1,080	-3.9	-2.8	5,869	.293

Table V. ETF Users: A Probit Test

This table reports the marginal effects of a probit regression. The dependent variable is a dummy (*Dummy user*) set to one for individual investors who hold at least one ETF during the sample period. For the estimation of the probit model, our independent variables are time-invariant or measured at the beginning (08/2005) of our sample period or at the first day an investor enters our sample. The independent variables are: a dummy that is equal to 1 if an investor is male (*Dummy male*), the age of an investor (*Age*), a dummy that is equal to 1 if an investor falls into categories 1 to 3 of a micro-geographic status rating (*Dummy low wealth*), a dummy that is equal to 1 if an investor falls into categories 7 to 9 of the micro-geographic status (*Dummy high wealth*), the risky portfolio value in euros of the investor (L*og portfolio value*) on the day he enters the sample, years the investor has been with the bank (*Length of relation*), and the proportion of risky assets in the account (*Risky share*) on the day the investor enters the sample. Heteroscedasticity robust *p*-values are in parentheses ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dummy user			
	(1)	(2)	(3)	(4)
Dummy male	-0.011	-0.012	-0.006	-0.013
	(0.328)	(0.313)	(0.607)	(0.351)
Age (08/2005)	-0.002***	-0.002***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Dummy low wealth (08/2005)	-0.008	-0.008	-0.009	-0.011
	(0.670)	(0.678)	(0.642)	(0.602)
Dummy high wealth (08/2005)	0.015	0.014	0.014	0.005
	(0.107)	(0.112)	(0.129)	(0.626)
Log portfolio value (first day)		0.004	0.007**	0.015***
		(0.114)	(0.013)	(0.000)
Length of relationship (08/2005)			-0.005***	-0.001
			(0.001)	(0.575)
Risky share (08/2005)				-0.000
				(0.593)
Observations	6,949	6,949	6,949	5,172
Pseudo-R^2	0.00470	0.00516	0.00715	0.00657

Table VI. Do ETFs Improve Portfolio Performance?

