# The Role of Taxes in the Rise of ETFs

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## Abstract

The immense growth of ETFs is often attributed to their intraday liquidity and low expenses, which are favored by short-term investors. This paper argues that lesser known, yet economically significant, tax elimination and deferral features of ETFs' security design are critical to their success in the last two decades. By relying on the in-kind redemption exemption, authorized participants help ETFs avoid distributing realized capital gains and reduce their tax overhang, partly by deploying "heartbeat" trades. We estimate that the tax efficiency of ETFs relative to mutual funds increases long-term investors' after-tax returns by an average of 0.92% per year in recent years. Exploiting cross-sectional and time-series variations in investors' tax burden, we document that tax efficiency is likely the driver of the capital migration by high-net-worth investors from active mutual funds into ETFs. Our results suggest an equilibrium where taxable mutual fund assets migrate or convert to ETFs.

Keywords: ETFs, Mutual Funds, Capital Gains, Fund Flows, In-Kind Redemptions, Section 852(b)(6) Exemption, Heartbeat Trades, Tax Deferral, High-Net-Worth Individuals, Step-up in Basis

JEL Classification: G11, G23, G28, K22

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# I. Introduction

Exchange-traded funds (ETFs) have witnessed spectacular growth in the last two decades, reaching $7.2 trillion in December 2021.[1] The success of ETFs has been generally attributed to several factors, including intraday liquidity, lower transaction costs, and lower expense ratios (Ben-David, Franzoni, & Moussawi (2017)). While these factors appeal mostly to investors who trade frequently, such as retail investors and institutions, less attention has been dedicated to the steady capital migration from mutual funds to ETFs by long-term investors who are primarily attracted by another aspect of the ETF innovation: its tax efficiency. Therefore, a better understanding of the ETF tax efficiency would help researchers and policymakers better gauge the state of competition between ETFs and mutual funds, predict future equilibrium, assess unintended consequences, and design policies to level the playing field from a taxation perspective and enhance the efficiencies of various investment vehicles.

In this study, we argue that ETFs' tax efficiency relative to mutual funds is a significant driver behind the capital migration of long-term investors into ETFs in recent years, particularly during a challenging decade when $1 trillion of investors' capital left active mutual funds, and a similar amount flowed into ETFs (Figure I). We explore the unique security design of ETFs that gives rise to their tax efficiency: in-kind redemptions with ETFs' authorized participants enjoy an exemption originally incepted for open-end funds to forgo capital gains distributions by transferring appreciated stocks "in-kind". We then quantify the magnitude of this tax efficiency and show that it is statistically and economically significant and persistent for all fund styles. Next, we show that the tax inefficiency of mutual funds was a leading determinant of outflows in recent years. Interestingly, during the same period when mutual funds exhibited the most outflows by tax-sensitive investors, we find that investment advisors with "high-net-worth" clients – considered as tax-sensitive investors in Blouin, Bushee, & Sikes (2017) – had the largest allocations to ETFs, both relative to their total portfolios and proportional to overall ETF assets. As a result of their persistent outperformance on an after-tax basis, even when compared with mutual funds that hold the same portfolios, ETFs are likely to be the preferred investment vehicle for long-term investors in coming years.

The capital migration by long-term investors from active mutual funds to ETFs could be due to a variety of reasons. First, active mutual funds' lack of outperformance, net of fees, could be an

[1] See ICI Factbook (2022) available at: https://www.icifactbook.org/pdf/2022_factbook.pdf



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important reason behind the trend. Second, ETFs are attractive because of their lower expense ratios, which allows them to compete for investor flows not only with open-end mutual funds but even with futures and other index products.[2] Indeed, recent media reports highlight ETFs' fee efficiency as the primary reason behind the decline in the average expense ratio of mutual funds.[3] Third, tax advantage may have spurred the capital migration into ETFs especially by tax-sensitive investors. While all three factors represent important determinants of the after-tax, net-of-fees, returns for taxable investors, and should be assessed in isolation, there is little research, so far, on the role that taxes play in determining investor flows.

Prior studies have overlooked the importance of taxes in the competition between ETFs and mutual funds, especially as ETF and mutual fund returns are reported net of fees but before taxes. However, given that ETFs are held primarily in taxable accounts, it is important for long-term investors to consider the differences in after-tax returns between mutual funds and ETFs, even for mutual funds that might not seem different from ETFs at first glance. To provide intuition, the ETF tax efficiency can be illustrated with an example of a mutual fund and an ETF of the same fund family that track the same index: the State Street S&P 500 Index Fund (SVSPX) and the SPDR S&P 500 ETF (SPY). Both funds hold the same portfolio and have nearly the same before-fees, before-tax annual returns. Even though both funds have comparable realized capital gains, the ETF distributed zero capital gains in recent years due to the distribution exemption for in-kind redemptions, which makes it superior to the index fund tracking the same portfolio. The realized capital gains are reinvested in the ETF indefinitely until investors sell their ETF shares, while investors in the index fund have to pay annual taxes on all capital gains distributions. As a result, when factoring in the effect of taxes, the net after-tax return for investors of the index fund was around 2% lower than the return of the ETF in 2021, and this gap was around 4% in 2020.[4] By examining the tax burdens of all

[2] ETFs arguably have lower fees than the annualized futures roll costs. Joe Rennison, "Low-cost ETF challengers eat into derivatives market," *Financial Times*, September 11, 2016. Rochelle Toplensky, "Investors replace futures with ETFs," *Financial Times,* March 23, 2016.

[3] See for example: Robin Wigglesworth, "Asset managers slash expenses as 'feemageddon' bites," *Financial Times,* March 21, 2019. Chris Flood, "Fund fees forecast to fall by a fifth," *Financial Times,* October 21, 2018. Jason Zweig and Sarah Krouse, "Fees on Mutual Funds and ETFs Tumble toward Zero," *The Wall Street Journal*, January 26, 2016. Dawn Lim, "Index Funds are the New Kings of Wall Street," *The Wall Street Journal*, September 18, 2019. In the Internet Appendix, we provide Figure A.II which illustrates the declining patterns in average expense ratios for U.S. mutual funds.

[4] In 2021, SPY and SVSPX reported similar (net-of-fees) annual returns of 28.7% and 28.5% respectively. During this year, SPY made no capital gains distributions, while SVSPX had a 9.38% capital gains distributions yield (relative to NAV) primarily due to long-term capital gains distributions (9.05%). This resulted in a tax burden of 2.26% for SVSPX



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U.S. equity mutual funds and ETFs, we find that this gap in recent years is 0.92% per year, on average, and that it is higher for more active growth strategies with higher turnover and thus higher realized capital gains. For taxable investors, especially high net-worth individuals, this difference in after-tax returns represents an annual "tax alpha" that is hard to beat.

Our study has three parts. We first document the source and mechanism of ETFs' tax efficiency. Due to their unique security design, ETFs are hardwired to take advantage of Section 852(b)(6) of the U.S. Internal Revenue Code of 1986, which exempts the distribution of capital gains when the appreciated stocks are handed "in-kind" to redeeming investors. ETFs are tax efficient because all redemptions from ETFs are made "in-kind" with authorized participants, thereby avoiding capital gains distributions and their tax consequences for taxable investors. In contrast, mutual funds, absent the layer of authorized participants, typically engage in "cash" transactions to meet investors' redemption requests, and therefore make little use of the in-kind redemption exemption. By avoiding the distribution of capital gains, ETFs are essentially deferring all short-term and long-term realized capital gains until investors sell their ETF shares, which is very valuable for long-term taxable investors. Investors can then decide to sell ETF shares and time their capital gains realization when it is most optimal for their tax considerations. Bogle (1997) considers the capital gains tax deferral as an interest-free loan from the government that is reinvested in the fund. By avoiding the distribution of short-term and long-term capital gains, ETFs are effectively converting short-term realized capital gains at the fund level into long-term gains at the investor level (Colon (2017)), which is especially valuable for higher turnover strategies.

Furthermore, we find that ETFs maximize this tax benefit provided by the in-kind redemption process using a "synthetic" in-kind redemption mechanism dubbed "heartbeat" trades. Heartbeat trades, a term coined by Kashner (2017) as the plot of daily ETF flows resembles an ECG graph (Figure II), consist of large ETF inflows followed by in-kind redemptions of similar magnitudes a

investors in 2021, while the tax burden for SPY was 0.27% primarily due to dividends distributions. The expense ratio for SVSPX is 0.16% and for SPY is 0.09%, explaining part of the 0.2% return difference between the two funds tracking the S&P 500 index. In 2020, SVSPX's tax burden was 4.04% while for SPY the tax burden was 0.35%. Net realized gain for SPY was slightly higher than SVSPX due to higher investor flow activities. Realized gains are reported in the "Statements of Changes in Net Assets" and can be found for SPY in the annual report to shareholders (https://www.sec.gov/Archives/edgar/data/0000884394/0001193125-22-161896-index.htm) and for SVSPX in the certified shareholders report (https://www.sec.gov/Archives/edgar/data/0000826686/0001193125-21-340502-index.htm). The after-tax return figure is typically disclosed in fund prospectuses distributed to investors. For example, the "Return Before Taxes" and "Return After Taxes on Distributions" are provided in page 5 of the State Street S&P 500 index fund's prospectus for 2020 filed with the SEC: https://www.sec.gov/Archives/edgar/data/826686/0001193125-21-362172-index.htm.



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few days later, typically around ETF rebalancing dates. They are specifically designed to siphon away realized capital gains of appreciated constituents that are departing the ETF portfolio, rather than requiring the fund to directly sell these securities. Heartbeat trades are likely to be deployed whenever ordinary investor outflows are insufficient to offload all departing securities with substantial capital gains, and are especially beneficial for higher turnover strategies (such as active and smart-beta ETFs).

ETFs appeal to "high-net-worth" and other tax-sensitive investors particularly because they avoid the distributions of realized capital gains, lowering their annual tax bills. In addition to the deferral of short-term and long-term capital gains, the "step-up in basis" feature of the tax code, which could exempt all accumulated capital gains from taxes, makes these funds especially attractive to high-net-worth individuals.[5] In this paper, we provide novel evidence on the behavior of these tax-sensitive investors by focusing on investment advisors that manage the assets for high-net-worth individuals. Additionally, we use the change in capital gains tax rates due to the Affordable Care Act of 2010, which raises capital gains tax rates on high-income earners, as a quasi-natural experiment to better identify the role of taxes in explaining the wave of outflows from active mutual funds as well as the surge of inflows into ETFs.

In the second part of the paper, we quantify the magnitude of the ETF tax efficiency and provide empirical evidence on the underlying mechanism. Using data on realized and unrealized capital gains and distributions extracted from SEC's Form N-SAR for a comprehensive sample of all U.S. equity mutual funds and ETFs during the period between 1993 and 2017, we show that the superior tax efficiency of ETFs is visible from their near-zero capital gains distributions. In 2017, for example, around 65% of U.S. equity mutual funds distributed capital gains, while only 6.1% of ETFs have non-zero capital gains distributions. We draw a clearer picture when looking at the average magnitudes of capital gains as a fraction of net assets. While ETFs and mutual funds with similar characteristics and investment styles all *realize* capital gains (3.89% for ETFs, 3.86% for index mutual funds, and 5.88% for active mutual funds, on average), ETFs *distribute* almost no capital gains at all

[5] The "step-up" in basis is more valuable for ETFs because of the accumulated short- and long-term capital gains that are not distributed and therefore remain in the fund (in contrast, mutual funds distribute their realized capital gains each year which are taxed at corresponding tax rates). Once ETF shares are transferred to the investor's heirs, a "step-up" in basis to the fair market value at the time of transfer is applied, which allows investors to avoid paying tax on the cumulative deferred capital gains. See Laura Saunders, "Capital Gains: A Century-Old Tax Break Gets a Rush of Attention", *The Wall Street Journal*, June 18, 2021: https://www.wsj.com/articles/capital-gains-a-century-old-tax-break-gets-a-rush-of-attention-11624008609.



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(0.1%), in contrast to the average capital gains distribution yield of 3.44% (1.76%) for active (index) mutual funds (Figure IV).

To assess the magnitude of the ETF tax advantage, we follow Sialm (2009) and use corresponding marginal tax rates for dividends, short-term, and long-term capital gains distributions to estimate the overall tax burden as a percentage of the prior year's net assets for taxable investors in ETFs and mutual funds. During our sample period (and in particular after 2012), we find that index mutual funds experience an average tax drag of 0.73% per year (0.98% per year in the five years after 2012), while active mutual funds have a larger tax drag of 0.96% (1.28%) per year. On the other hand, ETFs have the lowest tax burden during each of the years in our sample, with an average of 0.42% (0.36%) per year, primarily due to dividend distributions. Therefore, our results show that ETF tax savings relative to active mutual funds represent 0.92% on average in the last five years of our sample. When comparing investments within similar styles, we find that this positive alpha that ETF investors experience on a net-of-fee after-tax basis is more pronounced in styles that experience higher realizations of capital gains.

We further explore in-kind redemptions, the mechanism behind ETF tax efficiency, which can be driven either by ordinary investors' outflows or by synthetic "heartbeat" trades. While ETFs are not discernibly different from mutual funds in how performance, turnover, and investors' outflows affect realized capital gains yields, we notice that outflows have the opposite effect on distributions and unrealized capital gains due to the effective exemption applied to all ETFs' in-kind redemptions. While mutual fund "cash" outflows typically trigger taxable events resulting in higher distributions at the end of the year, ETF in-kind redemptions during the year substantially reduce capital gains distributions. Additionally, outflows from mutual funds have negative tax externalities because they force the early realization of capital gains that must be distributed to the remaining investors in the fund. In contrast, ETFs mitigate these negative tax externalities because of the in-kind redemption feature that is applied to all ETF outflows. To this point, we find that ETF in-kind redemptions result in a higher cost basis for the remaining stocks in the ETF portfolio, leading to lower unrealized capital gains and tax overhang. This is consistent with the fact that ETFs, unlike mutual funds, strategically use outflows to allocate stocks with the lowest cost basis to in-kind redemption baskets. As a result, there is a stark difference between mutual funds and ETFs regarding the effect of outflows on distributed and unrealized capital gains.

Next, we examine the "synthetic" in-kind redemptions executed through "heartbeat" trades. ETFs employ "heartbeat" trades with the help of market makers and authorized participants, which



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results in ETF capital gains being realized without being distributed to investors. The fraction of ETFs that rely on heartbeat trades has steadily increased after 2010, along with total ETF assets and the realized capital gains of underlying portfolios. We document that up to 30% of ETFs make use of heartbeat trades in any given year, performing on average two heartbeat trades per year. Our results show that ETFs are more likely to employ heartbeat trades when ordinary investors' outflows during the year are not sufficiently large to flush away the bulk of realized capital gains through in-kind redemptions. Also, heartbeat trades are more likely in ETFs with higher portfolio turnover ratios and with a larger number of portfolio constituents. We find that heartbeat trades are as powerful as ordinary outflows in reducing overall capital gains distributions and are especially effective in reducing short-term capital gains distributions. As a result, ETFs end up with significantly lower tax burdens compared with mutual funds: for example, an ETF with two heartbeat trades per year ends up, on average, with a 0.86% lower tax burden than a comparable mutual fund of the same style, after controlling for various fund characteristics.

In the third part of our study, after establishing the tax efficiency of ETFs, we investigate the clientele effect behind the migration of capital into ETFs. ETF tax efficiency is especially appealing to tax-sensitive investors, such as "high-net-worth" individuals. We test this clientele effect in four steps. First, using regression analysis on active fund flows, we run a horse race of the flow sensitivities to the three components of net-of-fees after-tax returns: performance, fees, and tax burden. Namely, outflows from mutual funds could be explained by the relative underperformance of active mutual funds compared to passive funds, or by the fee efficiency of index funds and ETFs. However, tax efficiency due to the in-kind redemption exemption is unique to ETFs. We find that the flow-tax sensitivity is statistically and economically a strong determinant of active mutual fund flows, and the effects are even stronger when focusing on outflows and after 2012 when capital gains tax rates increased.

Second, to better identify that outflows are driven by taxable distributions, we run a test where we focus on the investors' outflows observed after realized gains are publicly reported but before they are distributed. This allows us to examine the effect of potential strategic complementarities due to the negative externalities of outflows for mutual fund investors, especially given that investors cannot use short-term capital gains distributions to offset losses. Outflows trigger early realizations of capital gains that would further exacerbate future outflows from the fund. Therefore, a tax-sensitive investor can be better off leaving the fund after they learn about its realized capital gains and before the fund distribution ex-dividend date, usually in December. Our results confirm the evidence that tax



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considerations are the strongest determinant of mutual funds outflows in anticipation of capital gains distributions. We conclude that tax-sensitive investors constitute a significant driver of outflows from active mutual funds during our sample period.

Third, we sort active mutual funds by their realized capital gains yields and examine their flows along with the flows of index funds and ETFs in the same investment styles. We find that mutual funds with the largest gains experience the largest outflows, while ETFs of the same investment styles exhibit relatively higher inflows than other ETFs. Index mutual funds do not exhibit similar patterns. We interpret this evidence as suggesting a migration of capital from active mutual funds to ETFs. Our results are also consistent with the conjecture that tax-sensitive investors are driving this capital migration to take advantage of the superior ETF tax efficiencies.

Finally, we present direct evidence of the clientele effect by confirming that the flows into ETFs are driven by tax-sensitive investors. Following Blouin, Bushee, & Sikes (2017), we identify institutions that manage the investment accounts for high-net-worth investors from Form ADV and use their 13-F holdings reports to explore ETF allocations over time and relative to other institutions. We find that investment advisors with high-net-worth clients are the most attuned to the tax efficiency needs of their clients and have been increasingly allocating more assets to ETFs during our sample period. Even though they represent a smaller asset base, their ETF ownership and flows relative to total ETF assets are the largest compared to other institutional advisors, and they constitute most of the ETF flows by investment advisors in recent years. In 2017, for example, allocations to ETFs by investment advisors with high-net-worth clients made up 21% of their overall portfolio, compared with 5% by other investment advisors. ETF allocations by tax-sensitive investors have increased significantly since 2012 when short-term and long-term capital gains tax rates increased due to the passages of the Taxpayer Relief Act and the Affordable Care Act, which disproportionally affected high-net-worth taxpayers (Figure V). This regulatory change in capital gains tax rates presents a quasi-natural experiment that we exploit to better identify the observed capital migration into ETFs due to tax reasons. Using difference-in-differences regressions, we examine the portfolio of investment advisors with high-net-worth clients relative to other advisors and find an overwhelming trend in allocation and flows into ETFs by tax-sensitive investors which accelerated with the increase in capital gains tax rates after 2012. Our evidence points to the important role of ETF tax efficiencies behind the dramatic surge of flows into ETFs in recent years.

Overall, we establish that ETFs are hardwired to take advantage of the special capital gains distribution exemption due to their built-in in-kind redemption mechanism, allowing them to generate



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significant tax savings that are appealing to tax-sensitive investors. We show that this tax efficiency has propelled the growth of ETFs in recent years as tax-sensitive investors gradually switched from mutual funds to ETFs. On March 29, 2021, the first conversion of a mutual fund into an exchange-traded fund (ETF) was announced to be completed, ushering in a new era of ETF growth and representing a watershed moment for the mutual fund industry.[6] These tax-free conversions are perhaps the clearest examples of the capital migration from mutual funds to ETFs.[7] Our results show that ETFs' tax advantage, the likely driver of this recent wave of fund conversions, has been a major catalyst behind the massive capital migration from active mutual funds to ETFs over the last two decades. Going forward, it is not inconceivable that this trend will continue until taxable mutual fund assets convert or migrate to ETFs, leading to a new equilibrium where ETFs dominate the taxable investment space.[8]

Our study ties in with the literature on mutual funds and taxation, where Sialm & Starks (2012) document that the average tax burden for mutual fund investors is of the same magnitude as the expense ratio, around 1% per year, and funds implement tax reduction practices based on their investor clientele. Bergstresser & Poterba (2002) analyze the determinants of mutual funds' tax

[6] On September 26, 2019, the SEC adopted Rule 6c-11, also known as the ETF Rule, which helped pave the way for conversions of mutual funds into ETFs. See: https://www.bbh.com/us/en/insights/investor-services-insights/making-the-switch-new-impetus-for-turning-a-mutual-fund-into-an-exchange-traded-fund.html. After two years of correspondence with SEC lawyers, Guinness Atkinson charted the path and completed the first tax-free conversion of two of its mutual funds into ETFs on March 29, 2021: https://www.bloomberg.com/news/articles/2021-03-29/history-made-as-first-mutual-fund-formally-converts-into-an-etf. A mutual fund's conversion to an ETF is not a taxable event as it is legally structured as a merger of the old mutual fund with a newly-created ETF portfolio: https://www.ft.com/content/deabe21a-ea76-486d-a941-813bb657e1f9 and https://www.ft.com/content/9eb2fbba-51f6-4c43-982b-98844d1f1bc0.

[7] The conversion of mutual fund assets into ETFs has been accelerating in recent months, including well-known fund families such as Dimensional Fund Advisors, Vanguard, JP Morgan, and Fidelity. Dimensional Fund Advisors announced in November 2020 the conversion of some of their mutual funds into ETFs: https://www.ft.com/content/7a6da469-b2d7-4ad4-b857-b3049752efb6. JP Morgan announced similar conversion in 2022: https://www.ft.com/content/1bc5829f-cc94-4342-982e-35a8ed0401ca. Fidelity Magellan fund announced in September 2020 that the fund will be repackaged as an ETF: https://www.cnbc.com/2020/10/02/fidelity-magellan-mutual-fund-moves-to-etf-format-what-may-be-next.html. As of December 2020, Vanguard recorded $178 billion of inflows into its ETFs in the first 11 months of 2020, partly because of $37 billion of tax-free conversions of some of its mutual fund clients to ETF shares of the same funds: https://www.ft.com/content/57c71ce2-fc23-491d-9062-54ceca303b74. Vanguard allows tax-free conversions for assets in Admiral mutual fund share classes into ETF share classes, which are easier due to their patented hybrid mutual fund-ETF structure: https://investor.vanguard.com/etf/faqs.

[8] According to the 2022 ICI Factbook, $11.64 trillion out of $26.96 trillion in mutual fund net assets are held in taxable accounts as of December 2021: $8.476 held in taxable household accounts and $3.165 trillion held in taxable non-household accounts, corresponding to 43% of overall mutual fund assets. See Figure 3.5 in the 2022 ICI Factbook: https://www.icifactbook.org/pdf/2022_factbook.pdf. Recent numbers suggest that active ETF assets are reaching new records and that "the combined assets of active equity ETFs in the U.S. rose by 35.5 per cent in the first six months of 2022," partly due to fund conversions: https://www.ft.com/content/8eeaa162-140d-4086-a344-3310125b8d3f.



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burdens and find that after-tax returns better explain inflows to mutual funds than before-tax returns. Gibson, Safieddine, & Titman (2000) document mutual funds' tax-loss harvesting at the end of the tax year following the Tax Reform Act of 1986. Sialm & Zhang (2020) present a theoretical model of equilibrium performance of active mutual funds that depends on the size of their tax clienteles and show empirically that tax-efficient funds exhibit superior skills that translate in higher before- and after-tax performance. Arnott, Kalesnik, & Schuesler (2018) note that most funds still underuse tax deference strategies. Our paper is also related to research on the competition between mutual funds and ETFs. Guedj & Huang (2009) develop an equilibrium model and find that open-end mutual funds and ETFs can coexist in equilibrium because they attract different liquidity clienteles. Similarly, Agapova (2011) concludes that index mutual funds and ETFs are imperfect substitutes, and they can coexist due to liquidity or tax-driven clientele effects. Our study contributes to the literature as it documents the sources, mechanism, and magnitude of ETF tax efficiency, highlights the importance of heartbeat trades for ETFs to realize their superior tax efficiency, and pinpoints the clientele effect that taxes have on ETF flows.

The paper proceeds as follows. Section II reviews the literature and discusses heartbeat trades and institutional details regarding the unique security design that gives rise to superior ETF tax efficiency. Section III provides the sample construction methodology followed by descriptive statistics. Section IV documents the gap between realized capital gains and distributions that gives rise to the ETF tax efficiency, which we quantify using the "tax burden" measure. Section V digs deeper into the mechanism behind the ETF tax efficiency. In Section VI, we run a horse race between the flow sensitivities of relative performance, fees, and taxes of active mutual funds to assess the comparative effects of each of these determinants of flows, and specifically outflows, from active funds. Section VII provides direct evidence on the ETF allocations by tax-sensitive investors. Section VIII concludes.

## II. ETF Security Design and Tax Efficiency

ETFs have exhibited unprecedented growth since their launch in 1993 and have become a popular investment vehicle by institutions and retail investors alike.[9] Benefits of ETFs include lower

[9] There are costs and benefits of ETF investments (Ben-David, Franzoni, & Moussawi (2017)). ETF investors do incur brokerage transaction fees and bid-ask spreads, but these costs have decreased over time. ETF investors may also incur a price difference between the price of the ETF and the net asset value (NAV) of its basket. Among the costs are also



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costs, the ease with which one can obtain a diversified portfolio, less cash drag, as well as tax efficiencies (Gastineau (2001)). As illustrated in Table A.I, there are 1,029 domestic equity-focused ETFs trading publicly in the U.S. as of December 2017, with aggregate assets under management (AUM) of around $1.8 trillion.[10] In contrast, open-end active (index) equity mutual fund assets represent about $4.1 trillion ($2.2 trillion) owned by over 3,750 actively managed mutual funds (around 600 index funds) as shown in Figure A.I. While passive investing is generally attributed to tax efficiencies due to low portfolio turnover, Easley, Michayluk, O'Hara, & Putniņš (2021) report that 93% of all ETFs have active elements, either in their portfolio turnover or in their flows. That is, while the majority of ETFs track an index, a growing segment of ETFs represent actively managed (e.g. ARK Innovation ETF (ARKK)), thematic ETFs (e.g. VanEck Morningstar Wide Moat ETF (MOAT)), and smart-beta ETFs (e.g. Vanguard Small-Cap Growth Index ETF (VBK)), all of which are active-in-form due to a higher level of portfolio turnover within the fund consistent with active management (Easley, Michayluk, O'Hara, & Putniņš (2021)). Therefore, ETF tax efficiency goes beyond the general tax benefits of indexing.

The tax efficiency of ETFs relies on an exemption, originally designed for open-end mutual funds, which allows them to forgo the distribution of realized capital gains when the appreciated stocks are handed "in-kind" to redeeming investors. When faced with outflows or rotating into new positions, mutual funds are often forced to sell stocks in their portfolios, thereby realizing capital gains for appreciated stocks. This typically causes negative externalities on remaining fund investors (Dickson, Shoven, & Sialm (2000)).[11] Under the Investment Company Act of 1940, and to avoid double taxation, funds are required to pass through and distribute their dividends and realized capital

various effects on the securities in the underlying basket, such as increased volatility (Ben-David, Franzoni, & Moussawi (2018)), decreased liquidity (Hamm (2014)), reduced informational efficiency (Israeli, Lee, & Sridharan (2017)), increased return comovement (Da & Shive (2017)) and increased liquidity comovement (Agarwal, Hanouna, Moussawi, & Stahel (2019)).

[10] The figures in the 2018 Investment Company Institute Factbook: https://www.ici.org/doc-server/pdf%3A2018_factbook.pdf match the numbers in our sample. The total ETF assets in the U.S. increased from $3.4 trillion in 2017 (1,836 ETFs) to $5.4 trillion in 2020 (2,203 ETFs) and $7.2 trillion in 2021 (2,570 ETFs) according to the Investment Company Institute (ICI) Factbook: https://www.icifactbook.org/.

[11] For a registered investment company, there are two ways to avoid distributions. One way is to offset net realized capital gains by loss carryovers. Another is through redemption-in-kind transactions where a pro-rata or a custom basket of portfolio assets, rather than cash, are delivered to redeeming shareholders. The realized gains through redemption-in-kind transactions will be reclassified as paid-in capital and not subject to federal taxation. The Notes to Financial Statements section in iShares' Annual Report provide important information about the significant accounting policies related to in-kind redemptions: https://www.ishares.com/us/literature/annual-report/ar-ishares-evolved-us-sectors-etfs-07-31.pdf



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gains to investors on an annual basis, which will be taxed at the shareholder level. However, since the inception of the Tax Reform Act of 1969, open-end funds have enjoyed an exemption to forgo capital gains distributions by handing over appreciated stocks "in-kind" to redeeming investors. Agarwal, Ren, Shen, & Zhao (2020) identify only 367 active mutual funds that issued in-kind redemptions to investors.[12] They find that mutual funds do not usually take advantage of the in-kind redemption mechanism due to the minimum in-kind redemption size, reputational costs, and because mutual fund investors usually prefer cash to less liquid underlying securities. Therefore, mutual funds end up predominantly using in-kind redemptions to accommodate large redemption requests mainly with sophisticated clients. With most mutual fund investors preferring redemptions in cash, ETFs stand at a sharp contrast given that all redemptions are in-kind through authorized participants, who are typically sophisticated institutions such as investment banks, market makers, and brokerage companies (Ben-David, Franzoni, & Moussawi (2017)).

This in-kind redemption exemption rule was codified as Section 852(b)(6) of the U.S. Internal Revenue Code of 1986. [13] In essence, Section 852(b)(6) allows ETFs and mutual funds to defer both short-term and long-term capital gains until investors sell their shares in the fund, which enhances the tax-timing option of taxable investors. One of the unique advantages of ETFs arise from the in-kind creation and redemption transactions with authorized participants that ETFs rely on to accommodate investor flows. The innovation of ETFs lies in the ability of ETF sponsors and authorized participants (and/or market makers) [14] to engage in the primary market of creating/redeeming ETF shares,

[12] The 1940 Investment Company Act allows for redemption-in-kind to alleviate instances when the fund must meet very large redemptions, or the underlying shares are very illiquid (Section 2(a)(32). See: https://www.govinfo.gov/content/pkg/COMPS-1879/pdf/COMPS-1879.pdf). Section 270.18f-1 of the Investment Company Act of 1940 allows a registered open-end investment company to redeem in kind if a redemption request is over $250,000 or more than 1% of the AUM.

[13] Section 852(b)(6) of the Internal Revenue Code stipulates that: "Section 311(b) shall not apply to any distribution by a regulated investment company to which this part applies, if such distribution is in redemption of its stock upon the demand of the shareholder." See: https://www.law.cornell.edu/uscode/text/26/852. Colon (2017) provides a detailed discussion of the taxation of in-kind redemption and the 852(b)(6) exemption rule, following Section 311(b) of the Tax Reform Act of 1969, https://www.pgdc.com/files/generalexplanati00jcs1670_bw.pdf, December 3, 1970. Based on this rule, ETFs and mutual funds can deliver appreciated stocks to investors instead of handing over cash, and therefore realize the capital gains without triggering a capital gains distribution event.

[14] We refer interchangeably to authorized participants (APs) and market makers (MMs), but not all APs are market makers and vice versa. An AP is typically a market maker or large institutional investor that has a legal agreement with the ETF to create and redeem shares of the fund. Evans, Moussawi, Pagano, & Sedunov (2019) discuss this issue in more details and report that an ETF usually has several APs that are active registered market makers with obligations to provide continuous buy and sell quotes for ETF shares on secondary markets. We assume that an ETF market maker is also an



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incentivized by arbitrage profits, in order to satisfy demand for ETF shares in secondary markets, which keeps the ETF price in line with the net asset value of the underlying basket (Evans, Moussawi, Pagano, & Sedunov (2019)). This process allows authorized participants to exchange baskets of securities or cash for ETF shares, and vice versa. Therefore, ETFs are hardwired to actively take advantage of the in-kind redemption exemption because all outflows are in-kind transactions with authorized participants, resulting, on average, in near-zero short- and long-term capital gains distributions in recent years.[15] This effectively represents a deferral of the taxation of capital gains until the investor sells their shares in the ETF. Furthermore, if ETF shares are instead transferred at death to an investor's heirs, a "step-up" in basis to the fair market value at the time of transfer is applied, which readjusts the cost basis of appreciated assets for tax purposes.[16]

We will survey the mutual fund tax literature next, before discussing the ETF security design and the heartbeat mechanism in the following subsections.

### *A. Mutual Fund Taxes, Flows, and Clienteles*

Capital gains taxes represent an important cost for long-term investors that own mutual funds in taxable investment accounts. Mutual fund returns are reported net of management fees but on a pre-tax basis and they do not capture these tax costs. Longmeier & Wotherspoon (2006) find that taxable investors lost on average 1.84% per year due to taxes during the period 1995-2005, while Peterson, Pietranico, Riepe, & Xu (2002) found a similar effect of 2.2% during 1981-1998. Overall, Sialm & Starks (2012) document that the average annual tax burden is of a magnitude similar to the expense ratio at around 1% of the fund's value. The distribution of capital gains is taxable and incurs a cost to tax-sensitive mutual fund investors.

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authorized participant or has an agent with an AP agreement with the ETF sponsor, and therefore we refer to such a market maker interchangeably in the paper as AP or MM.

[15] The differential treatment of ETFs and mutual funds under the tax code appears to be absent in most other countries. In their study on regulation and taxation across 26 markets, Morningstar (2020) observes that the "U.S. and Australia are notable exceptions where taxes are due on capital gains incurred by the fund, regardless of whether an investor has sold the fund or not" (quote from press release).

[16] The step-up in basis is defined in the Internal Revenue Code, Section 1014(a) as follows: "the basis of property in the hands of a person acquiring the property from a decedent or to whom the property passed from a decedent shall, if not sold, exchanged, or otherwise disposed of before the decedent's death by such person, be the fair market value of the property at the date of the decedent's death." See https://www.law.cornell.edu/uscode/text/26/1014.



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After-tax returns are generally lower depending on the type of investment account (taxable vs. tax-advantaged retirement account), investor tax bracket, and the taxable distributions of the fund (short term vs. long term capital gains, ordinary vs. qualified dividends), which are a function of the fund's investment style and turnover. In 2018, mutual funds distributed $511 billion in capital gains to shareholders (the Investment Company Institute's Fact Book (2019)). For investors in the highest tax bracket around the end of our sample period, short-term (long-term) capital gains would be taxed federally at 43.4% (23.8%) (Sialm & Zhang (2020)). On the flip side, net capital losses are not passed through to shareholders but are carried forward to offset future capital gains (Longmeier & Wotherspoon (2006)).[17]

Prior research found that investors are paying close attention to the effect of taxes on their returns. For example, Bergstresser & Poterba (2002) find that after-tax returns better explain inflows to mutual funds than before-tax returns. Additionally, they find that investors avoid funds with high unrealized capital gains overhangs, which is consistent with Barclay, Pearson, & Weisbach (1998), who argue that managers have incentives to reduce capital gains overhangs to attract new investors. Christoffersen, Geczy, Musto, & Reed (2005) document a clientele effect in international equity funds resulting in differential dividend arbitrage strategies to take advantage of the tax credit when non-retirement accounts are the majority. Similarly, Sialm & Starks (2012) find that mutual funds choose investment strategies that reduce tax burdens when they are held primarily by taxable investors, for example through employing strategies that reduce capital gains distributions by offsetting capital gains with capital losses, known as tax-loss harvesting.

More recently, Blouin, Bushee, & Sikes (2017) use client information in Form ADV filings to classify 13F institutional investors as tax-sensitive or tax-insensitive in order to evaluate their portfolio characteristics and trading behavior. They find that tax-sensitive investors earn lower pre-tax returns on average, likely due to tax reduction practices. Arnott, Kalesnik, & Schuesler (2018) note that many tax deference strategies (such as tax loss harvesting, wash sale management, and holding period management, among others) are still underused by funds, causing most active funds to have difficulty delivering alpha in excess of their fees and taxes. Bergstresser & Pontiff (2013) show that investment style is an important driver of tax burden, documenting that value and size risk premia are reduced once taxes are taken into account. Moreover, Peterson, Pietranico, Riepe, & Xu

[17] Before 2011, mutual funds could carry forward capital losses for up to eight years. https://www.wsj.com/articles/SB10001424052748704893604576200921149587458



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(2002) find that past pretax performance, expenses, risk, prior tax efficiency, and large recent redemptions significantly affect after-tax performance for mutual funds as well. Additionally, Beggs & Liu (2022) find that mutual funds that are managed side-by-side with tax-exempt separate account clients incur higher tax burdens.

### *B. ETF Tax Efficiencies, and Heartbeats*

In this paper, we further explore the tax efficiencies of ETFs and what effects they have on fund flows. Given the in-kind redemption exemption under Section 852(b)(6), ETF fund managers are incentivized to exchange securities from tax lots with the lowest cost basis and highest unrealized gains (Poterba & Shoven (2002), Kostovetsky (2003), Colon (2017)). This can be employed whenever ETF shares are being redeemed to meet investors' outflows in ETF primary or secondary markets, or as part of the ETF arbitrage process. As a result, the remaining shares of underlying securities in the ETF have a higher cost basis and most capital gains can be deferred. Going forward, investors may not even incur capital gains during portfolio rebalancing as a result of the adjusted cost basis.

This benefit is not limited to ETF shareholders. Colon (2017) documents that Vanguard and Eaton Vance have offered mutual funds with ETF *share classes*, which in turn help the fund reduce its unrealized capital gains through the in-kind redemption process. In a recent Bloomberg investigative article, Mider, Massa, & Cannon (2019) document that Vanguard was able to syphon away realized capital gains for $130 billion of their appreciated assets between 2000 and 2018 from both their ETFs and open-end mutual funds due to their patented hybrid ETF-mutual fund share class structure.[18]

Many ETFs aim to maximize the benefit from the in-kind redemption process to avoid realization of capital gains using a synthetic creation/redemption mechanism called "heartbeat" trades.[19] A heartbeat trade, a term coined by Kashner (2017) as the plot of daily ETF flows resembles an ECG graph (Figure II.B), is initiated by the ETF with the help of a market maker (and/or authorized participants). The process relies on a large inflow to the ETF where the market maker provides a short-term loan to the ETF and creates new ETF shares. This is followed by a large outflow where

[18] Bloomberg provides examples of various cases where Vanguard funds stopped distributing taxable capital gains after the introduction of the ETF share class in its funds as documented by Mider, Massa, & Cannon (2019) in their article from May 1, 2019: https://www.bloomberg.com/graphics/2019-vanguard-mutual-fund-tax-dodge/

[19] Heartbeats are also called friendlies or tax kickers (Loder (2019)).



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the same market maker redeems ETF shares equal in size to the creation order from days earlier, which marks the return of the capital. The outflow trade occurs a few days later and is aimed specifically to use appreciated securities in the in-kind redemption basket, thereby washing away all capital gains that otherwise would have had to be realized and distributed if sold by the fund directly.[20] This trade allows ETF investors to "convert short-term gains at the fund level into long-term gains at the shareholder level" (Colon (2017)). Mider, Evans, Wilson, & Cannon (2019) estimate that over 400 U.S. equity ETFs together deferred taxes on more than $211 billion in gains in 2018 alone. While the flexibility and control around the timing of tax payments are valuable benefits to ETF investors, the reduced application of short-term (and in some cases long-term) capital gains tax rates are foregone income for tax agencies.

## III. Sample Construction and Data Description

To construct our sample, we first identify an exhaustive list of U.S. Equity ETFs and mutual funds since 1993 using CRSP Mutual Fund Database. While our argument extends to mutual funds and ETFs in various investment styles and asset classes, we focus on U.S. equity funds since taxation is more straightforward than foreign equity funds and capital gains are typically a more substantial component of distributions than fixed income funds. We then combine our sample with various data sources, including Form N-SAR, Bloomberg, Form ADV, and Thomson-Reuters, for information on realized and unrealized capital gains, dividends and capital gains distributions, ETF heartbeat trades, and institutional ownership by advisors with high-net-worth clienteles. Our sample ends in 2017 which is the last year with complete Form N-SAR data that represents the source of our realized, distributed, and unrealized capital gains information.

[20] Heartbeat trades are operationally easier to implement for certain ETFs that qualify for the custom basket exemption, as the redemption basket would consist only of the appreciated securities leaving the fund, thus reducing the size and costs of the overall heartbeat trades. Through the adoption of Rule 6c-11 in 2019, the SEC made it easier for ETFs to seek custom basket exemptions. The use of custom and negotiated in-kind baskets for ETF creations and redemptions made it easier to effectively deploy heartbeat trades and further enhanced the tax efficiency for index and active ETFs. According to this rule, an ETF "will be permitted to use baskets that do not reflect a pro-rata representation of the fund's portfolio or that differ from the initial basket used in transactions on the same business day ('custom baskets') if the ETF adopts written policies and procedures setting forth detailed parameters for the construction and acceptance of custom baskets that are in the best interests of the ETF and its shareholders." See Rule 6c-11 for more information: https://www.sec.gov/news/press-release/2019-190, and https://www.sec.gov/rules/final/2019/33-10695.pdf.



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### *A. ETF and Mutual Fund Sample*

We construct three fund samples: ETFs, index mutual funds, and active mutual funds. All three samples are extracted from the CRSP Mutual Fund Database. We use the *et_flag* and *index_fund_flag* variables to identify ETFs and index mutual funds. We use the Lipper Class (*lipper_class*) and *crsp_obj_cd* variables to filter out any non-equity funds. For all investment style analyses and variables constructed at the fund style level, we rely on Lipper Class information which is inferred by Lipper from fund holdings, while other classifications such as CRSP Objective code and Lipper Objective code are typically based on self-reported fund styles. Our data on funds' realized capital gains and distributions, as well as monthly inflows and outflows, are extracted from the SEC's Form N-SAR filings. More details about the sample construction and Form N-SAR data are provided in the Internet Appendix.

Table A.I Panel A in our Internet Appendix reports the overall sample of U.S. Equity ETFs, index funds, and active mutual funds over the years using statistics at the share class and portfolio levels. All three groups have witnessed exponential growth from a combined 1,834 fund share classes at the end of 1993 to 15,920 share classes at the end of 2017. In terms of unique fund portfolios, the fund industry has seen an increase from 1,438 to 4,793 portfolios during our sample period.