This table reports the results of a panel regression where the dependent variable is the net return of an investor (model 1) or excess net return of an investor (models 2-7). Here excess net return is the excess return over the 3-month Euribor rate. The sample includes all non-users and all users of ETFs. The independent variable of interest is *First Use of ETFs*, which is set to one from the first month in which an investor holds an ETF. We also include a user fixed effect using a dummy variable (*User fixed effect*), which is set to one if an investor holds an ETF during our sample period. The regressions include the following independent variables: time-varying risk factors (*MSCI ACWI, World Bond, CDAX, German Bond, CDAX* (*SMB*), *CDAX* (*HML*), and/or *CDAX* (*MOM*)), and time-varying portfolio characteristics of the investor (the log of the risky portfolio value in euros (*Log portfolio value*), the systematic risk-adjusted return (*Alpha*), portfolio turnover, and average number of trades). All these time-varying portfolio characteristics of the investor are rolling moving averages calculated on a monthly basis at *t* over the prior six months from *t*-7 to *t*-1 (*6 months MA*). "*Alpha (net) 6 months MA"* comes from a regression of excess net portfolio returns on the German benchmark index CDAX in the *t*-7 to *t*-1 window, and is estimated separately for each investor. The regression is estimated with demographic controls as well as year fixed effects. Demographic controls, defined in Table IV, are: *gender, age, dummy low and high wealth, and length of relation.* Standard errors are clustered by month. *P*-values are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Performance						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Net return	Excess net return	Excess net return	Excess net return	Excess net return	Excess net return	Excess net return
First Use of ETFs	-0.687	0.628	1.358	-3.777	-4.144	-3.380	-3.774
	(0.887)	(0.895)	(0.734)	(0.222)	(0.174)	(0.276)	(0.217)
User fixed effect	1.439	0.716	0.367	3.033	3.227	2.830	3.032
	(0.594)	(0.820)	(0.890)	(0.173)	(0.130)	(0.197)	(0.155)
MSCI World All Country excess return		1.072***	0.989***				
		(0.000)	(0.000)				
World bond index excess return			-0.822***				
			(0.000)				
CDAX excess return				0.837***	0.807***	0.918***	0.911***
				(0.000)	(0.000)	(0.000)	(0.000)
German bond index excess return					0.670**		0.656***
					(0.011)		(0.008)
CDAX (SMB)						0.282***	0.263***
						(0.002)	(0.003)
CDAX (HML)						-0.035	-0.024
						(0.756)	(0.818)
CDAX (MOM)						0.012	0.062
						(0.820)	(0.327)
Dummy male	-0.014	-0.014	-0.014	-0.014	-0.014	-0.015	-0.014
	(0.521)	(0.594)	(0.588)	(0.601)	(0.608)	(0.585)	(0.596)
Age (08/2005)	-0.965	-1.009	-0.944	-1.136	-1.147	-1.137	-1.152
	(0.345)	(0.422)	(0.462)	(0.375)	(0.370)	(0.376)	(0.369)
Dummy low wealth (08/2005)	0.743	0.789	0.765	0.803	0.808	0.784	0.784
	(0.350)	(0.402)	(0.427)	(0.412)	(0.413)	(0.424)	(0.427)
Dummy high wealth (08/2005)	0.485	0.510	0.489	0.509	0.503	0.504	0.501
	(0.337)	(0.405)	(0.438)	(0.424)	(0.433)	(0.430)	(0.436)
Length of relationship (08/2005)	0.086	0.126	0.048	0.206	0.211	0.185	0.200
	(0.720)	(0.491)	(0.790)	(0.173)	(0.152)	(0.227)	(0.171)
Log portfolio value 6 months MA	-4.395***	-3.356***	-3.047***	-2.451***	-2.227***	-2.297***	-2.241**
	(0.004)	(0.000)	(0.001)	(0.003)	(0.009)	(0.006)	(0.010)
Alpha (net) 6 months MA	1.308***	0.929***	0.898***	0.896***	0.896***	0.867***	0.873***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Portfolio turnover 6 months MA	-28.931	-12.062	-21.323	-12.400	-13.884	-12.282	-12.304
	(0.228)	(0.448)	(0.128)	(0.288)	(0.248)	(0.254)	(0.264)
Average number of trades 6 months MA	-0.450	-0.568	-0.717*	-0.476	-0.508	-0.519	-0.533
	(0.402)	(0.185)	(0.071)	(0.245)	(0.209)	(0.185)	(0.173)
Constant	5.825	-1.035	-7.104	-9.711*	-8.119	-5.101	-5.080
	(0.645)	(0.848)	(0.214)	(0.065)	(0.114)	(0.303)	(0.213)
Observations	284,866	284,866	284,866	284,866	284,866	284,866	284,866
R-squared	0.194	0.435	0.461	0.476	0.480	0.482	0.485
Number of investors	6,893	6,893	6,893	6,893	6,893	6,893	6,893
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table VII. Our Counterfactual Portfolios

BM, "Only non-ETF securities," is the non-ETF portion of investors' portfolios. This portfolio serves as the benchmark in our analysis. *ETF*, "Only ETF securities," is the ETF portion of investors' portfolios. *FULL* is the actual full risky portfolio of investors. In *B&H*, "Non-ETF part + ETF part with B&H," we disregard all ETF sell transactions. In *MSCI*, "Non-ETF part + ETF part with MSCI", each ETF transaction is replaced by a transaction in a Vanguard fund that tracks the MSCI World Index. In *MBM*, "Non-ETF part + ETF part with B&H MSCI", we disregard all ETF sell transactions and each ETF purchase is replaced by a purchase in a Vanguard fund that tracks the MSCI World Index.

Portfolio	Abbreviation	Construction	Description
Benchmark (Non-ETF part)	BM	Only non-ETF securities	The non-ETF part of the full portfolio
ETF part	ETF	Only ETF securities	The ETF part that of the full portfolio
Full portfolio	FULL	Non-ETF part + ETF part	The actual full portfolio consisting of the ETF part and the non-ETF part
Full portfolio with B&H ETF	B&H	Non-ETF part + ETF part with B&H	The full portfolio with only buy-and-hold ETFs
Full portfolio with MSCI ETF	MSCI	Non-ETF part + ETF part with MSCI	The full portfolio with all ETFs replaced by MSCI
Market benchmark	MBM	Non-ETF part + ETF part with B&H MSCI	The full portfolio with buy-and-hold MSCI