US Equity ETFs have grown from 28 funds at the end of 1998 to 1,029 at the end of 2017, an almost 37-fold increase. There is a similar growth trend in passive index mutual funds as well, which increased from 58 index mutual funds at the end of 1993 to 1,007 share classes at the end of 2017, a 17-fold increase. Active mutual funds, on the other hand, reached a high at the end of 2015 with 14,225 share classes being offered. With growing competition for investor capital from ETFs and index mutual funds, active mutual funds have seen a slowing growth rate and substantial investor outflows in recent years. Figure I corroborates this overall trend. Panel A of Figure I is uniquely interesting, as it illustrates the massive outflows after 2004 from active mutual funds exceeding $1 trillion vis-à-vis ETFs which experienced inflows of similar magnitude during the same period.

### *B. ETF Heartbeat Trades*

ETFs can use the in-kind redemption exemption of Section 852(b)(6) to wash away their realized capital gains in two ways. For ETFs that receive a lot of routine creation and redemption requests during regular operations, it is sufficient for the ETF to use ordinary investor outflows to syphon away the shares with the lowest cost bases. This would reduce the unrealized capital gains



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associated with these stocks long before the portfolio rebalancing dates when the ETF will need to sell departing stocks and realize their gains. However, for larger ETFs with less frequent redemption requests, ETFs resort to synthetic redemptions to avoid selling stocks with embedded capital gains on rebalancing dates. These synthetic redemption requests, dubbed "heartbeat trades," are characterized by a large outflow preceded by a large inflow several days earlier. Therefore, these heartbeat trades typically occur on reconstitution and rebalancing days (1 to 4 events per year for most Russell and S&P indexes) but could be more frequent for other ETFs (e.g. smart-beta ETFs, active ETFs, ETFs with derivative contracts, convertible arbitrage etc. (Kashner (2017)).

In order to identify heartbeat trades in ETF flows, we build on the procedure by Mider, Evans, Wilson, & Cannon (2019). A heartbeat trade is characterized by flows that are at least three times in magnitude as the maximum non-heartbeat percentage flow observed in the surrounding 30 trading days. We start by looking for large inflows, defined as flows in ETF shares that have a magnitude of at least 1% relative to total ETF shares outstanding. Then, a large inflow needs to be followed by outflows during the subsequent 7 trading days that together offset at least 75% of the magnitude of the inflow.[21] Figure II Panel A provides the timeline that illustrates the windows and conditions that we use to identify heartbeat trades. We exclude flows that are equal to 25,000 or 50,000 shares, which are typical sizes of one creation unit (Ben-David, Franzoni, & Moussawi (2017)), as these flows likely belong to infrequently traded ETFs and are liquidity driven. Daily shares outstanding are obtained from Bloomberg using unique shares outstanding tickers for each ETF.[22] The term "heartbeat trade" is coined by Kashner (2017) as the plot of daily ETF flow chart resembles an ECG graph as illustrated in Figure II Panel B for the Vanguard Small-Cap Growth Index ETF (VBK), which is constructed as the time series plot of changes in shares outstanding with solid blue markings indicating the heartbeat trades that we detected in our sample.

The number of heartbeat trades has been steadily increasing in recent years with both the growth in ETF assets and market returns.[23] Figure III shows the number of heartbeats detected during

[21] It's unlikely that the heartbeat's creation and redemption trades take place on the same day because of concerns by ETF lawyers that the brief holding period absent of substantial economic risks would cause the IRS to deem the transaction questionable. For this reason, legal interpretations of the tax law emphasize on keeping the creation and redemption legs of the heartbeat trades spaced by at least 48 hours. (Mider, Evans, Wilson, & Cannon (2019))

[22] Tickers to retrieve shares outstanding figures often end in SO. If a percentage change in shares outstanding was missing (6% of observations), we substituted values based on Bloomberg's shares outstanding variable EQY_SH_OUT, followed by Morningstar (Shares_Outstanding), and FactSet measures (P_COM_SHS_OUT or ETP_SHS_OUT).

[23] The two ETF families with the highest dollar value of heartbeat trades during our sample period are Vanguard and Blackrock corresponding to nearly half the overall dollar value of heartbeat trades identified using our methodology.



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each month across all ETFs in our sample. The use of heartbeats has increased to approach the level of 80 heartbeat trades per month in 2018, with an average of 1-2 heartbeat trades per ETF per year, consistent with the frequency of the underlying index rebalancing.

### *C. Holdings of Investment Advisors to Tax-Sensitive Investors*

Thomson-Reuters Global Ownership database is our source for the 13F institutional ownership data which includes their holdings in ETFs, while investment advisors' Form ADV filings are our source for tax-sensitive client information.[24] Thomson-Reuters classifies 13F institutions into different categories using the "OwnerType" variable, which we use to focus on investment advisors registered with the SEC that manage assets for private clients and other institutions.[25] Investment advisors are the most common institution type found in Thomson-Reuters 13F data and it consists of buy-side institutions who invest on behalf of their clients as they have discretionary power over assets under management. We link the Thomson-Reuters 13F entities to their investment advisors through Form ADV filings by using CIK, phone numbers, addresses, and name information.[26]

To identify institutional investment advisors that manage the portfolios of tax-sensitive investors, we rely on the client type disclosures in investment advisors' Form ADV filings.[27] Following Blouin, Bushee, & Sikes (2017), we classify institutions as tax-sensitive once they manage more than 25% of their total assets under management on behalf of high-net-worth clients.[28] Moreover, we expect the effect to be stronger for advisors with the majority of their assets coming from high-net-worth clients, which we include as additional robustness.[29]

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[24] Holdings in ETFs by institutional managers are required to be reported in Form 13F filings as ETFs are on the official list of 13(f) securities: https://www.sec.gov/divisions/investment/13flists.htm.

[25] As a group, investment advisors are the largest owners of ETFs surpassing aggregate retail ETF ownership in December 2021: https://www.ft.com/content/792e3e98-5848-4a6c-bdff-07bb2cc660f6 .

[26] Our mapping results in 5,913 Thomson 13F institutional managers (OwnerCode) mapped to Form ADV entities (CRD).

[27] Form ADV provides 'Clients' information under question D of "Item 5 Information About Your Advisory Business - Employees, Clients, and Compensation", which describes the types of clients of investment advisors including: high-net-worth individuals, banking or thrift institutions, trusts, investment companies, pension plans, charitable organizations, insurance companies, government entities (including government pension plans), sovereign wealth funds, corporations, other pooled investment vehicles (e.g. hedge funds), and other individuals (other than high-net-worth individuals). Form ADV can be publicly accessed in this page: https://advisorinfo.sec.gov/IAPD/Default.aspx. Historical ADV data can be obtained in the FOIA section of the SEC website: https://www.sec.gov/foia/docs/form-adv-archive-data.htm.

[28] We use the fraction of the number of clients by each client type in earlier years, when the fraction of assets under management by client type was not available.

[29] According to the SEC's Amendments to Form ADV in 2010, a "High Net Worth" individual client of a fund advisory service is defined as individual with at least $750,000 managed by the advisor, or whose net worth is believed to exceed $1,500,000, or who is a "qualified purchaser" as defined in section 2(a)(51)(A) of the Investment Company Act of 1940.



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## *D. Descriptive Statistics*

Table I presents summary statistics for the main variables used in this paper. On average, the sample consists of 88% U.S. Equity actively managed mutual funds, 8% index mutual funds, and 4% ETFs during the sample period. Although the average pretax and net-of-fees return over the last twelve months is 8.54%, the Fama-French-Carhart four factor alpha is -1.45%, which is consistent with prior studies that document a lack of outperformance for the average mutual fund and is similar in magnitude to the net expense ratio which is on average 1.35% per year. The funds in our sample have an average annual turnover ratio of 86% and hold on average 167 stocks in their portfolios.[30]

In order to study the differences in capital gains distributions between mutual funds and ETFs, we create several variables. First, we create a dummy variable that equals to 1 when a fund reports any capital gains distributions during the year. On average, capital gains distributions take place in 37% of the fund-year observations in our sample and it is higher for active mutual funds (e.g. 64.66% in 2017 as shown in Table II). To get a sense of the magnitude, we scale the capital gains distribution by the net realized capital gains of the fund as reported on N-SAR. The average capital gains distribution is around 3% relative to total net assets. We also keep track of the funds' realized and unrealized capital gains and losses, as reported on form N-SAR. Realized capital gains represent 8.4% of fund assets, while net realized capital gains (realized capital gains minus realized capital losses) make up 2.8% of fund assets, which is comparable with the average capital gains distribution of 3%. Unrealized capital gains are of similar magnitude at 6.1% of assets, on average.

Investors in a fund typically receive three types of distributions from the fund: dividends, short-term, and long-term capital gains distributions. On average, long-term capital gains distributions represent the largest value component for fund investors, since the long-term capital gains yield is 2.3%. This is followed by the dividend yield of 0.61% and the short-term capital gains yield of 0.59%. In Section IV, we follow Sialm & Zhang (2020) and compute the tax burden for each fund using the various distributions yield. On average, we find that the return of an investor is reduced by 0.82% due to taxes on dividends, short-term and long-term capital gains distributions.

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The net worth of an individual may include assets held jointly with his or her spouse. See Amendments to Form ADV, Appendix B, Glossary of Terms: https://www.sec.gov/rules/final/2010/ia-3060.pdf.

[30] During our sample period, the expense ratio for active mutual funds exhibits a decline on average over time as illustrated in Figure A.II. The observations for the fund holdings are lower because they are measured at the fund level using fund holdings data when available.



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## IV. Capital Gains and Tax Efficiency: Mutual Funds versus ETFs

In this section, we first establish that ETFs are consistently distributing significantly fewer capital gains than mutual funds, despite having similar realized and unrealized capital gains figures. Then, we present a measure that quantifies the reduction in tax drag for ETFs relative to index and active mutual funds.

### *A. Realized Capital Gains and Distributions*

We start by examining the difference in capital gains distributions between ETFs, index mutual funds, and active mutual funds. Index funds and passive ETFs are expected to have tax efficiencies due to their lower portfolio turnover, which should result in lower frequencies and magnitudes of their capital gains distributions, relative to active mutual funds. Additionally, ETFs take advantage of the Section 852(b)(6) exemption to lower the frequency and magnitude of their capital gains distributions. In Table II Panel A, we document that index mutual funds (*IMF*) and active mutual funds (*AMF*) both distribute capital gains significantly more often than ETFs, typically in the order of ten times larger than that of ETFs. Furthermore, even when ETFs distribute capital gains, the amount distributed is merely a tiny fraction of the net realized capital gains, likely due to the in-kind redemption exemption. On the other hand, index and active mutual funds distribute a much larger portion of their net realized capital gains, up to 70% in certain years, and it is even higher when looking at size-weighted averages.

These trends in capital gains distributions are also illustrated in Figure IV. In years following significant market downturns, funds may be able to offset realized capital gains by carrying forward capital losses incurred in prior years. Table II Panel A and Figure IV indeed document substantial reductions in the capital gains distributions as a proportion of net realized capital gains for several years following the downturns in 2002 and 2009. Overall, these findings are consistent with Elton, Gruber, & de Souza (2019).

To avoid distributing realized capital gains to investors, ETFs can resort to heartbeat trades around rebalance dates, when securities scheduled to leave the ETF portfolio can have substantial unrealized capital gains. Through heartbeat trades, the capital gains are *realized* without requiring the ETF to distribute them to investors pursuant to the Section 852(b)(6) exemption. We document that up to 30% of the ETFs make use of heartbeat trades, with around 1 to 2 heartbeat trades being performed per ETF per year. This is consistent with the rebalancing and reconstitution frequencies of



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major indexes underlying these ETFs, especially since heartbeat trades are typically only needed when past ordinary in-kind redemptions were not sufficient to wash away the unrealized capital gains of low cost basis lots.

In Panel B of Table II, we report the magnitude of the capital gains distributions, measured as a percentage of total fund assets, and compare it to the net realized and unrealized capital gains yields. We can clearly see the superior tax efficiency of ETFs from the near-zero capital gains distribution yield (below 20bps in most years). In contrast, mutual funds distributed capital gains that were on average several percentage points higher than that of ETFs over the last 25 years, with index mutual funds distributing less than active mutual funds in most years, consistent with their lower portfolio turnover.[31] Interestingly, ETFs and mutual funds realize capital gains to the same order of magnitude, which indicates that the main source of the ETF tax efficiency is the Section 852(b)(6) exemption.[32] Net unrealized capital gains are also more similar for index and active mutual funds, but slightly lower for ETFs, attributed to funneling out the lowest cost basis lots in their in-kind outflows.

### *B. Tax Burden: Quantifying Tax Efficiency*

To measure the overall tax costs for long-term investors in a fund, we compute the total tax burden as defined by Sialm & Zhang (2020). Using CRSP data on dividend and short- and long-term capital gains distributions and the time series of the top marginal federal tax rates from Sialm & Zhang (2020), the tax burden is calculated for each fund in each period as follows:

$$TB_{f,t} = \tau_t^{DIV} Y_{f,t}^{DIV} + \tau_t^{SCG} Y_{f,t}^{SCG} + \tau_t^{LCG} Y_{f,t}^{LCG}$$

where $TB_{f,t}$ is the tax burden of fund *f* in year *t*, $\tau_t^{DIV}$, $\tau_t^{SCG}$, and $\tau_t^{LCG}$ are the tax rates on dividends, short-term capital gains, and long-term capital gains, and $Y_{f,t}^{DIV}$, $Y_{f,t}^{SCG}$, and $Y_{f,t}^{LCG}$ are the fund's dividend, short-term, and long-term capital gains yields, respectively. This tax burden, or more specifically a reduction in tax drag, represents an important component, a tax "alpha", in the investors' net after-tax returns.

[31] It is worth noting that the index fund capital gains distribution yield is affected by the Vanguard hybrid ETF-index share class structure, which caused Vanguard index funds to eliminate capital gains distributions after the introduction of their ETF share classes, as illustrated by Mider, Massa, & Cannon (2019).

[32] We measure net realized capital gains as the difference between realized capital gains and realized capital losses as reported on form N-SAR, scaled by total fund assets at the portfolio level. Since capital losses are likely carried forward to offset future capital gains resulting in lower net capital gains and distributions, we set negative values of this measure to zero, going forward, since net capital losses are not passed through to shareholders but instead carried forward to offset future capital gains.



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Table III shows that long-term capital gains distributions are often the largest source of distributions for active mutual funds. Active mutual funds seem to have a lower exposure to dividend-paying stocks. For index mutual funds, long-term capital gains and dividend distributions are the largest of the three distributions, although they vary in magnitude from year to year.

For ETFs, dividends represent the main form of distributions made by the fund (1.38%). ETFs have much lower short-term (0.07%) and long-term (0.03%) distributions than index funds (0.41% and 1.39%) and active mutual funds (0.71% and 2.48%, respectively). In 2017 for example, the prevailing top marginal federal tax rates were 43.4% for short term capital gains and 23.8% for long term capital gains. Therefore, ETF investors are deferring tax on 0.64% in short term capital gains and 2.45% in long term capital gains, on average, relative to active mutual funds, which translates into average savings of 0.86% in annual taxes.[33] This tax "alpha" increased to 1.12% in the last five years[34] of our sample period (between 2013 and 2017) coinciding with increases in tax rates due to regulatory changes as well as increases in capital gains distributions, which we will discuss in more detail in Section VII.

Figure IV Panel C illustrates the substantial tax burdens of index and active mutual funds, relative to ETFs. The tax burden ranges between 0.17 and 0.48% for ETFs, mostly due to dividend distributions, while index mutual funds experience tax burdens between 0.22 and 1.37% during the same time period and active mutual funds have tax burdens between 0.18 and 1.85%. These figures are consistent with the findings of Arnott, Kalesnik, & Schuesler (2018), who estimate an average tax burden over 1993-2017 equal to 1.1% for mutual funds and 0.3% for ETFs, resulting in a net 0.8% reduction of tax drag for ETFs compared to mutual funds, which they refer to as "tax alpha" as this translates directly into taxable investors' net after-tax return.

ETFs cannot eliminate tax burdens, because dividends from underlying stocks will have to be distributed to ETF investors as shown in Table III.[35] Despite that, in the last 5 years of our sample, ETFs have a tax burden that is on average 0.92% (0.62%) lower than active mutual funds (index funds). To interpret the magnitude of these figures, we also report the average yearly expense ratios for all fund types. Between 2013 and 2017, ETFs have an average expense ratio of 0.48%, which is 0.79% lower than active funds. This shows that the tax efficiency of ETFs relative to active mutual

[33] 0.86% = 43.4%*(0.71%-0.07%) + 23.8%*(2.48%-0.03%).

[34] 1.12% = 43.4%*(0.54%-0.06%) + 23.8%*(3.86%-0.04%).

[35] Furthermore, some ETFs did not have custom redemption basket exemptions, which makes it difficult for those funds to use heartbeat trades to wash away capital gains.



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funds is of similar economic magnitude, if not larger, than the ETFs' fee efficiency. Moreover, these tax savings would add to the savings from ETFs' lower expense ratios.

Since capital gains can vary by style and as the distribution of funds across styles is different for ETFs and active mutual funds, we also report in Table IV how the tax burden varies by investment style (broad/large-cap, mid-cap/small-cap, sector, and by detailed Lipper Class classification) in the last five years of our sample period. While realized and unrealized capital gains yields are shown to be similar for ETFs, index, and active funds that follow the same style, the tax burden for ETFs is generally the lowest of the three fund types. Mutual funds have a higher tax burden relative to ETFs in almost all styles, particularly in the small and mid-cap fund category where the average tax burden difference amounts to 1.05%. Across all investment styles, ETFs distribute less than 0.14% in capital gains, a trivial amount compared to index and active mutual funds.

For a more detailed apples-to-apples comparison, Table IV Panel D presents the results using the Lipper Class investment objective classifications, which are inferred by Lipper based on fund holdings. The first row corresponds to S&P 500 index mutual funds and ETFs (Lipper Class SPSP). It illustrates that, similar to the SPY and SVSPX example discussed earlier, there are substantial tax benefits to the ETF wrapper even for funds holding the same portfolio, such as S&P 500 funds, resulting in a tax burden difference of 0.43%. This demonstrates that ETF tax efficiency is not an indexing phenomenon. To further confirm this, we provide a robustness check in Table A.III that separates Vanguard index funds from index funds offered by other families. Vanguard has patented a unique fund structure where ETFs are offered as share classes of the parent investment fund, allowing all mutual fund share classes to benefit from the in-kind redemption distribution exemption.[36] Table A.III confirms two important facts. First, Vanguard index funds have a very low tax burden, averaging 0.41% which is comparable to the ETFs' average tax burden of 0.39%. Second and most importantly, the tax burden for non-Vanguard index funds is much higher at 1.07%, on average, confirming that ETF tax efficiency is not an indexing phenomenon.

[36] Vanguard filed a patent in 2001 to issue ETFs as share classes of the original mutual fund portfolios: https://patents.google.com/patent/US6879964B2/en. For example, Vanguard 500 index fund has 4 share classes on the same fund portfolio: Investor share class (VFINX), Admiral share class (VFIAX), Institutional Select share class (VFFSX), and ETF share class (VOO). Vanguard's patents expires in May 16, 2023, but we do not expect that many fund families will follow Vanguard suit given that SEC's Rule 6c-11 excludes mutual funds with ETF share classes explicitly from the exemptive relief and other benefits granted to ETFs under the rule. See Rule 6c-11, Section "E. Share Class ETFs" for more details https://www.govinfo.gov/content/pkg/FR-2019-10-24/pdf/2019-21250.pdf.



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Table IV Panel D also illustrates that ETF tax efficiency is more valuable for portfolios with higher capital gains. All growth investment styles in various size categories have substantial tax burden differences of up to 1.47% per year, which is much higher than tax burden differences for value, core, and other investment styles.[37] For a more precise apples-to-apples comparison, the last column of Panel D presents results based on a matched sample of active mutual funds and ETFs within the same Lipper Class style. Each active mutual fund in our sample is matched to the closest ETFs based on Fama-French-Carhart four factor loadings, annual fund return and volatility, portfolio turnover, and fund size, using a nearest-neighbor propensity score matching algorithm. As the last column shows, differences in tax burdens between active mutual funds and the closest ETF benchmarks are economically and statistically significant, averaging 0.97% per year, confirming prior results on the importance and the magnitude of ETF tax efficiency for taxable investors.

As additional robustness, we explicitly address any influence of differences in the cross-sectional dispersion between the returns of mutual funds and ETFs. Table A.IV presents results after splitting our active mutual fund sample into high and low volatile funds based on the standard deviation of fund returns over the year, while using the same cutoff for the ETF sample to broadly match the dispersion of the active mutual funds that are part of the same subsample. Comparing the capital gains yields and tax burdens for more volatile and less volatile funds separately, we find that funds with relatively high volatility realize more capital gains, as expected. Most importantly, the differences in tax burden between these active mutual funds and ETFs with similar volatility is larger than the difference between less volatile funds and ETFs, suggesting the ETF tax efficiency is even more pronounced for more active funds that have higher return volatility, which explains why recently many active mutual funds have been the first to convert to ETFs.

## V. The Mechanism behind ETF Tax Efficiency: In-Kind Redemptions

After quantifying the significant savings in the form of a reduced tax burden that ETFs provide to investors, we now explore the mechanism through which they deliver these savings. We first examine what drives the differences in realized capital gains, distributions, and tax burdens between ETFs and mutual funds, and document that in-kind redemption exemption is the primary mechanism

[37] ETF tax burden is lower than IMF and AMF for all investment styles with the exception of mid-cap value (MCVE), which is explained by the presence of Vanguard index funds in this style, as illustrated in Table A.III.



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behind the ETF tax efficiency. Then, we explore the role and determinants of heartbeat trades and examine the effects of the in-kind redemption exemption on the ETF tax overhang.

### *A. Determinants of Capital Gains Distributions: The Effects of Outflows and Heartbeat Trades*

In Table V Panel A, we report results from regressions of realized capital gains yields and distributions on various plausible determinants, including lagged fund size, portfolio turnover, annual returns, and outflows, where we interact each determinant with an ETF dummy to capture any differential effects for ETFs. Specifications 1 and 2 show that higher performance, turnover, and expense ratio are all significantly positive drivers for capital gains realizations, as expected. Index funds and ETFs which typically have lower turnover, are likely to have lower realized capital gains compared to active mutual funds, with no discernible difference between ETFs and index funds as the ETF interaction dummy is insignificant. The only difference in realized capital gains determinants is with regard to expenses, perhaps due to the fact that, while ETFs in general have low expense ratios, more active ETFs with higher trading activity are typically associated with relatively higher expense ratios (e.g. smart beta ETFs, thematic ETFs, active ETFs etc.), which might still be lower than the expense ratio for active mutual funds (Ben-David, Franzoni, Kim, & Moussawi (2022)). For additional robustness, we add style fixed effects in specifications 5 and 6 and the results are unchanged.

Outflows have a big impact on the tax efficiency of mutual funds because they force *realization* of capital gains as they sell securities with unrealized gains to accommodate these outflows. Interestingly, the evidence from specification 2 indicates that there is no significant differential effect of outflows on realized capital gains between mutual funds and ETFs. However, the effect of outflows on capital gains *distributions* diverges significantly between ETFs and mutual funds. While outflows, measured using N-SAR redemptions in the last twelve months, are associated with higher distributions for mutual funds, they have the opposite effect for ETFs due to the Section 852(b)(6) exemption, which is applicable to all ETF outflows. ETF outflows have a negative and offsetting effect on capital gains distributions due to the in-kind redemption mechanism that avoids the distribution of realized capital gains. These results are similar whether we control for date (specifications 3-4) or date and style fixed effects (specifications 7-8) and confirm in-kind redemptions as the mechanism behind ETF tax efficiency. Additionally, specifications 9 and 10 show that there is a positive relation between capital gains realizations and their distributions among mutual



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funds, suggesting that mutual funds, on average and after controlling for all other factors, distribute slightly more than 25% of their capital gains realizations, which potentially reflects the netting effect of losses and loss carryovers. Interestingly, this relation is completely reversed for ETFs, as the negative coefficient on the ETF dummy nearly offsets the coefficient on realized capital gains. As expected, ETFs do not experience a clear relationship between realized capital gains and their distributions, because ETFs rarely distribute capital gains.

After confirming redemption-in-kind as the primary mechanism through which ETFs reduce their capital gains distributions, we explore the effects of *heartbeat trades* more closely. We regress realized capital gains, the overall capital gains distribution yield and its components (the short-term and long-term capital gains distribution yield), as well as the overall tax burden, on the same set of independent variables plus the number of heartbeat trades in the last twelve months. Panel B of Table V shows heartbeat trades are a significant driver in reducing capital gains distributions and tax burden in all specifications. Notably, heartbeat trades seem to be very effective in reducing both the short-term and long-term capital gains distribution yields. This is consistent with the fact that an ETF sponsor cannot time investor outflows to offset capital gains realized over shorter periods, but they can manufacture the heartbeat's synthetic redemptions on-demand when these short-term capital gains are being realized. After controlling for heartbeat trades, outflows are significant in reducing the more predictable long-term capital gains distributions, and in significantly reducing the overall tax burden.

Overall, the results show that an ETF with an average of two heartbeat trades per year generally ends up with a reduction in its tax burden equal to 0.86%, compared to a mutual fund with a similar style and after controlling for various fund characteristics.[38] We conclude that heartbeat trades help reduce the tax burden by flushing away both short-term and long-term capital gains.

### *B. Determinants of Heartbeat Trades*

Table V Panel C explores the determinants of the use of heartbeat trades by ETFs and examines their relationship with fund size, turnover, and performance over the last twelve months. The results confirm our priors that larger ETFs with higher turnover and better performance during

[38] The reduction in tax burden for ETFs is 0.86%, attributed to the combination of ordinary outflows captured by the ETF dummy (0.52%) and the rest to heartbeat trades (0.31% * $ln(1+2)$ = 0.34%).



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the year are expected to realize larger capital gains, which necessitates more in-kind redemptions during the year. We indeed find that ETFs with higher realized capital gains are more likely to make use of heartbeat trades. Furthermore, ETFs that hold more stocks, and thus are more likely to be affected by potential rebalancing due to index reconstitution leading to more capital gains realizations, tend to use heartbeat trades more. We also document a substitution effect between ETF ordinary outflows and synthetic heartbeat trades: when ETFs have sufficient ordinary outflows to distribute appreciated assets through in-kind redemption baskets, they are less likely to employ heartbeat trades.

We include specifications with family and fund fixed effects to acknowledge the role of fund families in facilitating these large transactions with the family broker networks. We also expect heartbeat trades to be more prevalent in certain ETFs than in others (Mider, Massa, & Cannon (2019)). The increase in explanatory power between specifications 1-2, 3-4, and 5-6 by adding family and fund fixed effects shows that there is substantial variation in the use of heartbeats by ETF and ETF family. When including ETF fixed effects in specifications 5 and 6, which absorb fund-level characteristics, it appears that ETFs use more heartbeat trades in years when they incur higher realized capital gains and have higher portfolio turnover.

### *C. Tax Externalities of Outflows*

Outflows have a big impact on the tax efficiency of mutual funds because they force early realization of capital gains that in turn must be distributed to the remaining investors in the fund, as the fund sells securities with unrealized capital gains to accommodate these outflows. As such, redemptions by mutual fund investors can present a negative externality on remaining longer-term investors, who may receive additional unwelcome distributions if the fund was forced to sell appreciated assets (Dickson, Shoven, & Sialm (2000)).

On the other hand, ETFs achieve their tax efficiencies through their outflows: the in-kind redemption mechanism of ordinary outflows and the use of heartbeat trades for synthetic outflows help ETFs offload low cost-basis stocks, resulting in lower unrealized capital gains and tax overhang for the remaining stocks. Therefore, we expect a differential effect of outflows on tax overhang and test that directly in Table V Panel D. While mutual funds may want to dampen the impact of outflows on their remaining investors by avoiding the sale of appreciated shares, ETFs can see the redemption requests as an opportunity to offload shares with the lowest cost bases, and as a result be left with lower unrealized capital gains. Consequently, all ETF investors benefit from this in-kind redemption mechanism if they stayed invested with the fund.



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Specification 1 in Panel D shows that, for an average fund, unrealized capital gains yields are increasing in expense ratios, returns, and outflows, and decreasing in turnover. We add interactions with the ETF dummy in specification 2, which illustrates that there is no differential effect between mutual fund and ETF characteristics on unrealized capital gains yields, except for outflows. As expected, outflows are associated with significant increases in unrealized capital gains for mutual funds. However, outflows are negatively related to unrealized capital gains for ETFs and this pattern is robust to controlling for style and fund fixed effects, representing a stark difference with active mutual funds. Interestingly, heartbeat trades do not appear to be a significant determinant of tax overhang, which is consistent with the fact that they are the mechanism of last resort against large impending capital gains that are about to be realized. In particular, heartbeat trades of ETFs with custom redemption baskets are expected to contain only the appreciated stocks that are leaving the portfolio, and therefore have no effect on the remaining stocks in the ETF portfolio.[39] Overall, the results are consistent with ETFs strategically using ordinary outflows to allocate lower cost basis stocks in redemption baskets, taking advantage of the in-kind distribution exemption, and leaving the fund with lower unrealized capital gains.

## VI. Mutual Fund Flow Sensitivities to Performance, Fees, and Tax Burden

After documenting that ETFs are significantly more tax efficient than mutual funds, and establishing the mechanism of such tax efficiency, we now explore the importance of taxes and their effects on mutual fund flows. Building on Sirri & Tufano (1998) and Dannhauser & Pontiff (2019) who document *performance* and *expense ratio* as the primary determinants for mutual fund and ETF flows, we include *tax burden* to the list of flow drivers and run a horse race between these three determinants. Flows from mutual funds to ETFs could be explained by the underperformance of active mutual funds relative to index funds and ETFs of the same investment style, especially in the last two decades, and by the fee efficiency of index funds and ETFs (see Figure I). However, tax efficiency is unique to ETFs, and, as documented in the previous sections, ETFs have significantly lower tax burdens than both index and active mutual funds. Therefore, we interpret the evidence on the importance of tax considerations in explaining outflows from active mutual funds as a likely indication of the capital migration to the tax-efficient ETFs. Ultimately, we will confirm the second

[39] Before the adoption of Rule through Rule 6c-11 in 2019, not all ETFs had a custom redemption basket exemption, which required some ETFs to use larger "pro-rata" heartbeat trades to wash away capital gains.



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leg of this migration more directly in the next section when we look at ETF allocations by tax-sensitive investors.

### *A. Flow Sensitivity Horse Race between Performance, Fees, and Tax Burden*

To run the horse race between the three main drivers of mutual fund flows (performance, fees, and tax burden), we follow the framework from Sirri & Tufano (1998). Table VI Panel A reports the results using monthly flows on standardized lagged performance, fees, and tax burden. Performance is captured as the fund's annual excess return using the Fama-French four factor model, compounded over the last twelve months. Fee gap and tax burden gap variables measure the difference between a mutual fund's expense ratio or tax burden over the last twelve months from the average level across all active and passive funds with the same style. We multiply monthly flows by twelve to make them comparable with the robustness specifications using annual flows that can be found in Table A.V of the Internet Appendix.

The results show that performance, fees, and tax burden are all significant determinants of active mutual fund flows, and their economic and statistical significance is comparable and consistent across various specifications. Both fee gap and tax burden gap variables are negatively related to fund flows, and the effect is more visible when we look at N-SAR monthly outflows. We expect that tax-sensitive investors are inclined to withdraw their investments when the fund experiences a high tax burden. In specification 1, we find that a one standard deviation increase in the tax burden gap (fee gap) is associated with a 2.4% (5.0%) decrease in net fund flows. When looking at total outflows separately, we see that a one standard deviation increase in the tax burden gap (fee gap) increases outflows by 1.8% (0.6%). A one standard deviation decrease in performance is attributed to a 1.5% increase in outflows. Tax considerations seem to be stronger than the effect of performance and three times more powerful than fees in driving active mutual fund outflows.

To better understand the impact of tax burden on monthly active mutual fund outflows, we decompose tax burden into its various components and include realized capital gains and unrealized capital gains yields. From specifications 3 and 4, we learn that the (standardized) realized capital gains yield is the strongest driver for monthly fund outflows compared with other components of tax burden, with a coefficient equal to 4.8%.

Tax burden and realized capital gains appear to be the strongest determinants of monthly mutual fund outflows suggesting that tax-sensitive investors were responsible for the substantial



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outflows from active mutual funds during the sample period. We interpret this evidence as an indication on the importance of tax considerations for the bulk of mutual fund outflows during our sample period. This also suggests potential strategic complementarities (Chen, Goldstein, & Jiang (2010)) due to the negative externalities of outflows. Outflows are triggering early realization of capital gains that lead to future outflows. Therefore, tax-sensitive investors might be better-off leaving the fund as soon as they observe any indications of higher realized capital gains, which we will directly address in the next section.

### *B. Outflows between Fiscal Period Ends and Distribution Dates*

To better understand potential strategic complementarities and better identify the influence of tax burden on outflows, we exploit the timing difference between when realized capital gains are reported to investors (usually around a mutual fund's fiscal year-end) and when these gains are distributed (typically at calendar year-end). Our objective is to focus on investors' outflows after realized capital gains are reported to investors, and before these realized gains are distributed, as these outflows are more likely to be motivated by tax considerations. Gibson, Safieddine, & Titman (2000) document that the Tax Reform Act of 1986 mandated October 31st as a tax year-end for all funds and required funds to distribute "at least 98% of ordinary income and net capital gains to avoid paying an excise tax." Consistent with this, we document that 96.2% of funds in our sample have their capital gains distributions in December.[40] Investors in mutual funds with high realized capital gains may want to withdraw their capital from a fund before the capital gains are distributed to avoid future tax repercussions and to preempt the tax effects of further redemptions by other investors. Therefore, this experiment allows us to focus on the effect of potential negative tax externalities, especially given that short-term capital gains distributions cannot be offset by other losses. So, a taxable investor is likely better-off moving out of the fund after they learn about the realized capital gains and before the fund distribution ex-date, likely in mid-December according to our data.

Knowing that realized capital gains are typically reported on a quarterly basis to shareholders and certainly before the ex-dividend date of related distributions, we focus on the sample of funds

[40] Some of the capital gains distributions occurring in earlier months are due to fund closures and merger events. Most mutual fund and ETF providers announce on their websites their expected capital gains distributions beginning in September, with a payable date typically in December. See Morningstar for more information, https://www.morningstar.com/articles/720873/what-you-need-to-know-about-capital-gains-distributions.



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that have fiscal period end before December of each year.[41] Because 62.4% of funds in our sample have a fiscal period end on or before October 31st, we assume that the realized capital gains reported to investors are a good proxy for the realized capital gains reported for tax reasons at the end of October.[42] We focus on this subsample of funds to compute the cumulative outflows between the fiscal year-end month and the calendar year-end month and regress those outflows on the realized capital gains reported in fiscal year-end filings.

Table VI Panel B provides the results on whether a higher expected tax burden gap is associated with increased redemptions between the fiscal year-end, when the realized capital gains are reported, and the calendar year-end, when they are distributed. The results confirm our earlier findings and the tax burden gap again emerges as the strongest and most significant determinant, statistically and economically, of mutual fund outflows measured over the months between when expected realized capital gains are reported to investors and when they are distributed. Additionally, specifications 4-6 show that the driver behind this effect is the realized capital gains yield. These specifications confirm that tax burden considerations dominate both fee efficiency and excess performance, surprisingly, as the main driver of active mutual fund outflows.

This evidence supports our conjecture that tax considerations are very significant in explaining the outflows from active mutual funds. Taxes appear to be an important factor, and we conclude that tax sensitive investors played a big role in these outflows. In the next section, we show that tax-sensitive investors also represent a significant driver of inflows into ETFs, around the same time when active mutual fund outflows are observed.

## VII. Clientele Effects: The Role of Tax-Sensitive Investors

So far, our evidence strongly suggests that the flow-tax sensitivity is a stronger determinant, statistically and economically, of active mutual fund outflows than flow-fee sensitivity, and it is as meaningful as, and sometimes stronger than, flow-performance sensitivity. The tax efficiency of

[41] Around 29.25% of funds have fiscal year-ends in December.

[42] Investors can learn about expected fund distributions from multiple sources, including periodic fund filings (through Forms N-CSR, N-CSRS, and N-Q, and every six months through Form N-SAR) and announcements from the fund to shareholders about upcoming distributions. Investors can learn from the fund company about expected capital gains distributions: e.g. Vanguard, "Preliminary year-end distributions," Nov. 1, 2021, https://advisors.vanguard.com/iwe/pdf/taxcenter/FAPYEEST.pdf. Morningstar provides a compilation of realized gains and expected distributions in their year-end roundups: e.g. Morningstar, "Capital Gains Roundup: 2021 Edition," Nov. 3, 2021: https://www.morningstar.com/articles/1065314/capital-gains-roundup-2021-edition.



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ETFs is evident in the fact that ETFs realize similar capital gains as do mutual funds but distribute near zero amounts due to the in-kind redemption exemption that is boosted by the use of heartbeat trades. This tax efficiency seems very appealing to tax-sensitive investors who are more likely to migrate out of active mutual funds for tax considerations. In this section, we provide further evidence that tax-sensitive investors did indeed reallocate capital into the more tax-efficient ETFs. We first present evidence that mutual funds with higher realized capital gains experienced more outflows than other active funds, at the same time when ETFs with the same investment styles experienced relatively higher inflows. Then, we identify the institutions that manage the investment accounts for tax-sensitive investors and explore the patterns of ETF investments during that period. Finally, we use the increase in capital gains taxes after 2012 as a quasi-natural experiment to better identify the observed capital migration due to tax reasons.

### *A. Flow Migration from Active Mutual Funds to similar ETFs*

We start by directly measuring the flows from active mutual funds to ETFs within the same investment style. We expect that tax-sensitive investors that are concerned about their tax burden will move capital from mutual funds to ETFs that follow the same investment style.[43] To test whether there is a tax-sensitive clientele effect driving flows into ETFs, we compare net flows as a percentage of assets under management across quintiles based on realized capital gains yields. More precisely, we sort active mutual funds into quintiles by their realized capital gains every year and then compare the flow patterns with other similar funds including ETFs in the same year. For each fund, we construct a value-weighted benchmark of all funds with the same investment style,[44] categorized by active mutual funds, index funds, and ETFs. Table VII reports value-weighted averages of total net flows, realized capital gains, and distributions by quintile.

As expected, funds with the highest realized capital gains experienced, on average, higher outflows, amounting to -22.76% per year for the funds in quintile 5. The benchmark group of other active mutual funds matched to the sorted funds by style also exhibited a pattern of increasing

[43] Anecdotal evidence of this can be read in the following article describing changes made recently in the portfolio managed by MSD Capital, Michael Dell's $16 billion family office: https://www.wsj.com/articles/michael-dells-money-managers-change-how-his-wealth-is-invested-11575628204 (WSJ, December 6, 2019).

[44] We use Lipper Class codes for the investment style information because it is categorized by Lipper using the holdings of the fund (as opposed to being self-reported style or investment objective), and we keep only styles to which more than one ETF belongs.



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outflows by quintile, suggesting that style-related reasons are behind the higher capital gains realizations. On the other hand, index mutual funds and ETFs with the same style both experienced inflows in all quintiles, consistent with the overall trends. More interestingly, however, ETFs that follow the same styles as the ranked active funds experienced relatively higher inflows in quintiles 4 and 5, while index funds experienced the highest inflows in quintile 1. The results suggest that while active funds with higher realized capital gains were suffering outflows likely driven by tax-sensitive investors, ETFs with the same investment styles witnessed relatively higher inflows in the same period compared with other ETFs.

The results thus are consistent with tax-sensitive investors migrating from active funds to ETFs in similar investment styles when they expect to face a higher tax bill due to realized and distributed capital gains. To confirm that matching ETFs distribute much fewer capital gains, we report the average realized capital gains and distributions for the ranked active mutual funds as well as their benchmarks. The results show that while both matching active and index funds exhibit increased realized and distributed capital gains in the highest quintiles, ETF distributions were the lowest in higher quintiles, despite the fact that ETFs and index funds have similar realized capital gains. [45] This suggests that tax-related flow migration is not an active to passive phenomenon, but strictly a flow migration into ETFs.

### *B. ETF Allocations by High-Net-Worth Individuals*

The optionality that ETFs provide to investors to decide when to realize capital gains for optimal tax purposes and the ability to indefinitely defer capital gains allowing future heirs to forgo capital gains taxes using the step-up in basis are especially valuable to high-net-worth individuals. High-net-worth investors, faced with the highest marginal income and capital gains tax rates, are expected to be among the most tax-sensitive investors. We resort to institutional ownership data to identify institutions with tax-sensitive clients and explore their allocations to ETFs during the same period when active mutual funds were experiencing the largest outflows. To do that, we follow Blouin, Bushee, & Sikes (2017), as described in subsection III.C, and study the portfolio allocations

[45] It is important to mention here that a substantial part of mutual fund assets (active and index mutual funds) are in tax deferred accounts which are outside the scope of our study because tax efficiencies and tax-motivated flows are not relevant for tax deferred accounts (ICI Factbook (2022) available at: https://www.icifactbook.org/).



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by investment advisors, in particular those to high-net-worth clients who are likely to be most attuned to tax efficiencies.

Table VIII Panel A shows the aggregate amount of 13F assets (U.S. exchange-listed stocks and ETFs) held by each group of investment advisors.[46] We find that allocations to ETFs by investment advisors of high-net-worth clients are nearly four times higher than those by investment advisors with low or no high-net-worth clients and have reached 32.4% of their overall 13F assets in 2017, compared with less than 9% for other investment advisors. After scaling by the total assets reported on Form ADV, which include mutual funds and other non-13F qualified investments, we find that ETFs make up 21% of the overall portfolios of these tax-sensitive advisors, compared with 5% of other investment advisors' portfolios, and this allocation has increased significantly since 2012. Figure V shows these patterns graphically and illustrates how investment advisors of high-net-worth clients have significantly higher allocations to ETFs relative to the total assets managed by advisors across all asset classes over the time periods, and especially after 2012, which we will explore further in the next subsection.