Table VIII. Counterfactual Portfolios and Performance Decomposition

This table reports the results from a portfolio performance decomposition using counterfactual analysis at the investor level. If no ETF is held on day *t*, we replace the return with the return of the non-ETF part. Panel A displays results after transaction costs, whereas Panel B presents results before transaction costs. Portfolios in the top half of each panel are created by either changing the securities considered (actual securities or Vanguard MSCI) or the trading strategy (actual behavior or B&H). The description of theses portfolios is in Table VII. The performance metrics are: return p.a. (average of time series mean returns of individual investors), standard deviation p.a. (mean of the standard deviations of time series returns of individual investors), the relative Sharpe ratio loss, and measures based on a one-factor model of performance evaluation using the MSCI ACWI as the benchmark index. Alpha represents Jensen's alpha, *p*-value is a test of the alpha against 0, beta is the coefficient on the market factor, and unsystematic variance share is the fraction of the variance the model is unable to explain. The column "Return Difference from benchmark in %" is the difference in returns between the non-ETF part of the portfolio (*BM*) and the respective portfolio. The column "*p*-value of return difference from benchmark" presents the results of a test of whether the difference is statistically different from zero. The last column reports the number of investors. The bottom half of each Panel in Table VIII decomposes the return contribution of ETFs. ETFs' impact on portfolio performance is shown in row 1 (calculated as: *FULL* minus *BM*). The decomposition of row 1 into ETF timing ability (*FULL* minus *B&H*) and ETF selection ability (relative to not choosing ETFs) (*B&H* minus *BM*) is shown in rows 2 and 3, respectively. The opportunity loss they have incurred by not investing into a theoretically sound ETF is shown in row 4 (*FULL* minus *MBM*). The decomposition of row 4 into market timing (*MSCI* minus *MBM*) and ETF selection (relative to choosing MSCI) (*FULL* minus *MSCI*) is shown in rows 5 and 6, respectively. The columns "*p*-value of return (RSRL, alpha) difference" presents *p*-values of a test of whether the return (RSRL, alpha) difference is statistically different from zero. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Net of transaction costs

Portfolio	Description	Return p. a. in %	Standard Deviation p.a. in %	Relative Sharpe Ratio Loss in %	Alpha p. a. in %	p-Value of Alpha against 0	Beta	Unsystematic Variance Share in %	Return difference from Benchmark in %	p-Value of return difference from Benchmark	N
BM	Non-ETF part	3.91	23.48	45.49	-0.24	.710	0.75	39.41	0.00	n.a.	1,061
ETF	ETF Part	-0.55	24.37	85.40	-2.72	.000***	0.75	39.52	-4.46	.000***	1,061
FULL	Non-ETF part + ETF part	2.74	21.96	54.64	-0.35	.526	0.74	34.54	-1.16	.058*	1,061
B&H	Non-ETF part + ETF part with B&H	3.52	20.87	51.82	0.76	.054*	0.73	30.98	-0.39	.547	1,061
MSCI	Non-ETF part + ETF part with MSCI	4.02	22.09	37.73	0.77	.190	0.75	33.66	0.12	.913	1,061
MBM	Non-ETF part + ETF part with B&H MSCI	4.43	20.36	36.63	1.43	.000***	0.73	30.03	0.52	.630	1,061

Difference	Performance decomposition	Return difference	p-Value of return difference	RSRL difference	p-Value of RSRL difference	Alpha difference	p-Value of alpha difference
FULL - BM	ETF's impact on portfolio performance	-1.16	.058*	9.15	.000***	-0.11	.687
FULL - B&H	ETF timing ability	-0.77	.075*	2.82	.071*	-1.11	.001***
B&H - BM	ETF selection ability (relative to not choosing ETFs)	-0.39	.547	6.33	.006***	1.00	.018**
FULL - MBM	Opportunity loss	-1.69	.007***	18.01	.000***	-1.79	.000***
MSCI - MBM	Market timing	-0.41	.236	1.10	.436	-0.67	.074*
FULL - MSCI	ETF selection ability (relative to choosing MSCI)	-1.28	.022**	16.91	.000***	-1.12	.000***