Next, we break down the aggregate institutional ownership of ETFs by investment advisor type, focusing on their overall ETF ownership as a fraction of the overall ETF market capitalization. Panel B of Table VIII reports that institutional ownership of ETFs has increased from 31% to 59% between 2000 and 2017 as the ETFs industry grew in number of products and assets under management. ETF ownership by investment advisors overall grew from 11% to 30% during this time, which represents half of the ETF ownership by all institutions. Additionally, in our sample of investment advisors matched to Form ADV data, we document that in the most recent five years of the sample, investment advisors with high exposures to high-net-worth clients – the most tax-sensitive investors – account for the largest share of ETF ownership by advisors.[47] This is remarkable because this group accounts for the least amount of assets under management overall as shown in Panel A.

Finally, we document the trends in ETF flows across different types of institutions and advisors with varying levels of high-net-worth clients, which we report in the Internet Appendix. Overall, we notice a trend in ETF flows that is in parallel with capital gains realized by active mutual

[46] It is important to note that the advisors with the highest exposure to high-net-worth clients represents a smaller group in terms of assets than the groups with low or no exposure to high-net-worth clients ($0.94 trillion vs. $2.3 trillion and $2.5 trillion for low and no high-net-worth client groups, respectively.

[47] This shift lines up with the adjustments to form ADV in 2011 to add fields requiring advisors to disclose the assets managed for each client type in addition to the number of clients in each group that was being reported before.



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funds, especially after 2012. During the sample period, when realized capital gains yields of active mutual funds spiked up, it coincided with a relatively high proportion of ETF allocations by advisors with a high exposure to tax-sensitive clients. In the following subsection, we use the increase in the capital gains tax rates for high earners in 2013 as a quasi-natural experiment to directly test the flows into ETFs by tax-sensitive clientele.

### *C. Changes to Capital Gains Tax Rates in 2013 and ETF Allocations*

Two major changes to the tax code that became effective in 2013 – the American Taxpayer Relief Act of 2012 (ATRA) and the Affordable Care Act (ACA) of 2010 – significantly increased capital gains tax rates for high-income taxpayers. The ATRA was proposed to address the expiration of the favorable tax rates set by the Economic Growth and Tax Relief Reconciliation Act of 2001 and the Jobs and Growth Tax Relief Reconciliation Act of 2003 (Perez Cavazos & Silva (2019)). The ATRA raised the ordinary income rate from 35% to 39.6%, and the dividend and long-term capital gains rate from 15% to 20% on top earners ($450,000 for married joint filers and $400,000 for single filers). The ACA also introduced a 3.8% income tax on passive investment income for taxpayers with income above $250,000 if filing jointly and $200,000 if filing single. Overall, the ATRA and ACA jointly raised the maximum tax rate on high-income taxpayers. As a result, taxes on short-term capital gains, based on ordinary income rates, increased from 35% to 43.4%, and taxes on long-term capital gains increased from 15% before 2012 to 23.8% afterwards.[48] Extant literature found that these reforms had significant effects on capital gains realizations in 2012 (Perez Cavazos & Silva (2019), and Auten, Splinter, & Nelson (2016)).

We follow Beggs & Liu (2022) and use the enactment of the ATRA and ACA as a quasi-natural experiment to study how these increases in tax rates affect advisors' allocations to ETFs on behalf of their most tax-sensitive investors: their high-net-worth clients. We hypothesize that advisors with more high-net-worth clients have increasing incentives to allocate their clients' assets to ETFs by the end of 2012, in anticipation of higher capital gains tax rates in 2013.[49] Henceforth, the tax

[48] The Tax Cuts and Jobs Act (TCJA) of 2017 reduced tax rates for high earners on short-term and long-term capital gains but was effective in 2018 after the end of our sample period.

[49] Another reason was the rush by wealthy investors in 2012 to complete transactions before the end of the calendar year when the estate tax exemption was scheduled to drop in 2013. See: https://www.bloomberg.com/news/articles/2020-12-21/wealthy-americans-fearing-higher-taxes-hurry-to-move-money-now.



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efficiencies of ETFs would enable fewer capital gains distributions, deferring more taxes for high-net-worth clients due to the increased maximum marginal rates.

To test this hypothesis, we implement a difference-in-differences analysis to explore the incremental effects of tax increases on the allocations to ETFs by tax-sensitive advisors, as a fraction of their assets under management (AUM):

$$ETF\ Allocation_{i,t} = \beta_0 + \beta_1 HNW_{i,t} + \beta_2 Post\ 2012 * HNW_{i,t} + \beta_3 Log(AUM_{i,t}) + FE + \epsilon_{i,t}\ ,$$

where the dependent variable $ETF\ Allocation_{i,t}$ is the percentage of AUM allocated to ETFs for advisor *i* in year *t*. The independent variable $HNW_{i,t}$ is an indicator variable equal to one if an advisor has high-net-worth clients and zero otherwise, in order to separate our treatment group from remaining tax-insensitive advisors, which include advisors with pension clients, government, insurance companies, charitable institutions, etc. In some specifications, we further strengthen our treatment group by specifically focusing on those advisors with the majority of their assets (≥75%) corresponding to their high-net-worth clients, as they are expected to be the most sensitive to the capital gains tax increase. We then interact the high-net-worth investor indicator variable with an indicator variable that is equal to one for the years 2012 and after, and zero otherwise. If those most tax-sensitive advisors allocated more to ETFs due to the tax reforms, we expect the interaction term to be positive and statistically significant.

The results are presented in Table IX Panel A. All specifications use quarter fixed effects and standard errors are clustered by institution and date. The first three specifications report the main effect using ETF allocations as fraction of 13F AUM, ETF allocations as a fraction of all advisor assets reported on form ADV, and the quarterly percentage change in ETF flows, respectively. Advisors with high-net-worth clients tend to have higher allocations to ETFs overall and explain part of the flow into ETFs as well.

In specification 4, we add a dummy variable for the period after 2012 with the capital gains tax rate increase. The results show that the allocation to ETFs has increased significantly on and after 2012 in anticipation of higher capital gains tax rates. Although the significance of this result declines a bit when we include institution fixed effects in specifications 6 and 7, the interaction effect remains positive and statistically significant for the institutions that have the greatest exposure to high-net-worth clients (specifications 8 through 10). The results confirm our prior findings that advisors with high-net-worth clients were incentivized and did in fact allocate more of their assets to ETFs after 2012, which are more tax efficient than other assets.



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The migration of active fund flows to ETFs is visible when we examine the change in ETF allocation by investment advisors of high-net-worth individuals who are most sensitive to tax considerations, where we document an overwhelming increase in allocations and flows into ETFs relative to advisors with lower fractions of high-net-worth clients especially after the increase in capital gains tax rates after 2012. We also explore the effect of this tax increase on mutual fund outflows and their sensitivities to tax burden. Panel B shows that the relationship between fund outflows and tax burden gap likewise strengthens after 2012, while the fee gap remains less important in explaining fund outflows. Overall, the results in Table IX provide strong support for our hypothesis that clientele effects and tax efficiency play an important role in explaining the flows to ETFs. Overall, our evidence points to the central role of ETF tax efficiencies behind the massive outflows from active mutual funds and the dramatic surge of flows into ETFs in recent years.

## VIII. Conclusion

The popularity of ETFs among long-term investors is to a large extent driven by their fee and tax efficiencies. ETFs achieve their tax efficiency through the in-kind redemption process and the use of heartbeat trades which help ETFs offload low-basis stocks without triggering a taxable event pursuant to the Section 852(b)(6) exemption. This feature of ETFs is particularly appealing to high-net-worth individuals and other tax-sensitive investors that face higher marginal capital gains tax rates. Our paper emphasizes the importance of the in-kind redemption exemption and heartbeat trades for ETFs to realize their superior tax efficiencies and pinpoints the tax clientele effect by using the holdings of investment advisors to high-net-worth individuals.

Our empirical evidence first documents that open-end mutual funds distribute capital gains significantly more often and in larger magnitudes than ETFs. In many years, the fraction of mutual funds that distribute capital gains is to the order of ten times larger than that of ETFs. Furthermore, even when ETFs distribute capital gains, the amount distributed (close to 4bps in recent years) is merely a small fraction of the net realized capital gains. ETFs are able to avoid distributing capital gains by taking advantage of regular outflows when sufficiently available, and by employing a mechanism known as "heartbeat" trades. As a result of these trades, ETF capital gains are *realized* without being required to be distributed to investors. We document that in any given year, between 5% and 33% of the ETFs make use of heartbeat trades, performing 1 to 2 heartbeat trades per ETF on average, typically coinciding with major rebalancing events of the ETFs' underlying indexes. The



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fraction of ETFs that rely on heartbeat trades has steadily increased after 2010, along with the growth of underlying portfolios. Additionally, the majority of ETFs did not distribute capital gains during the last years of our sample period either due to heartbeat trades or because they had sufficient outflows to offload securities with the highest unrealized capital gains. In our regression analyses, ETF outflows indeed emerge as an important and significant substitute for heartbeat trades for ETFs with unrealized capital gains.

Overall, we establish that ETFs are hardwired to take advantage of Section 852(b)(6) exemption due to their unique security design and the creation/redemption process. This tax efficiency is especially appealing to tax-sensitive investors. Using holdings data of institutional investment advisors to high-net-worth clients, we find that their ETF allocations are nearly four times higher compared with investment advisors with low or no high-net-worth clients, reaching 32.4% of the overall 13F-reported assets managed by these advisors in 2017. We use the increase of capital gains tax rates after 2012 as a quasi-natural experiment and find that the migration of active fund flows from tax-sensitive investors is more visible, with a higher sensitivity of outflows to tax burdens and a sharper increase in ETF allocations mainly by the investment advisors of high-net-worth clients.

The optionality on when to realize capital gains for optimal tax purposes and the possibility to indefinitely defer capital gains taxes, which allows future heirs to forgo capital gains taxes using step-up in basis, is especially valuable for high-net-worth individuals. We find that these investors have in turn pursued ETFs to defer capital gains and lower their annual tax bills. We argue that this tax efficiency is among the primary reasons that propelled the growth and popularity of ETFs in recent years. As ETFs can avoid distributions on short-term and long-term capital gains, and convert short-term capital gains into long-term gains for tax purposes, this leads to externalities on investors in other products and taxpayers.

Mider, Evans, Wilson, & Cannon (2019) estimate that over 400 U.S. equity ETFs together deferred taxes on more than $211 billion in gains in 2018 alone. If U.S. equity ETFs were to distribute capital gains, these distributions would amount to somewhere between 2% to 3.4% per year based on the 10-year average distribution yields for index and active mutual funds respectively (Table II). Given that U.S. equity ETFs managed around $2 trillion in assets by the end of our sample period, it is reasonable to assume that U.S. equity ETFs would contribute to a deferral of at least $400 billion and up to $679 billion in short- and long-term capital gains distributions in the next decade. These projections will be much higher if we incorporate additional ETFs traded in the U.S. (other equity and fixed income ETFs, estimated to be more than $2 trillion in size), as well as future investors'



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flows into ETFs. ETFs allow tax-free compounding of short- and long-term capital gains, creating larger accumulated future capital gains. Furthermore, investors can forgo paying taxes on the accumulated capital gains if they bestow their ETF shares, which would enable the step-up in basis rule to kick in, erasing the capital gains for tax purposes.

The shift from active to passive, and specifically to ETFs, is expected to have monumental consequences on market efficiency and capital formation (Wermers (2021)). For these reasons, researchers and policymakers may want to further study the societal costs of ETF tax efficiency, especially the inequitable treatment of different investors regarding the flexibility and control of the timing of tax payments. Additionally, the reduced application of short-term capital gains taxes, and in some cases long-term capital gains taxes due to step-up in basis, represents a foregone income for tax agencies which creates a more profound challenge to the existing tax code and taxation philosophy (Colon (2017)). Without a doubt, the tax efficiency of ETFs is likely to continue exacerbating the capital migration from active mutual funds to ETFs and inevitably lead to more mutual fund conversions, ultimately leading to a new equilibrium where ETFs dominate the taxable investment space.



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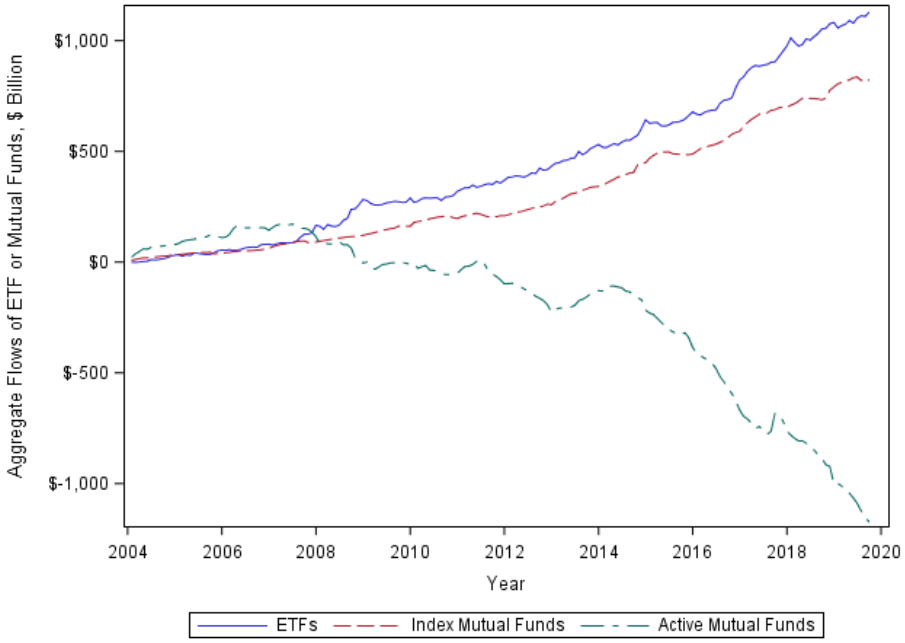
## Figure I: Growth of Equity ETFs and Mutual Funds – Flows, Assets, and Number of Funds

Panel A illustrates the cumulative flows of ETFs, Index Mutual Funds, and Active Mutual Funds since 2004 using the CRSP Mutual Fund Database. Panel B shows the growth in assets under management during our sample period for each fund type.

**Panel A: Cumulative Net Flows of U.S. Equity Funds since 2004 (CRSP Universe)**




**Panel B: Assets under management by U.S. Equity Funds (CRSP Universe)**

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## Figure II: Detecting Heartbeats

The figure shows the timeline and procedure that is used to detect heartbeats. Panel A shows a diagram of the process. Panel B shows an example from the data.

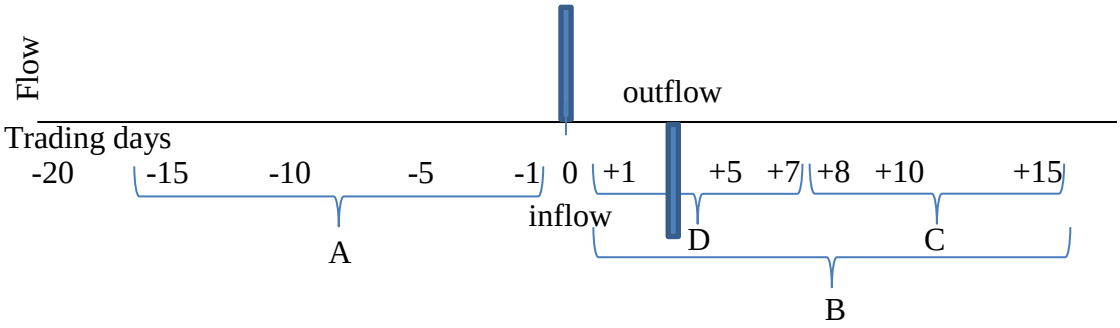
The algorithm to classify Heartbeat trades uses the following conditions:

1. Inflow on day 0 is at least 1% of AUM
2. The inflow is not exactly equal to 25,000 or 50,000 shares (typical size of one creation basket).
3. Inflow on day 0 is at least 3x as large as the largest of:

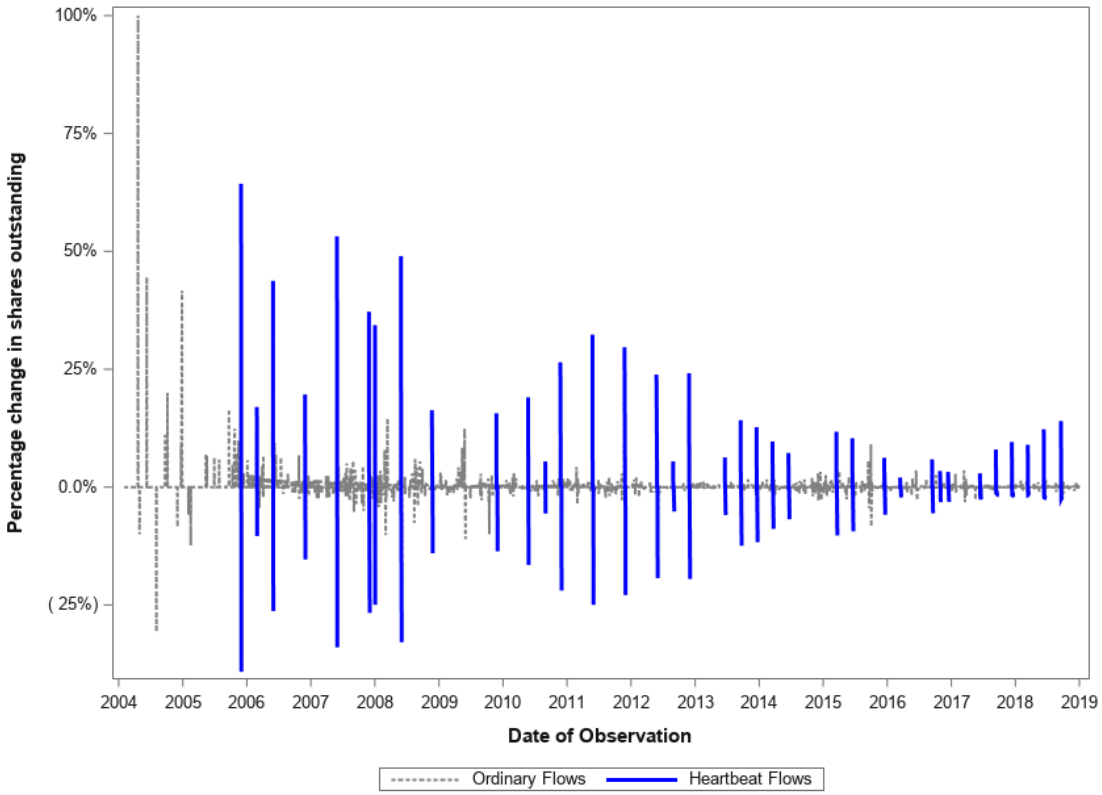
a. The maximum absolute percentage flow during days -15 to -1 (*window A*)
b. The maximum percentage inflow during days 1 to 15 (*window B*)
c. The maximum absolute percentage flow during days 8 to 15 (*window C*)

4. The cumulative flow during days 1 to 7 (*window D*) reverses at least 75% of the magnitude of the inflow.

### Panel A: Example of a heartbeat




### Panel B: Time Series of Daily Flows for the *Vanguard Small-Cap Growth Index Fund ETF (VBK)*



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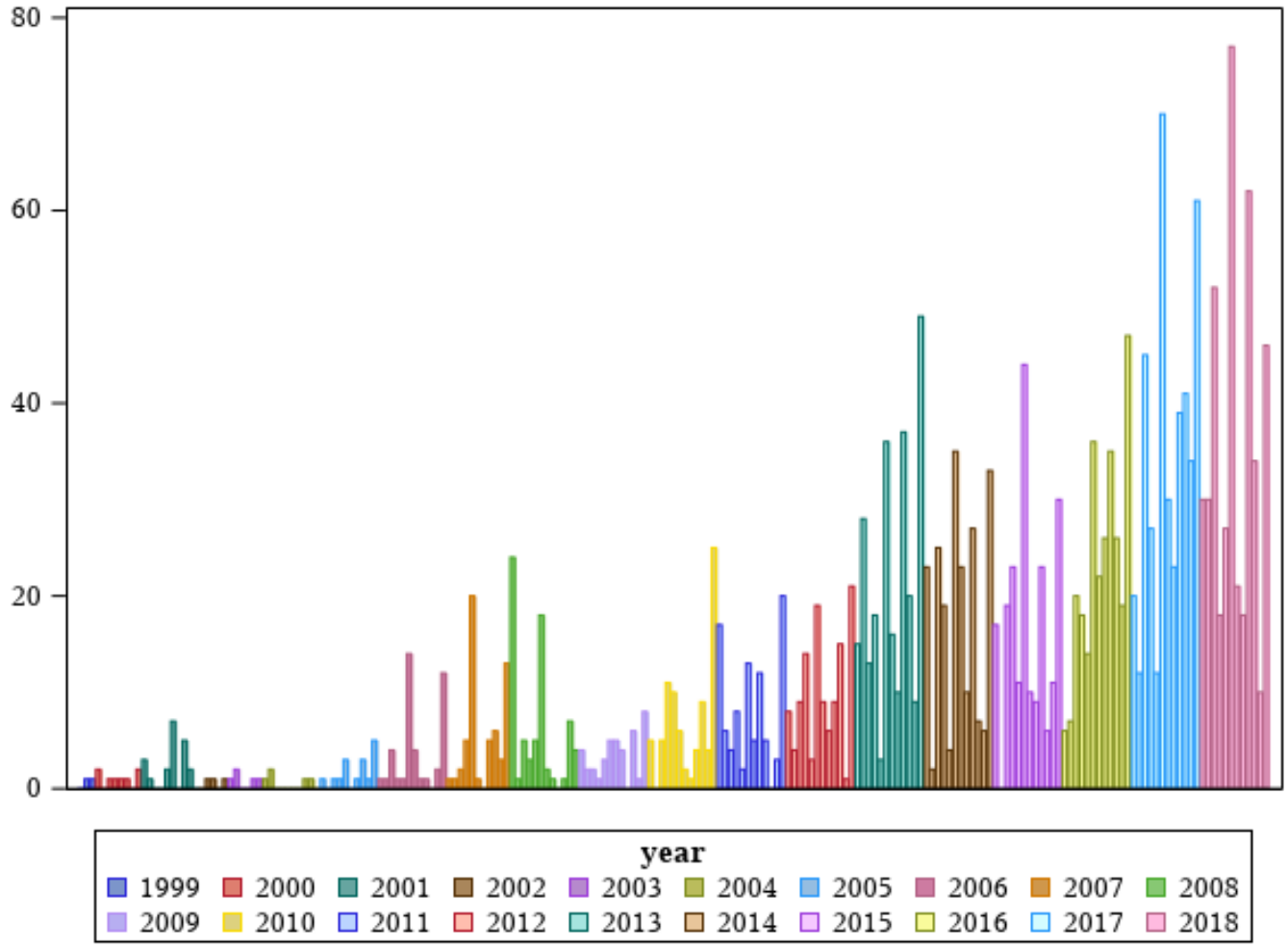
## Figure III: Number of Heartbeats per Month

The figure shows the number of heartbeats that are performed by ETFs in any given month, where heartbeat trades are identified as described in Section III.B. The sample consists of U.S. Equity ETFs.