Panel B: Gross of transaction costs

Portfolio	Description	Return p. a. in %	Standard Deviation p.a. in %	Relative Sharpe Ratio Loss in %		Alpha p. a. in %	p-Value of Alpha against 0	Beta	Unsystematic Variance Share in %	Return difference from Benchmark in %	p-Value of return difference from Benchmark	N
BM	Non-ETF part	5.51	23.24	35.72		1.18	.041**	0.75	39.18	0.00	n.a.	1,061
ETF	ETF Part	1.02	24.20	74.57		-1.24	.013**	0.75	39.25	-4.49	.000***	1,061
FULL	Non-ETF part + ETF part	4.18	21.78	45.15		0.97	.043**	0.74	34.27	-1.33	.033**	1,061
B&H	Non-ETF part + ETF part with B&H	4.75	21.56	43.36		1.56	.000***	0.75	31.57	-0.76	.234	1,061
MSCI	Non-ETF part + ETF part with MSCI	5.47	21.92	28.53		2.09	.000***	0.75	33.34	-0.04	.970	1,061
MBM	Non-ETF part + ETF part with B&H MSCI	5.41	20.28	28.73		2.26	.000***	0.73	29.67	-0.10	.927	1,061
Difference	Performance decomposition	Return difference	p-Value of return difference	RSRL difference	p-Value of RSRL difference	Alpha difference	p-Value of alpha difference					
FULL - BM	ETF's impact on portfolio performance	-1.33	.033**	9.43	.000***	-0.22	.415					
FULL - B&H	ETF timing ability	-0.57	.215	1.80	.354	-0.59	.038**					
B&H - BM	ETF selection ability (relative to not choosing ETFs)	-0.76	.234	7.63	.000***	0.37	.265					
FULL - MBM	Opportunity loss	-1.23	.045**	16.43	.000***	-1.29	.000***					
MSCI - MBM	Market timing	0.06	.839	-0.20	.884	-0.17	.542					
FULL - MSCI	ETF selection ability (relative to choosing MSCI)	-1.29	.019**	16.62	.000***	-1.12	.000***					

Table IX. Trading Behavior and Investment Performance Across Turnover Quintiles

In this table, all users of ETFs are divided into five quintiles in terms of their average monthly portfolio turnover before they start using ETFs. Quintile 1 has the lowest turnover and quintile 5 has the highest turnover. In Panel A, the mean turnover of each quintile group before ETF use is shown in row 1, portfolio turnover after ETF use is shown in row 2, ETF turnover after ETF use is shown in row 3, and non-ETF turnover after ETF use is shown in row 4. In Panel B, the ETFs' impact on portfolio performance (net of transactions costs) is shown in row 1 (calculated as: *FULL* minus *BM* of top half in Table VIII). The decomposition of row 1 into ETF timing ability (net) (*FULL* minus *B&H* in top half of Table VIII) and ETF selection ability (relative to not choosing ETFs) (net) (*B&H* minus *BM* in top half of Table VIII) is shown in rows 2 and 3, respectively. The opportunity loss (net) they have incurred by not investing into a theoretically sound ETF is shown in row 4 (*FULL* minus *MBM* in top half of Table VIII). The decomposition of row 4 into market timing (net) (*MSCI* minus *MBM* in top half of Table VIII) and ETF selection (relative to choosing MSCI) (net) (*FULL* minus *MSCI* in top half of Table VIII) is shown in rows 5 and 6, respectively. ETFs' impact on portfolio diversification (net RSRL) is shown in row 7 (net RSRL of *FULL* minus net RSRL of *BM* in top half of Table VIII) and opportunity loss from portfolio diversification (net RSRL) is shown in row 8 (net RSRL of portfolio *FULL* minus net RSRL of portfolio *MBM* in top half of Table VIII). Sample size, 902, is different from previous tables because we only include users of ETFs who do not hold ETFs throughout our sample period. The column "*p*-value" presents p-values of a test of whether the difference between Q1 and Q5 is different from zero on a per investor level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