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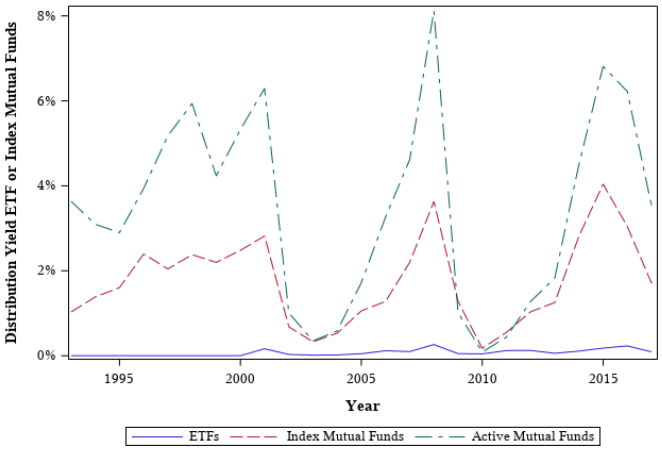
## Figure IV: Capital Gains Yields and Tax Burdens

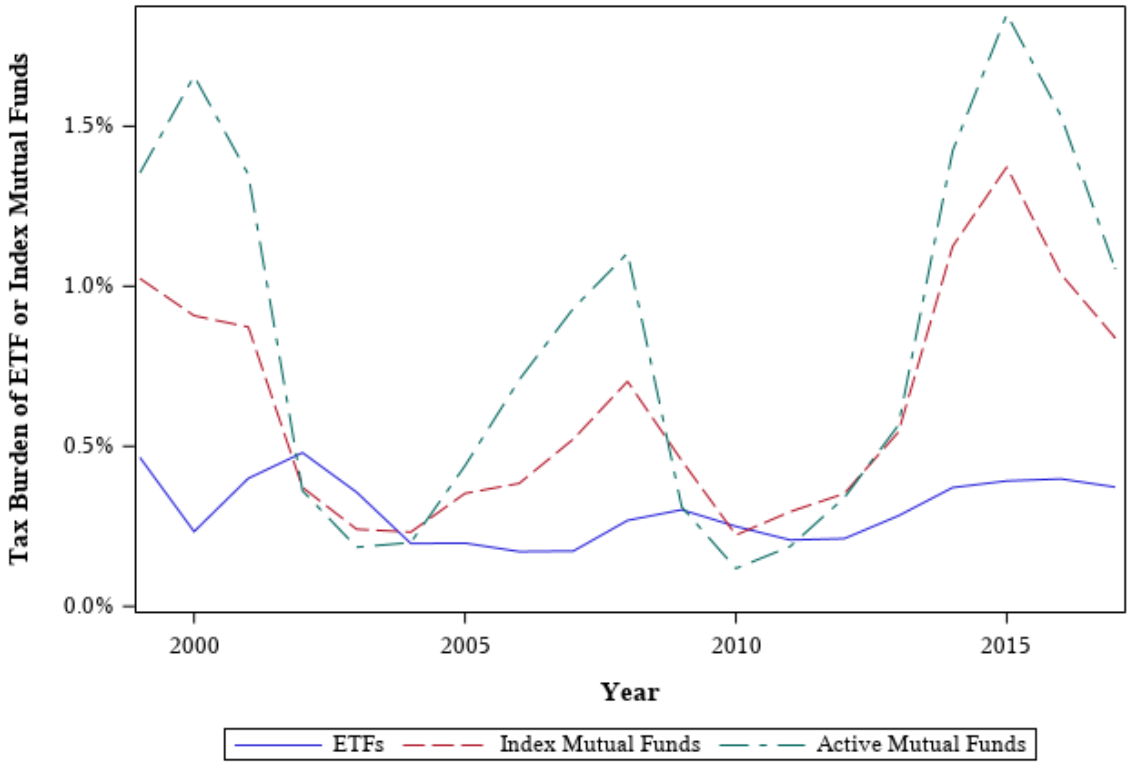
Panels A and B illustrate the realized and distributed (short and long-term) capital gains yields (relative to AUM) for ETFs, Index Mutual Funds, and Active Mutual Funds as collected from the N-SAR data. Panel C represents the Tax Burdens for ETFs, Index Mutual Funds, and Active Mutual Funds computed following Sialm & Zhang (2020).

Panel A: Realized Capital Gains Yields


Panel B: Capital Gains Distribution Yields




Panel C: Tax Burdens of ETFs and Mutual Funds



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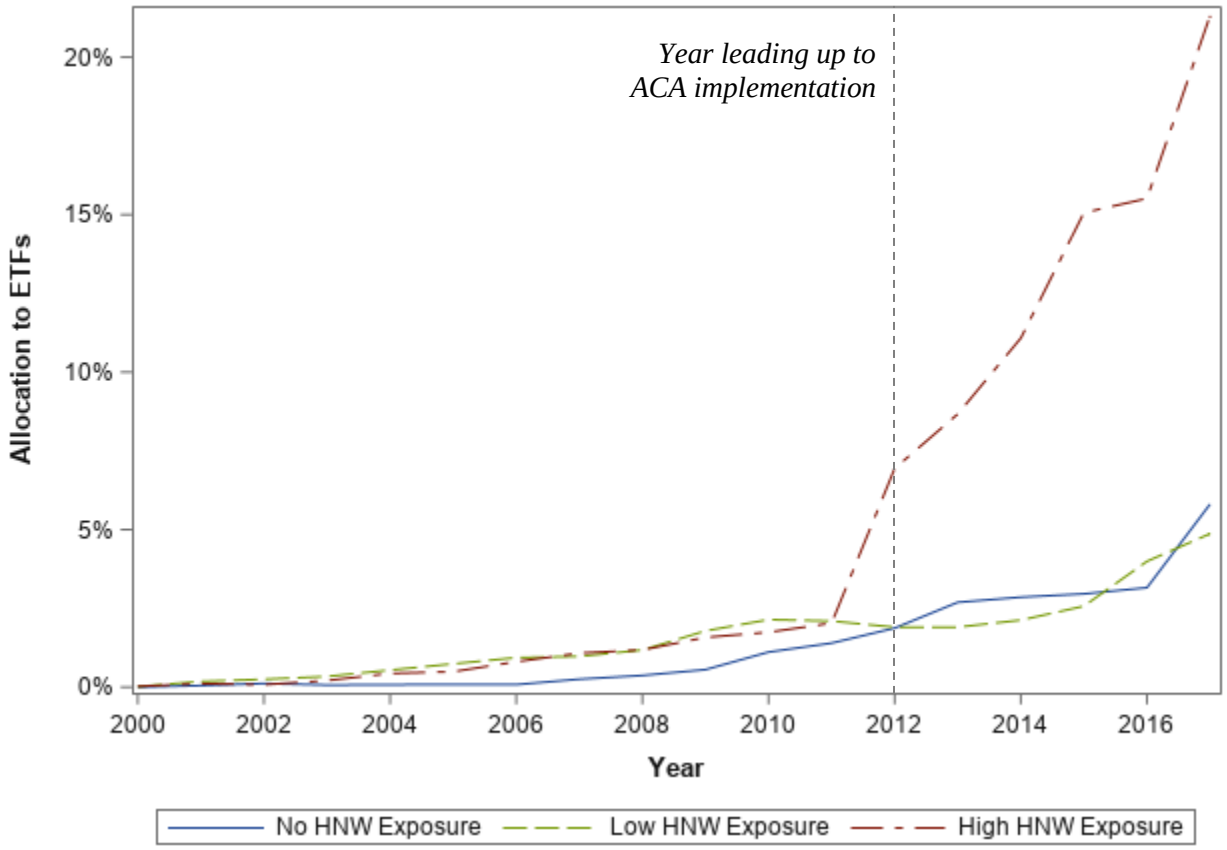
## Figure V: Allocation to ETFs by Investment Advisors to Tax-Sensitive Clientele

The figure shows the allocation to ETFs by investment advisors with high-net-worth clients, our proxy for tax-sensitive investors. ETF ownership by investment advisors is determined using 13F holdings data from Thomson-Reuters Global Ownership Database (OP), while the exposure to high-net-worth clients (HNW) is based on client data reported on Form ADV. Advisors are determined to have high exposure to high-net-worth individuals if more than 25% of their AUM comes from high-net-worth clients (if assets are unavailable, the determination is made using a client count). Total assets of institutions are used to scale ETF allocations, and averages are constructed using institutional assets as weights.



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## Table I: Summary Statistics

The table presents summary statistics for the variables used in this study. The unit of observation is at the share class level and the sample period ranges from 1993 to 2017. All variables are winsorized at 1% by year, except dummy variables, the number of portfolio holdings, yields from CRSP, and tax burden.

| Variable | N | Mean | Std Dev | Min | 1st Pctl | Median | 99th Pctl | Max |
|---|---|---|---|---|---|---|---|---|
| ETF Dummy | 176,349 | 3.51% | 18.39% | 0.00% | 0.00% | 0.00% | 100.00% | 100.00% |
| IMF Dummy | 176,349 | 8.26% | 27.53% | 0.00% | 0.00% | 0.00% | 100.00% | 100.00% |
| AMF Dummy | 176,349 | 88.23% | 32.22% | 0.00% | 0.00% | 100.00% | 100.00% | 100.00% |
| Total Return, last 12 months | 159,040 | 8.54% | 19.84% | -66.97% | -44.92% | 10.65% | 57.07% | 100.00% |
| FF4F Excess Return, last 12 months | 156,156 | -1.45% | 6.79% | -33.76% | -21.28% | -1.32% | 17.27% | 39.71% |
| Expense Ratio | 151,621 | 1.35% | 0.60% | 0.06% | 0.11% | 1.28% | 2.74% | 3.25% |
| Fund Turnover Ratio | 150,738 | 85.98% | 90.17% | 0.00% | 3.00% | 60.00% | 500.00% | 500.00% |
| Flow Volatility, last 12 months | 153,746 | 7.63% | 11.92% | 0.15% | 0.27% | 3.04% | 58.49% | 83.34% |
| Total Net Flows, last 12 months, $m | 153,714 | 0.090 | 0.531 | -1.733 | -1.224 | -0.020 | 1.784 | 2.140 |
| Total Outflows, last 12 months, $m | 153,331 | 0.293 | 0.596 | 0.000 | 0.000 | 0.149 | 3.498 | 8.771 |
| # Portfolio Holdings | 77,441 | 167 | 304 | 1 | 3 | 81 | 1,947 | 3,805 |
| Cap Gains Distribution >0 dummy, N-SAR | 176,349 | 37.37% | 48.38% | 0.00% | 0.00% | 0.00% | 100.00% | 100.00% |
| Cap Gains Dist., % of Net Realized Cap Gains, N-SAR | 176,349 | 46.57% | 185.34% | 0.00% | 0.00% | 0.00% | 536.37% | 6218.18% |
| Realized Cap Gains, N-SAR ($000s) | 173,766 | 113,212 | 335,495 | 0 | 0 | 13,702 | 1,723,957 | 4,219,398 |
| Realized Cap Loss, N-SAR ($000s) | 173,376 | 40,589 | 159,932 | 0 | 0 | 72 | 679,506 | 2,731,846 |
| Unrealized Cap Gains, N-SAR ($000s) | 173,682 | 108,161 | 458,544 | 0 | 0 | 1,980 | 2,135,608 | 7,659,851 |
| Unrealized Cap Loss, N-SAR ($000s) | 173,256 | 63,902 | 359,352 | 0 | 0 | 0 | 1,418,589 | 8,785,179 |
| Distributed Capital Gains, N-SAR ($000s) | 173,444 | 51,682 | 202,846 | 0 | 0 | 0 | 1,001,239 | 3,203,313 |
| Distribution per share, N-SAR ($) | 172,934 | 0.58 | 1.22 | 0.00 | 0.00 | 0.00 | 5.91 | 11.20 |
| Realized Cap Gains, N-SAR, % of Assets | 167,338 | 8.38% | 9.24% | 0.00% | 0.00% | 6.17% | 42.80% | 97.85% |
| Net Realized Cap Gains, N-SAR, % of Assets | 166,756 | 2.79% | 14.49% | -160.32% | -50.05% | 4.03% | 34.37% | 54.63% |
| Unrealized Cap Gains, N-SAR, % of Assets | 175,782 | 6.05% | 8.94% | -1.28% | 0.00% | 2.14% | 39.13% | 92.04% |
| Distribution, N-SAR, % of Assets | 167,019 | 3.03% | 5.55% | 0.00% | 0.00% | 0.00% | 26.04% | 44.64% |
| Dividend Yield, CRSP | 176,349 | 0.61% | 1.05% | 0.00% | 0.00% | 0.04% | 4.76% | 22.55% |
| Short Term Cap Gains Yield, CRSP | 176,349 | 0.59% | 1.83% | 0.00% | 0.00% | 0.00% | 9.24% | 72.21% |
| Long Term Cap Gains Yield, CRSP | 176,349 | 2.26% | 4.22% | 0.00% | 0.00% | 0.00% | 18.84% | 112.17% |
| Tax Burden | 176,349 | 0.82% | 1.30% | 0.00% | 0.00% | 0.22% | 5.73% | 37.00% |



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## Table II: Capital Gains of ETFs and Mutual Funds

The table reports yearly statistics on heartbeat usage, averages regarding capital gains distributions as well as realized and unrealized capital gains for U.S. equity funds using data from CRSP and N-SAR forms. ETF stands for Exchange-Traded Fund, IMF represents Index Mutual Fund, and AMF stands for Active Mutual Fund. The sample ranges between January 1993 and December 2017.

### Panel A: ETF Heartbeats and Capital Gains Distributions from N-SAR data

| Year | ETF Heartbeats | | Capital Gains Distribution >0 Dummy (%) | | | Cap Gains Distribution, % of Net Realized Cap. Gain | | | Cap Gains Distribution >0 Dummy, weighted by AUM (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | % of ETFs | # of HBs per ETF | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* |
| 1993 | 0.00 | . | . | 77.27 | 59.76 | . | 71.29 | 61.19 | . | 96.23 | 83.51 |
| 1994 | 0.00 | . | . | 78.95 | 55.87 | . | 195.10 | 89.91 | . | 87.41 | 76.00 |
| 1995 | 0.00 | . | . | 63.74 | 60.03 | . | 47.48 | 122.20 | . | 86.49 | 71.78 |
| 1996 | 0.00 | . | . | 66.94 | 70.07 | . | 64.70 | 53.12 | . | 89.39 | 86.45 |
| 1997 | 0.00 | . | . | 67.05 | 72.56 | . | 48.04 | 57.36 | . | 89.13 | 86.61 |
| 1998 | 0.00 | . | . | 53.60 | 66.09 | . | 73.21 | 83.85 | . | 83.29 | 87.33 |
| 1999 | 10.00 | 1.00 | . | 52.92 | 60.53 | . | 51.83 | 60.86 | . | 82.34 | 86.08 |
| 2000 | 10.42 | 1.20 | . | 43.16 | 57.81 | . | 73.64 | 67.62 | . | 35.50 | 81.52 |
| 2001 | 13.11 | 1.00 | 26.23 | 18.40 | 27.60 | 3.84 | 81.17 | 92.96 | 13.09 | 10.17 | 44.63 |
| 2002 | 16.18 | 1.45 | 2.94 | 8.58 | 10.07 | 1.98 | 15.69 | 18.42 | 0.11 | 5.84 | 17.97 |
| 2003 | 5.00 | 1.00 | 1.25 | 9.52 | 8.63 | 0.24 | 6.71 | 6.98 | 0.04 | 3.78 | 15.88 |
| 2004 | 7.07 | 1.00 | 2.02 | 20.71 | 20.66 | 0.22 | 8.89 | 8.89 | 0.38 | 6.04 | 29.16 |
| 2005 | 5.52 | 1.13 | 1.38 | 30.00 | 37.98 | 0.83 | 24.94 | 24.90 | 0.16 | 11.05 | 51.39 |
| 2006 | 10.86 | 1.79 | 5.14 | 33.51 | 53.00 | 1.60 | 25.29 | 41.73 | 2.56 | 14.07 | 71.12 |
| 2007 | 9.57 | 1.55 | 4.63 | 42.13 | 63.47 | 0.67 | 29.99 | 51.77 | 1.37 | 14.67 | 77.94 |
| 2008 | 18.21 | 1.54 | 7.61 | 26.96 | 25.86 | 2.03 | 64.55 | 100.70 | 1.72 | 20.90 | 41.84 |
| 2009 | 12.70 | 1.21 | 0.54 | 3.66 | 1.43 | 0.15 | 1.83 | 0.61 | 0.01 | 0.66 | 2.08 |
| 2010 | 10.95 | 1.75 | 2.24 | 8.30 | 6.40 | 0.45 | 2.54 | 1.82 | 0.33 | 2.53 | 16.61 |
| 2011 | 13.79 | 1.63 | 3.85 | 13.56 | 12.90 | 2.43 | 8.85 | 7.18 | 1.01 | 7.10 | 23.00 |
| 2012 | 14.58 | 1.64 | 2.84 | 25.12 | 26.60 | 3.36 | 23.69 | 28.46 | 0.42 | 9.13 | 39.13 |
| 2013 | 21.17 | 1.57 | 3.30 | 37.11 | 40.88 | 1.07 | 20.46 | 23.05 | 0.12 | 10.83 | 55.06 |
| 2014 | 25.75 | 2.15 | 7.14 | 44.60 | 62.07 | 2.26 | 33.10 | 44.37 | 3.03 | 13.71 | 81.47 |
| 2015 | 22.15 | 1.72 | 8.18 | 52.09 | 68.92 | 3.36 | 53.76 | 85.10 | 2.33 | 23.38 | 87.56 |
| 2016 | 22.94 | 1.63 | 5.20 | 48.45 | 56.19 | 4.18 | 78.59 | 195.30 | 1.59 | 39.82 | 82.20 |
| 2017 | 29.71 | 1.95 | 6.14 | 53.90 | 64.66 | 1.97 | 39.14 | 42.74 | 3.20 | 28.43 | 84.84 |
| *Avg.* | *14.72* | *1.5* | *5.33* | *39.21* | *43.60* | *1.80* | *45.78* | *54.84* | *1.85* | *34.88* | *59.25* |



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**Panel B: Distributions, Realized, and Unrealized Cap Gains Yields from N-SAR data**

| Year | Cap Gains Distribution Yield (%) | | | Net Realized Cap Gains Yield (%) | | | Net Unrealized Cap Gains Yield (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* |
| 1993 | . | 1.03 | 3.63 | . | 1.20 | 4.84 | . | 6.03 | 3.72 |
| 1994 | . | 1.39 | 3.09 | . | 1.51 | 3.61 | . | 0.55 | 1.68 |
| 1995 | . | 1.60 | 2.90 | . | 3.60 | 4.70 | . | 11.71 | 9.67 |
| 1996 | . | 2.40 | 3.94 | . | 3.30 | 6.84 | . | 7.42 | 6.30 |
| 1997 | . | 2.04 | 5.18 | . | 3.29 | 7.59 | . | 10.00 | 7.79 |
| 1998 | . | 2.38 | 5.94 | . | 3.87 | 6.06 | . | 7.70 | 5.42 |
| 1999 | . | 2.20 | 4.23 | 2.05 | 3.10 | 6.67 | 1.78 | 8.16 | 8.68 |
| 2000 | . | 2.48 | 5.32 | 1.79 | 3.33 | 7.70 | 3.63 | 3.92 | 6.01 |
| 2001 | 0.16 | 2.82 | 6.29 | 2.40 | 1.37 | 2.02 | 0.96 | 1.60 | 2.08 |
| 2002 | 0.03 | 0.68 | 1.01 | 0.55 | 0.52 | 0.59 | 1.87 | 1.88 | 2.64 |
| 2003 | 0.01 | 0.33 | 0.35 | 0.94 | 1.41 | 1.62 | 8.43 | 14.84 | 15.56 |
| 2004 | 0.02 | 0.53 | 0.58 | 4.04 | 3.64 | 7.52 | 8.62 | 7.35 | 5.87 |
| 2005 | 0.05 | 1.06 | 1.72 | 3.32 | 3.69 | 7.20 | 2.53 | 3.93 | 3.66 |
| 2006 | 0.12 | 1.28 | 3.26 | 4.53 | 4.46 | 7.80 | 3.80 | 5.20 | 4.07 |
| 2007 | 0.10 | 2.20 | 4.61 | 4.99 | 6.08 | 8.85 | 3.62 | 3.24 | 4.20 |
| 2008 | 0.26 | 3.63 | 8.12 | 2.67 | 2.59 | 2.40 | 0.57 | 0.25 | 0.25 |
| 2009 | 0.05 | 1.28 | 1.01 | 0.46 | 0.74 | 0.19 | 7.85 | 12.24 | 17.66 |
| 2010 | 0.04 | 0.17 | 0.09 | 7.86 | 6.14 | 7.05 | 12.11 | 11.50 | 10.39 |
| 2011 | 0.12 | 0.55 | 0.44 | 6.10 | 6.89 | 9.46 | 5.25 | 3.87 | 4.02 |
| 2012 | 0.12 | 1.03 | 1.28 | 4.32 | 3.96 | 5.32 | 4.20 | 5.41 | 5.38 |
| 2013 | 0.06 | 1.25 | 1.83 | 6.12 | 6.65 | 8.92 | 9.08 | 10.46 | 9.51 |
| 2014 | 0.11 | 2.81 | 4.51 | 8.32 | 8.30 | 9.80 | 4.75 | 4.95 | 3.86 |
| 2015 | 0.18 | 4.04 | 6.81 | 5.31 | 6.25 | 7.99 | 1.75 | 1.38 | 1.00 |
| 2016 | 0.23 | 3.04 | 6.22 | 2.90 | 3.48 | 3.97 | 4.23 | 3.59 | 3.39 |
| 2017 | 0.09 | 1.71 | 3.53 | 5.19 | 7.23 | 8.22 | 6.80 | 7.60 | 7.38 |
| *Avg.* | *0.10* | *1.76* | *3.44* | *3.89* | *3.86* | *5.88* | *4.83* | *6.19* | *6.01* |



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## Table III: Tax Burdens of ETFs and Mutual Funds

The table reports average dividend, short-term and long-term capital gains distribution yields per year for ETFs, index mutual funds (IMF) and active mutual funds (AMF). These yields are then used in combination with marginal tax rates for investors that fall in the highest tax brackets to compute the tax burden for fund investors following Sialm & Zhang (2020). The final columns report the average yearly expense ratios by fund type for benchmarking purposes. The sample ranges from January 1993 to December 2017.

| Year | Dividend Yield (%) | | | ST Cap Gains Dist. Yield (%) | | | LT Cap Gains Dist. Yield (%) | | | Tax Burden (%) | | | Expense Ratio (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* |
| 1993 | 1.80 | 1.40 | 0.87 | 0.00 | 0.24 | 0.71 | 0.00 | 0.55 | 2.17 | 0.71 | 0.80 | 1.22 | 0.18 | 1.06 | 1.47 |
| 1994 | 2.47 | 1.37 | 0.83 | 0.06 | 0.44 | 0.65 | 0.00 | 0.81 | 2.11 | 1.00 | 0.95 | 1.18 | 0.31 | 1.03 | 1.41 |
| 1995 | 2.49 | 1.50 | 0.87 | 0.00 | 0.26 | 0.62 | 0.00 | 1.11 | 2.06 | 0.98 | 1.01 | 1.17 | 0.34 | 1.02 | 1.44 |
| 1996 | 2.13 | 1.24 | 0.77 | 0.00 | 0.68 | 1.15 | 0.00 | 1.81 | 2.58 | 0.84 | 1.27 | 1.48 | 0.24 | 0.87 | 1.43 |
| 1997 | 1.55 | 1.09 | 0.60 | 0.11 | 0.65 | 1.55 | 0.05 | 1.78 | 3.34 | 0.67 | 1.15 | 1.70 | 0.20 | 0.82 | 1.44 |
| 1998 | 1.27 | 1.01 | 0.54 | 0.00 | 0.99 | 1.97 | 0.00 | 1.67 | 3.49 | 0.50 | 1.12 | 1.69 | 0.19 | 0.85 | 1.48 |
| 1999 | 1.02 | 0.79 | 0.50 | 0.09 | 0.59 | 1.02 | 0.13 | 2.39 | 3.78 | 0.46 | 1.02 | 1.35 | 0.46 | 0.84 | 1.49 |
| 2000 | 0.52 | 0.68 | 0.48 | 0.06 | 0.70 | 1.65 | 0.01 | 1.80 | 4.07 | 0.23 | 0.91 | 1.66 | 0.27 | 0.97 | 1.51 |
| 2001 | 0.86 | 0.62 | 0.40 | 0.15 | 0.67 | 1.43 | 0.01 | 1.82 | 3.14 | 0.40 | 0.87 | 1.35 | 0.26 | 1.00 | 1.57 |
| 2002 | 1.05 | 0.59 | 0.35 | 0.18 | 0.06 | 0.22 | 0.01 | 0.59 | 0.70 | 0.48 | 0.37 | 0.36 | 0.36 | 1.02 | 1.60 |
| 2003 | 1.13 | 0.62 | 0.36 | 0.01 | 0.09 | 0.09 | 0.03 | 0.23 | 0.29 | 0.36 | 0.24 | 0.18 | 0.35 | 1.04 | 1.60 |
| 2004 | 1.14 | 0.70 | 0.36 | 0.07 | 0.22 | 0.22 | 0.01 | 0.33 | 0.46 | 0.20 | 0.23 | 0.20 | 0.33 | 1.04 | 1.54 |
| 2005 | 1.16 | 0.83 | 0.40 | 0.05 | 0.29 | 0.44 | 0.04 | 0.85 | 1.51 | 0.20 | 0.35 | 0.44 | 0.37 | 1.02 | 1.49 |
| 2006 | 1.04 | 0.85 | 0.40 | 0.01 | 0.27 | 0.70 | 0.07 | 1.09 | 2.69 | 0.17 | 0.38 | 0.71 | 0.37 | 1.01 | 1.46 |
| 2007 | 0.92 | 0.98 | 0.47 | 0.10 | 0.34 | 0.91 | 0.01 | 1.71 | 3.61 | 0.17 | 0.52 | 0.93 | 0.50 | 0.98 | 1.44 |
| 2008 | 1.28 | 1.18 | 0.59 | 0.21 | 0.48 | 1.22 | 0.01 | 2.39 | 3.93 | 0.27 | 0.70 | 1.10 | 0.55 | 0.98 | 1.43 |
| 2009 | 1.85 | 1.41 | 0.78 | 0.07 | 0.10 | 0.13 | 0.00 | 1.38 | 0.99 | 0.30 | 0.46 | 0.31 | 0.52 | 1.00 | 1.44 |
| 2010 | 1.27 | 1.12 | 0.59 | 0.17 | 0.12 | 0.05 | 0.00 | 0.10 | 0.07 | 0.25 | 0.22 | 0.12 | 0.52 | 1.01 | 1.39 |
| 2011 | 1.13 | 1.13 | 0.56 | 0.10 | 0.18 | 0.13 | 0.01 | 0.41 | 0.40 | 0.21 | 0.30 | 0.19 | 0.50 | 1.02 | 1.37 |
| 2012 | 1.24 | 1.05 | 0.61 | 0.05 | 0.18 | 0.16 | 0.04 | 0.88 | 1.27 | 0.21 | 0.35 | 0.34 | 0.50 | 1.01 | 1.35 |
| 2013 | 1.50 | 1.15 | 0.70 | 0.04 | 0.33 | 0.27 | 0.01 | 1.10 | 1.79 | 0.28 | 0.54 | 0.57 | 0.51 | 1.01 | 1.31 |
| 2014 | 1.39 | 0.96 | 0.60 | 0.07 | 0.90 | 0.84 | 0.04 | 2.12 | 3.84 | 0.37 | 1.12 | 1.42 | 0.48 | 0.99 | 1.29 |
| 2015 | 1.42 | 1.00 | 0.62 | 0.09 | 0.88 | 0.89 | 0.06 | 3.15 | 5.52 | 0.39 | 1.37 | 1.85 | 0.48 | 0.96 | 1.27 |
| 2016 | 1.49 | 1.12 | 0.72 | 0.06 | 0.32 | 0.40 | 0.08 | 2.65 | 4.98 | 0.40 | 1.04 | 1.53 | 0.48 | 0.88 | 1.25 |
| 2017 | 1.42 | 1.10 | 0.73 | 0.06 | 0.26 | 0.29 | 0.03 | 1.96 | 3.18 | 0.37 | 0.84 | 1.05 | 0.47 | 0.84 | 1.21 |
| *Avg.* | *1.38* | *1.02* | *0.59* | *0.07* | *0.41* | *0.71* | *0.03* | *1.39* | *2.48* | *0.42* | *0.73* | *0.96* | *0.39* | *0.97* | *1.43* |
| *13-17* | *1.44* | *1.07* | *0.67* | *0.06* | *0.54* | *0.54* | *0.04* | *2.20* | *3.86* | *0.36* | *0.98* | *1.28* | *0.48* | *0.94* | *1.27* |



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## Table IV: Tax Burden by Style

The table reports average capital gains distribution yields as well as realized and unrealized capital gains yields for ETFs, index mutual funds and active mutual funds by style and year. Furthermore, the tax burden is computed for each of the three fund types. The final two columns display the difference between the tax burden of index mutual funds (IMF) and active mutual funds (AMF) relative to the tax burden of ETFs, respectively. Panel A displays average statistics for large-cap and broad market funds. Panel B focuses on small- and mid-cap funds. Panel C reports statistics for sector funds. Panel D breaks down the statistics by fund style, based on Lipper Class (SPSP corresponds to S&P 500 Index Objective Funds, EIEI to Equity Income Funds, and the remaining codes correspond to: first two codes indicating large cap (LC), mid cap (MC), small cap (SC), and multi cap (ML), and last two codes for core (CE), growth (GE), and value (VE) funds). Additionally, the last column of Panel D displays the difference between the tax burden of active mutual funds and ETFs that are matched to these funds using propensity scores (PS Match) based on four factor betas, turnover, log(size), annual return, and volatility. The capital gains data come from Form N-SAR. Tax rates are obtained from Sialm & Zhang (2020).

**Panel A: Large-Cap and Broad Market Funds**

| **Year** | **# of Funds** | Cap Gains Dist. Yield (%) | | | Realized Cap Gains Yield (%) | | | Unrealized Cap Gains Yield (%) | | | Tax Burden (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *IMF Diff* | *AMF Diff* |
| 2013 | 3,944 | 0.01 | 1.17 | 1.44 | 4.40 | 6.77 | 9.56 | 7.78 | 11.67 | 9.67 | 0.31 | 0.58 | 0.47 | 0.27 | 0.16 |
| 2014 | 3,764 | 0.10 | 3.24 | 4.08 | 5.87 | 7.41 | 10.55 | 5.83 | 6.21 | 4.36 | 0.43 | 1.28 | 1.34 | 0.85 | 0.91 |
| 2015 | 3,838 | 0.36 | 4.24 | 6.96 | 4.86 | 5.24 | 8.74 | 1.22 | 1.30 | 0.86 | 0.42 | 1.46 | 1.88 | 1.04 | 1.46 |
| 2016 | 3,887 | 0.13 | 3.06 | 6.72 | 2.81 | 3.26 | 4.44 | 2.43 | 3.15 | 2.30 | 0.41 | 1.08 | 1.65 | 0.67 | 1.24 |
| 2017 | 3,736 | 0.05 | 1.65 | 3.75 | 3.93 | 4.46 | 8.46 | 6.47 | 9.16 | 8.10 | 0.34 | 0.91 | 1.10 | 0.57 | 0.76 |
| *Avg.* | | *0.13* | *2.67* | *4.59* | *4.37* | *5.43* | *8.35* | *4.75* | *6.30* | *5.06* | *0.38* | *1.06* | *1.29* | *0.68* | *0.91* |

**Panel B: Small- and Mid-Cap Funds**

| **Year** | **# of Funds** | Cap Gains Dist. Yield (%) | | | Realized Cap Gains Yield (%) | | | Unrealized Cap Gains Yield (%) | | | Tax Burden (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *IMF Diff* | *AMF Diff* |
| 2013 | 3,357 | 0.13 | 1.48 | 2.41 | 9.88 | 6.99 | 9.14 | 11.21 | 9.50 | 10.45 | 0.23 | 0.53 | 0.68 | 0.30 | 0.45 |
| 2014 | 3,468 | 0.14 | 2.60 | 5.66 | 11.03 | 9.88 | 10.11 | 4.79 | 3.36 | 2.59 | 0.31 | 1.01 | 1.67 | 0.70 | 1.36 |
| 2015 | 3,570 | 0.17 | 4.23 | 7.59 | 6.08 | 7.84 | 7.95 | 2.21 | 1.41 | 0.75 | 0.35 | 1.35 | 2.00 | 1.00 | 1.65 |
| 2016 | 3,684 | 0.17 | 3.31 | 6.40 | 3.90 | 3.85 | 3.63 | 3.92 | 3.92 | 3.71 | 0.36 | 1.04 | 1.52 | 0.68 | 1.16 |
| 2017 | 3,805 | 0.11 | 1.95 | 3.54 | 7.34 | 10.87 | 8.41 | 7.28 | 6.15 | 7.18 | 0.37 | 0.78 | 1.01 | 0.41 | 0.64 |
| *Avg.* | | *0.14* | *2.71* | *5.12* | *7.65* | *7.89* | *7.85* | *5.88* | *4.87* | *4.94* | *0.32* | *0.94* | *1.38* | *0.62* | *1.05* |



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**Panel C: Sector Funds**

| Year | # of Funds | Cap Gains Dist. Yield (%) | | | Realized Cap Gains Yield (%) | | | Unrealized Cap Gains Yield (%) | | | Tax Burden (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *IMF Diff* | *AMF Diff* |
| 2013 | 1,028 | 0.03 | 0.06 | 1.52 | 4.26 | 2.10 | 6.01 | 8.12 | 6.93 | 6.14 | 0.30 | 0.29 | 0.54 | -0.01 | 0.24 |
| 2014 | 1,048 | 0.08 | 0.16 | 2.55 | 7.66 | 4.03 | 6.84 | 4.12 | 6.85 | 6.73 | 0.37 | 0.41 | 0.98 | 0.04 | 0.61 |
| 2015 | 1,066 | 0.08 | 0.62 | 4.29 | 5.07 | 3.44 | 6.00 | 1.73 | 2.07 | 2.49 | 0.39 | 0.50 | 1.37 | 0.11 | 0.98 |
| 2016 | 1,097 | 0.33 | 0.60 | 4.37 | 2.31 | 3.67 | 4.00 | 5.09 | 6.33 | 5.69 | 0.41 | 0.71 | 1.27 | 0.30 | 0.86 |
| 2017 | 1,101 | 0.10 | 0.45 | 3.35 | 4.48 | 2.72 | 7.19 | 6.64 | 6.07 | 6.59 | 0.39 | 0.64 | 1.15 | 0.25 | 0.76 |
| *Avg.* | | *0.12* | *0.38* | *3.22* | *4.76* | *3.19* | *6.01* | *5.14* | *5.65* | *5.53* | *0.37* | *0.51* | *1.06* | *0.14* | *0.69* |

**Panel D: Lipper Class Fund Styles and Propensity Score Matched Sample**

| ***Lipper Class*** | **# of Funds** | Cap Gains Dist. Yield (%) | | | Realized Cap Gains Yield (%) | | | Unrealized Cap Gains Yield (%) | | | Tax Burden (%) | | | | | TB (%) *PS Match* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *IMF Diff* | *AMF Diff* | *AMF Diff** |
| SPSP | 153 | 0.00 | 2.11 | | 2.16 | 4.41 | | 4.17 | 7.32 | | 0.43 | 0.85 | | 0.43 | | |
| LCCE | 899 | 0.07 | 2.64 | 4.28 | 4.21 | 5.86 | 8.09 | 4.93 | 5.79 | 4.72 | 0.39 | 1.05 | 1.27 | 0.66 | 0.88 | 0.85*** |
| LCGE | 712 | 0.05 | 1.97 | 6.40 | 2.80 | 6.12 | 9.93 | 4.05 | 6.69 | 4.91 | 0.28 | 0.82 | 1.57 | 0.54 | 1.29 | 1.48*** |
| LCVE | 518 | 0.14 | 1.13 | 3.29 | 3.30 | 3.88 | 7.60 | 4.73 | 5.23 | 4.78 | 0.48 | 0.81 | 1.09 | 0.33 | 0.62 | 0.58*** |
| MCCE | 394 | 0.21 | 4.15 | 6.38 | 5.70 | 6.93 | 8.89 | 5.26 | 6.26 | 4.95 | 0.32 | 1.29 | 1.61 | 0.98 | 1.30 | 1.33*** |
| MCGE | 406 | 0.08 | 1.29 | 6.50 | 6.05 | 8.19 | 9.16 | 6.57 | 4.02 | 4.73 | 0.18 | 0.46 | 1.60 | 0.28 | 1.42 | 1.50*** |
| MCVE | 175 | 0.19 | 0.00 | 4.25 | 6.19 | 3.43 | 8.16 | 5.56 | 7.60 | 5.30 | 0.50 | 0.39 | 1.30 | -0.11 | 0.79 | 0.85*** |
| SCCE | 801 | 0.09 | 4.36 | 5.83 | 5.51 | 6.16 | 8.93 | 5.12 | 6.59 | 5.19 | 0.30 | 1.42 | 1.48 | 1.12 | 1.17 | 1.23*** |
| SCGE | 543 | 0.09 | 3.45 | 6.91 | 7.02 | 9.15 | 9.68 | 5.94 | 4.94 | 5.45 | 0.21 | 1.01 | 1.68 | 0.80 | 1.47 | 1.63*** |
| SCVE | 283 | 0.13 | 2.10 | 5.00 | 6.56 | 9.56 | 7.68 | 4.62 | 4.89 | 5.69 | 0.43 | 0.81 | 1.40 | 0.38 | 0.96 | 1.07*** |
| MLCE | 724 | 0.13 | 2.63 | 3.82 | 5.17 | 4.57 | 7.63 | 5.35 | 6.45 | 5.41 | 0.36 | 1.25 | 1.18 | 0.89 | 0.82 | 0.80*** |
| MLGE | 504 | 0.39 | 7.51 | 5.72 | 6.19 | 9.71 | 9.01 | 4.60 | 4.81 | 5.51 | 0.23 | 1.66 | 1.35 | 1.43 | 1.11 | 1.29*** |
| MLVE | 325 | 0.17 | 2.50 | 3.20 | 5.76 | 7.51 | 7.06 | 4.90 | 4.31 | 5.31 | 0.62 | 1.41 | 1.18 | 0.79 | 0.56 | 0.56*** |
| EIEI | 463 | 0.11 | 2.88 | 3.10 | 3.14 | 6.07 | 5.30 | 3.57 | 4.51 | 4.98 | 0.66 | 1.40 | 1.22 | 0.74 | 0.57 | 0.58*** |
| Sector | 1,077 | 0.12 | 0.38 | 3.22 | 4.76 | 3.19 | 6.01 | 5.14 | 5.65 | 5.53 | 0.37 | 0.51 | 1.06 | 0.14 | 0.69 | 0.70*** |
| *Avg.* | | 0.13 | 2.61 | 4.85 | 4.96 | 6.32 | 8.08 | 4.97 | 5.67 | 5.18 | 0.39 | 1.01 | 1.36 | 0.62 | 0.97 | 0.97*** |



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## Table V: Determinants of ETF Tax Efficiency and Heartbeat Trades

This table reports estimates of regression analyses that relate ETF tax efficiency and heartbeat trade usage to various characteristics. Panel A reports estimates of regressions of realized capital gains yields (*CG Yield*) and capital gains distribution yields (*CG Distribution Yield*) on various fund characteristics. Fund characteristics are interacted with an ETF dummy to infer differences in effects between ETFs and mutual funds. Panel B reports regression estimates of short-term and long-term capital gains distribution yields as well as tax burdens on fund characteristics on outflows, interacted with an ETF dummy, along with the natural logarithm of the number of ETF heartbeat trades in the last twelve months. Panel C regresses the ETF's use of heartbeats on fund characteristics, and Panel D regresses the unrealized capital gains yield on the same determinants used in Panel B, interacted with an ETF dummy. Total net assets, expense ratio, and turnover ratio are as reported by CRSP. Annual Return is a fund's total return compounded over the last twelve months. Outflows represent the cumulative monthly redemptions extracted from Form N-SAR filings and scaled by total net asset at the beginning of the period. Realized and unrealized capital gains are also obtained from Form N-SAR. Flows and performance variables are computed on a rolling 12-month window. The number of holdings information has a lower number of observations because the ETF holdings data is not available for the entire sample period. Heartbeat trades are identified as described in Section III.B. Observations are at the share class-year level. Standard errors are clustered by fund and year. $^{***}$, $^{**}$, and $^{*}$ represent statistical significance at the 1%, 5%, and 10% levels, respectively.