		Q1 (lowest)	Q2	Q3	Q4	Q5 (highest)	Difference	t-test
# of investors		181	180	181	180	180	Q1 - Q 5	p-value
Panel A: Trading Behavior								
Portfolio turnover before ETF use (% per month)		1.36	3.16	5.56	9.80	30.30	-28.94	.000***
Portfolio turnover after ETF use (% per month)		1.84	2.18	5.09	7.34	16.20	-14.35	.000***
ETF turnover after ETF use (% per month)		2.80	4.60	5.98	7.95	15.94	-13.14	.000***
Non-ETF turnover after ETF use (% per month)		1.71	1.69	4.33	6.35	15.67	-13.97	.000***
Panel B: Portfolio Performance / Portfolio Diversification								
ETF's impact on portfolio performance	FULL - BM	-0.64**	-2.09***	-0.51	-0.96**	-2.98	2.35	.492
ETF timing ability	FULL - B&H	-0.08	0.29	-1.11**	1.82	-3.81***	3.74	.009***
ETF selection ability (relative to not choosing ETFs)	B&H - BM	-0.56	-2.38***	0.60	-2.78	0.83	-1.39	.626
Opportunity loss	FULL - MBM	-0.90***	-1.93***	-1.29***	-2.82*	1.19	-2.09	.583
Market timing	MSCI - MBM	0.65**	0.84***	-0.57	1.07*	-3.87**	4.52	.004***
ETF selection ability (relative to choosing MSCI)	FULL - MSCI	-1.62***	-2.49***	-1.83***	-2.06***	1.24	-2.86	.357
ETFs' impact on portfolio diversification (net RSRL)	FULL - BM	0.05	0.13***	0.09**	0.19***	0.11**	-0.05	.361
Opportunity loss from portfolio diversification (net RSRL)	FULL - MBM	0.17*	0.11***	0.16***	0.25***	0.36***	-0.19	.157

Table X. Trading Behavior and Investment Performance Across Portfolio Value Quintiles

In this table, all investors (users of ETFs and non-users of ETFs) divided into five quintiles in terms of their average monthly portfolio value before they start using ETFs. Quintile 1 has the lowest value and quintile 5 has the highest value. In Panel A, the mean turnover of each quintile group before ETF use is shown in row 1, portfolio turnover after ETF use is shown in row 2, ETF turnover after ETF use is shown in row 3, and non-ETF turnover after ETF use is shown in row 4. In Panel B (Portfolio Performance / Portfolio Diversification), the ETFs' impact on portfolio performance (net of transactions costs) is shown in row 1 (calculated as: *FULL* minus *BM* of top half in Table VIII). The decomposition of row 1 into ETF timing ability (net) (*FULL* minus *B&H* in top half of Table VIII) and ETF selection ability (relative to not choosing ETFs) (net) (*B&H* minus *BM* in top half of Table VIII) is shown in rows 2 and 3, respectively. The opportunity loss (net) they have incurred by not investing into a theoretically sound ETF is shown in row 4 (*FULL* minus *MBM* in top half of Table VIII). The decomposition of row 4 into market timing (net) (*MSCI* minus *MBM* in top half of Table VIII) and ETF selection (relative to choosing MSCI) (net) (*FULL* minus *MSCI* in top half of Table VIII) is shown in rows 5 and 6, respectively. ETFs' impact on portfolio diversification (net RSRL) is shown in row 7 (net RSRL of *FULL* minus net RSRL of *BM* in top half of Table VIII) and opportunity loss from portfolio diversification (net RSRL) is shown in row 8 (net RSRL of portfolio *FULL* minus net RSRL of portfolio *MBM* in top half of Table VIII). Sample size, 902, is different from previous tables because we only include users of ETFs who do not hold ETFs throughout our observation period. The column "p-value" presents p-values of a test of whether the difference between Q1 and Q5 is different from zero on a per investor level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

		Q1 (lowest)	Q2	Q3	Q4	Q5 (highest)	Difference	t-test
# of investors		181	180	181	180	180	Q1 - Q 5	p-value
Panel A: Trading Behavior								
Portfolio turnover before ETF use (% per month)		13.78	11.85	8.74	8.56	7.16	6.62	.000***
Portfolio turnover after ETF use (% per month)		7.16	7.85	5.05	6.10	6.46	-0.70	.587
ETF turnover after ETF use (% per month)		6.97	7.58	7.10	7.42	8.19	1.23	.448
Non-ETF turnover after ETF use (% per month)		6.66	6.98	5.02	5.33	5.72	-0.94	.397
Panel B: Portfolio Performance / Portfolio Diversification								
ETF's impact on portfolio performance	FULL - BM	-4.12	-0.79	-1.53***	0.15	-0.87	-3.25	.333
ETF timing ability	FULL - B&H	-1.09	-1.55***	-0.87	0.84	-0.22	-0.86	.347
ETF selection ability (relative to not choosing ETFs)	B&H - BM	-3.03	0.75	-0.65	-0.69	-0.65	-2.38	.373
Opportunity loss	FULL - MBM	1.07	-0.94	-2.23	-1.89	-1.76	-1.15	.447
Market timing	MSCI - MBM	0.24	-0.54	-0.48	-1.07	-0.02	-0.37	.747
ETF selection ability (relative to choosing MSCI)	FULL - MSCI	-0.26	-1.95***	-2.62***	0.02	-1.95***	1.70	.571
ETFs' impact on portfolio diversification (net RSRL)	FULL - BM	0.15***	0.09**	0.11***	0.06*	0.17**	-0.02	.799
Opportunity loss from portfolio diversification (net RSRL)	FULL - MBM	0.39***	0.20**	0.15***	0.06	0.25***	0.14	.305

Table XI. Trading Behavior and Investment Performance Across Relative Sharpe Ratio Loss Quintiles

In this table, all investors (users of ETFs and non-users of ETFs) are divided into five quintiles in terms of their average monthly relative Sharpe ratio loss (RSRL) before they start using ETFs. Quintile 1 has the lowest RSRL while quintile 5 has the highest RSRL. In Panel A, the mean turnover of each quintile group before ETF use is shown in row 1, portfolio turnover after ETF use is shown in row 2, ETF turnover after ETF use is shown in row 3, and non-ETF turnover after ETF use is shown in row 4. In Panel B, the ETFs' impact on portfolio performance (net of transactions costs) is shown in row 1 (calculated as: *FULL* minus *BM* of top half in Table VIII). The decomposition of row 1 into ETF timing ability (net) (*FULL* minus *B&H* in top half of Table VIII) and ETF selection ability (relative to not choosing ETFs) (net) (*B&H* minus *BM* in top half of Table VIII) is shown in rows 2 and 3, respectively. The opportunity loss (net) they have incurred by not investing into a theoretically sound ETF is shown in row 4 (*FULL* minus *MBM* in top half of Table VIII). The decomposition of row 4 into market timing (net) (*MSCI* minus *MBM* in top half of Table VIII) and ETF selection (relative to choosing MSCI) (net) (*FULL* minus *MSCI* in top half of Table VIII) is shown in rows 5 and 6, respectively. ETFs' impact on portfolio diversification (net RSRL) is shown in row 7 (net RSRL of *FULL* minus net RSRL of *BM* in top half of Table VIII) and opportunity loss from portfolio diversification (net RSRL) is shown in row 8 (net RSRL of portfolio *FULL* minus net RSRL of portfolio *MBM* in top half of Table VIII). Sample size, 902, is different from previous tables because we only include users of ETFs who do not hold ETFs throughout our sample period. The column "p-value" presents p-values of a test of whether the difference between Q1 and Q5 is different from zero on a per investor level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

		Q1 (lowest)	Q2	Q3	Q4	Q5 (highest)	Difference	t-test
# of investors		181	180	181	180	180	Q1 - Q 5	p-value
Panel A: Trading Behavior								
Portfolio turnover before ETF use (% per month)		9.54	7.82	9.90	11.38	11.47	-1.92	.166
Portfolio turnover after ETF use (% per month)		6.79	4.84	7.08	7.08	6.82	-0.04	.972
ETF turnover after ETF use (% per month)		6.74	6.21	7.15	9.33	7.82	-1.08	.426
Non-ETF turnover after ETF use (% per month)		6.20	4.10	7.47	5.70	6.24	-0.04	.969
Panel B: Portfolio Performance / Portfolio Diversification								
ETF's impact on portfolio performance	FULL - BM	-0.52	-0.71	-1.55***	-3.83	-0.56	0.04	.972
ETF timing ability	FULL - B&H	1.09	-1.76*	-0.70	-1.26	-0.26	1.35	.488
ETF selection ability (relative to not choosing ETFs)	B&H - BM	-1.62	1.06	-0.85	-2.57	-0.30	-1.32	.566
Opportunity loss	FULL - MBM	-2.95	-1.57	-2.26	2.68	-1.62	-1.15	.449
Market timing	MSCI - MBM	-0.04	-1.83	-0.79	0.56	0.22	-0.37	.761
ETF selection ability (relative to choosing MSCI)	FULL - MSCI	-1.82***	-1.51	-2.18***	0.86	-2.10***	0.28	.763
ETFs' impact on portfolio diversification (net RSRL)	FULL - BM	0.13***	0.03	0.16***	0.08**	0.17**	-0.04	.679
Opportunity loss from portfolio diversification (net RSRL)	FULL - MBM	0.25***	0.16***	0.25***	0.10***	0.29**	-0.05	.751