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**Panel A: Capital Gains Distribution of ETFs vs. Mutual Funds**

| | CG Yield | | CG Distribution Yield | | CG Yield | | CG Distribution Yield | | CG Distribution Yield | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| ETF Dummy | -0.0122** | -0.0569*** | -0.0398*** | -0.0180*** | -0.0052 | -0.0509*** | -0.036*** | -0.0159*** | -0.0346*** | -0.0214*** |
| | (-2.16) | (-3.459) | (-5.08) | (-3.62) | (-1.029) | (-3.30) | (-5.51) | (-3.71) | (-5.69) | (-4.16) |
| Log TNA | 0.0005* | 0.0005* | 0.0013*** | 0.0013*** | 0.0005* | 0.0006* | 0.0013*** | 0.0014*** | 0.0012*** | 0.0012*** |
| | (1.95) | (1.985) | (3.78) | (3.92) | (1.973) | (2.07) | (3.87) | (4.05) | (3.61) | (3.61) |
| x ETF Dummy | | 0.0020* | | -0.0027*** | | 0.0017* | | -0.0030*** | | |
| | | (1.992) | | (-4.34) | | (1.89) | | (-4.23) | | |
| Expense Ratio | 0.4813*** | 0.4542*** | 0.1681 | 0.1688 | 0.4160*** | 0.3865*** | 0.0528 | 0.0501 | -0.0520 | -0.0466 |
| | (3.11) | (2.929) | (1.31) | (1.34) | (3.229) | (3.01) | (0.45) | (0.43) | (-0.46) | (-0.41) |
| x ETF Dummy | | 7.0234** | | -0.0577 | | 8.6524*** | | 1.1285** | | |
| | | (2.349) | | (-0.14) | | (2.92) | | (2.63) | | |
| Turnover Ratio | 0.0068** | 0.0069** | -0.0022 | -0.0023 | 0.0064** | 0.0066** | -0.0020 | -0.0021 | -0.0036** | -0.0038** |
| | (2.81) | (2.797) | (-1.49) | (-1.53) | (2.708) | (2.71) | (-1.49) | (-1.50) | (-2.62) | (-2.67) |
| x ETF Dummy | | -0.0088 | | 0.0002 | | -0.0163* | | -0.0048 | | |
| | | (-0.894) | | (0.09) | | (-1.72) | | (-1.66) | | |
| Annual Return | 0.0669*** | 0.0666*** | -0.0281** | -0.0293** | 0.0636*** | 0.0636*** | -0.0319** | -0.0329** | -0.0479*** | -0.0476*** |
| | (5.70) | (5.665) | (-2.36) | (-2.42) | (5.292) | (5.25) | (-2.59) | (-2.64) | (-3.16) | (-3.13) |
| x ETF Dummy | | 0.0054 | | 0.0523* | | -0.0043 | | 0.0489* | | |
| | | (0.214) | | (1.93) | | (-0.21) | | (1.97) | | |
| Outflows, last 12 | 0.0709*** | 0.0695*** | 0.0277*** | 0.0292*** | 0.0754*** | 0.0741*** | 0.0292*** | 0.0306*** | 0.0103* | 0.0109** |
| months % | (6.42) | (6.126) | (4.24) | (4.10) | (6.295) | (6.06) | (3.96) | (3.87) | (2.03) | (2.14) |
| x ETF Dummy | | 0.0143 | | -0.0273*** | | 0.0141 | | -0.0259*** | | |
| | | (0.883) | | (-3.32) | | (0.92) | | (-3.28) | | |
| Realized Capital | | | | | | | | | 0.2520*** | 0.2589*** |
| Gain Yield | | | | | | | | | (4.98) | (5.02) |
| x ETF Dummy | | | | | | | | | | -0.2111*** |
| | | | | | | | | | | (-3.93) |
| Observations | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 |
| R-squared | 0.281 | 0.282 | 0.193 | 0.194 | 0.300 | 0.301 | 0.213 | 0.214 | 0.275 | 0.276 |
| Fixed Effects | Date | | Date | | Style & Date | | Style & Date | | Style & Date | |



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**Panel B: Tax Efficiency and Redemption-in-Kind, Outflows and Heartbeat Trades**

| | CG Yield | CG Distribution Yield | ST CG Distribution Yield | LT CG Distribution Yield | *Tax Burden* | CG Yield | CG Distribution Yield | ST CG Distribution Yield | LT CG Distribution Yield | *Tax Burden* |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| ETF Dummy | -0.0233*** | -0.0258*** | -0.0025*** | -0.0277*** | -0.0058*** | -0.0155** | -0.0221*** | -0.0021*** | -0.0255*** | -0.0052*** |
| | (-3.67) | (-4.73) | (-3.15) | (-5.60) | (-4.28) | (-2.61) | (-5.15) | (-2.91) | (-6.40) | (-4.86) |
| Log TNA | 0.0005* | 0.0013*** | -0.0000 | 0.0013*** | 0.0002*** | 0.0005* | 0.0013*** | -0.0000 | 0.0013*** | 0.0002*** |
| | (1.94) | (3.81) | (-0.82) | (5.71) | (4.62) | (1.98) | (3.90) | (-0.80) | (5.66) | (4.69) |
| Expense Ratio | 0.4822*** | 0.1672 | -0.0313 | 0.2809** | -0.0666** | 0.4183*** | 0.0522 | -0.0537** | 0.1950* | -0.0870*** |
| | (3.12) | (1.31) | (-1.45) | (2.62) | (-2.38) | (3.26) | (0.45) | (-2.12) | (1.96) | (-3.01) |
| Turnover Ratio | 0.0069** | -0.0023 | 0.0034*** | -0.0046*** | 0.0003 | 0.0066** | -0.0021 | 0.0035*** | -0.0045*** | 0.0005 |
| | (2.81) | (-1.53) | (4.00) | (-5.75) | (1.05) | (2.71) | (-1.53) | (4.21) | (-6.01) | (1.53) |
| Annual Return | 0.0667*** | -0.0280** | 0.0053* | -0.0014 | 0.0018 | 0.0635*** | -0.0317** | 0.0046 | -0.0043 | 0.0010 |
| | (5.69) | (-2.34) | (1.85) | (-0.27) | (1.12) | (5.28) | (-2.58) | (1.61) | (-0.85) | (0.67) |
| Outflows, last 12 | 0.0694*** | 0.0292*** | -0.0009 | 0.0106*** | 0.0019** | 0.0739*** | 0.0306*** | -0.0010 | 0.0113*** | 0.0019** |
| months % | (6.12) | (4.11) | (-1.20) | (3.46) | (2.50) | (6.05) | (3.87) | (-1.27) | (3.27) | (2.08) |
| x ETF Dummy | 0.0268 | -0.0276*** | 0.0005 | -0.0083* | -0.0023* | 0.0285 | -0.0248*** | 0.0016 | -0.0068* | -0.0015 |
| | (1.40) | (-3.31) | (0.44) | (-2.07) | (-2.00) | (1.53) | (-3.17) | (1.44) | (-1.81) | (-1.42) |
| Log (1 + # of | -0.0055 | -0.0068*** | -0.0019*** | -0.0054*** | -0.0021*** | -0.0126** | -0.0121*** | -0.0030*** | -0.0088*** | -0.0031*** |
| Heartbeat Trades) | (-0.93) | (-3.40) | (-3.77) | (-3.84) | (-4.92) | (-2.15) | (-5.61) | (-4.24) | (-6.58) | (-6.46) |
| Observations | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 | 122,629 |
| R-squared | 0.281 | 0.193 | 0.127 | 0.186 | 0.233 | 0.300 | 0.214 | 0.138 | 0.206 | 0.253 |
| Fixed Effects | | | Date | | | | | Style & Date | | |



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**Panel C: Determinants of Heartbeat Trades**

| | *HBT Dummy* | *Log(1+ # of HBTs)* | *HBT Dummy* | *Log(1+ # of HBTs)* | *HBT Dummy* | *Log(1+ # of HBTs)* |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Log TNA | 0.0126* | 0.0196** | 0.0108 | 0.0238** | -0.0152 | 0.0060 |
| | (1.84) | (2.70) | (1.27) | (2.52) | (-0.96) | (0.31) |
| Expense Ratio | -14.3336* | -10.0971 | -3.4344 | 8.1876 | -5.4591 | -3.0029 |
| | (-1.76) | (-1.05) | (-0.36) | (0.66) | (-0.53) | (-0.26) |
| Turnover Ratio | 0.1989*** | 0.2401*** | 0.1806*** | 0.2220*** | 0.1049 | 0.1356* |
| | (6.49) | (6.70) | (5.92) | (6.18) | (1.81) | (1.96) |
| Annual Return | 0.1371* | 0.1275 | 0.2049** | 0.2191* | -0.0316 | -0.0084 |
| | (2.03) | (1.36) | (2.35) | (1.87) | (-0.30) | (-0.07) |
| Realized Capital Gains Yield | 0.4361** | 0.4490** | 0.3378* | 0.4741* | 0.4856** | 0.6625** |
| | (2.31) | (2.12) | (2.03) | (2.19) | (2.83) | (2.68) |
| Unrealized Capital Gains Yield | -0.1070 | -0.1328 | -0.3435 | -0.3881 | 0.0748 | 0.0646 |
| | (-0.66) | (-0.83) | (-1.38) | (-1.55) | (0.33) | (0.304) |
| Outflows, last 12 months % | -0.0705*** | -0.0754*** | -0.0599** | -0.0698** | -0.0255 | -0.0188 |
| | (-5.29) | (-4.26) | (-3.20) | (-2.79) | (-1.23) | (-0.70) |
| Log # of Holdings | | | 0.0169** | 0.0188* | 0.0029 | 0.0077 |
| | | | (2.28) | (1.98) | (0.16) | (0.37) |
| Observations | 4,484 | 4,484 | 3,154 | 3,154 | 3,059 | 3,059 |
| R-squared | 0.097 | 0.122 | 0.258 | 0.301 | 0.480 | 0.572 |
| Fixed Effects | Date | | Family & Date | | Fund & Date | |



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**Panel D: Tax Externalities of Outflows**

| | Unrealized Capital Gains Yield | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ETF Dummy | | 0.0055 | | 0.0010 | | 0.0000 |
| | | (0.54) | | (0.11) | | (0.00) |
| Log TNA | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.0045*** | 0.0046*** |
| | (0.73) | (0.77) | (0.51) | (0.54) | (3.62) | (3.63) |
| x ETF Dummy | | 0.0011 | | 0.0013 | | -0.0027* |
| | | (0.73) | | (0.85) | | (-1.91) |
| Expense Ratio | 0.4981*** | 0.4874*** | 0.4161*** | 0.3750*** | 0.7634 | 0.7661 |
| | (3.51) | (3.26) | (4.11) | (3.53) | (1.42) | (1.44) |
| x ETF Dummy | | 3.1705 | | 2.1787 | | -4.9794* |
| | | (1.45) | | (0.95) | | (-1.84) |
| Turnover Ratio | -0.0091** | -0.0093** | -0.0099*** | -0.0103*** | -0.0062 | -0.0063 |
| | (-2.74) | (-2.76) | (-3.22) | (-3.25) | (-1.69) | (-1.71) |
| x ETF Dummy | | 0.0061 | | 0.0098 | | 0.0121 |
| | | (0.65) | | (1.05) | | (0.97) |
| Annual Return | 0.3022*** | 0.3021*** | 0.3042*** | 0.3040*** | 0.3161*** | 0.3157*** |
| | (6.40) | (6.31) | (6.53) | (6.44) | (7.57) | (7.46) |
| x ETF Dummy | | 0.0141 | | 0.0174 | | 0.0216 |
| | | (0.44) | | (0.54) | | (0.63) |
| Outflows, last 12 months % | 0.0192** | 0.0222*** | 0.0168** | 0.0200** | 0.0105 | 0.0126 |
| | (2.73) | (3.01) | (2.22) | (2.57) | (1.28) | (1.47) |
| x ETF Dummy | | -0.0621*** | | -0.0612*** | | -0.0641*** |
| | | (-4.84) | | (-4.83) | | (-4.38) |
| Log (1 + # of Heartbeat Trades) | | 0.0014 | | 0.0041 | | -0.0008 |
| | | (0.40) | | (1.07) | | (-0.17) |
| Observations | 122,629 | 122,629 | 122,629 | 122,629 | 121,569 | 121,569 |
| R-squared | 0.497 | 0.498 | 0.506 | 0.507 | 0.583 | 0.584 |
| Fixed Effects | Date | | Style & Date | | Fund & Date | |



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## Table VI: Determinants of Flows

This table reports regression analyses of flows on various fund characteristics within the sample of active mutual funds. Panel A uses annualized monthly net flows or outflows as the dependent variable, scaled by total net assets as of the beginning of the month. Outflows are based on monthly redemptions from Form N-SAR. Panel B uses fund flows measured from funds' fiscal year-end to December 31 as the dependent variable. Funds with December fiscal year-end month are not included in this analysis. Net flows and negative net flows (sum of negative monthly net flows, in absolute value) are computed over 12 months and scaled by total net assets at the beginning of the period. Outflows represent the cumulative monthly redemptions extracted from Form N-SAR filings and scaled by total net assets at the beginning of the period. Annual Excess Return is a fund's excess return relative to the Fama-French four factors, compounded over the last twelve months. Flows and performance variables are computed on a rolling 12-month window, and all performance variables, fees and assets are as of the end of the previous period (month or year) before flows are observed. Specifications (3) and (4) in Panel A and Specifications (4) – (6) in Panel B utilize the components of tax burden instead of tax burden itself. Annual Excess Return, Fee Gap, and Tax Burden Gap, as well as the components (Dividend yield, Capital Gains Distribution, Realized Capital Gains and Unrealized Capital Gains) are standardized to have zero mean and unit standard deviation (suffix *stdd*).



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**Panel A: The Effect of Tax Burden and Its Components on Monthly Flows**

| | Monthly Net Flows (%, x12) (1) | Monthly Outflows (%, x12) (2) | Monthly Net Flows (%, x12) (3) | Monthly Outflows (%, x12) (4) |
|---|---|---|---|---|
| Annual Excess Return (*standardized*), (t-1) | 0.057*** | -0.015*** | 0.055*** | -0.017*** |
| | (13.52) | (-7.68) | (12.03) | (-7.69) |
| Fee Gap (*stdd*), (t-1) | -0.050*** | 0.006*** | -0.049*** | 0.008*** |
| | (-8.26) | (3.33) | (-6.67) | (3.14) |
| Tax Burden Gap (*stdd*), (t-1) | -0.024*** | 0.018*** | | |
| | (-4.54) | (4.34) | | |
| Dividend Yield (*stdd*), (t-1) | | | -0.002 | 0.011*** |
| | | | (-0.50) | (3.48) |
| Capital Gains Distribution Yield (*stdd*), (t-1) | | | -0.021*** | 0.009*** |
| | | | (-5.69) | (2.91) |
| Realized Capital Gains Yield (*stdd*), (t-1) | | | -0.034*** | 0.048*** |
| | | | (-7.27) | (10.80) |
| Unrealized Capital Gains Yield (*stdd*), (t-1) | | | 0.003 | 0.009*** |
| | | | (0.52) | (3.22) |
| Log TNA, (t-1) | -0.029*** | -0.003*** | -0.026*** | -0.005*** |
| | (-7.66) | (-3.03) | (-6.95) | (-4.41) |
| Style Flows, (t-1) | 0.738*** | -0.109*** | 0.672*** | -0.174*** |
| | (12.62) | (-3.07) | (11.45) | (-4.58) |
| Return Volatility, (t-1) | 0.092 | 1.565*** | 0.443 | 0.499* |
| | (0.15) | (4.75) | (0.91) | (1.77) |
| Retail Dummy, (t-1) | 0.010 | 0.012*** | 0.012 | 0.016*** |
| | (0.77) | (3.50) | (0.95) | (4.05) |
| Log Age, (t-1) | -0.127*** | -0.016*** | -0.108*** | -0.024*** |
| | (-19.29) | (-4.41) | (-16.24) | (-6.76) |
| Observations | 1,054,206 | 905,809 | 629,192 | 588,617 |
| R-squared | 0.044 | 0.110 | 0.040 | 0.165 |



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**Panel B: Timing of Outflows – Focusing on Outflows Between Fund Fiscal Year-End Month and Calendar Year-End**

| | Net Flows (%) | Abs (Negative Net Flows) (%) | Outflows % | Net Flows (%) | Abs (Negative Net Flows) (%) | Outflows % |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Annual Excess Return (*stdd*) | 0.018*** | -0.008*** | -0.004** | 0.016*** | -0.008*** | -0.006** |
| | (7.50) | (-4.69) | (-2.70) | (6.74) | (-3.34) | (-2.42) |
| Fee Gap (*stdd*) | -0.016*** | 0.000 | -0.004** | -0.019*** | 0.004 | -0.003 |
| | (-4.47) | (0.26) | (-2.78) | (-4.00) | (1.49) | (-1.49) |
| Tax Burden Gap (*stdd*) | -0.027*** | 0.014*** | 0.011*** | | | |
| | (-9.01) | (8.19) | (5.98) | | | |
| Dividend Yield (*stdd*) | | | | -0.008** | 0.003 | 0.001 |
| | | | | (-2.39) | (1.08) | (0.27) |
| Capital Gains Distribution Yield (*stdd*) | | | | -0.012*** | -0.002 | -0.004 |
| | | | | (-5.96) | (-0.56) | (-1.09) |
| Realized Capital Gains Yield (*stdd*) | | | | -0.018*** | 0.015*** | 0.015*** |
| | | | | (-6.82) | (4.72) | (3.44) |
| Unrealized Capital Gains Yield (*stdd*) | | | | -0.001 | -0.007 | -0.004 |
| | | | | (-0.33) | (-1.00) | (-0.40) |
| Log TNA | -0.011*** | -0.010*** | -0.002** | -0.011*** | -0.010*** | -0.003** |
| | (-6.47) | (-10.52) | (-2.11) | (-6.68) | (-8.13) | (-2.70) |
| Style Flows | 0.327*** | -0.159*** | -0.075*** | 0.336*** | -0.168*** | -0.102*** |
| | (7.16) | (-9.04) | (-3.79) | (9.00) | (-5.54) | (-3.35) |
| Return Volatility | 0.338 | 0.344*** | 0.511*** | 0.356 | 0.124 | 0.088 |
| | (1.47) | (2.93) | (3.45) | (1.45) | (0.70) | (0.36) |
| Retail Dummy | 0.005 | 0.003 | 0.016*** | 0.011* | 0.002 | 0.019*** |
| | (0.94) | (1.09) | (5.90) | (2.06) | (0.44) | (5.38) |
| Log Age | -0.050*** | 0.022*** | 0.000 | -0.049*** | 0.016*** | -0.004 |
| | (-15.33) | (10.22) | (0.14) | (-13.13) | (5.81) | (-0.96) |
| Observations | 65,736 | 65,736 | 65,736 | 41,825 | 41,825 | 41,825 |
| R-squared | 0.111 | 0.098 | 0.105 | 0.104 | 0.126 | 0.135 |



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## Table VII: Flow Migration

The table reports TNA-weighted annual averages of total net flows, realized capital gains, and distributions by quintiles of active mutual funds formed by sorting on their realized capital gains yields. Each fund in each quintile is matched to a benchmark created using similar funds within each fund type, year, and similar investment style. We use Lipper Class code for the investment style information as it is computed by Lipper using the holdings of the fund. We keep only Lipper Classes with more than one ETF, and the sample period spans 2005 to 2017 when we have enough ETFs in various Lipper Class categories. For each Lipper Class and year, benchmark values are computed as the AUM-weighted averages using all the funds with the designated fund type in same Lipper class. After sorting active funds into quintiles by realized capital gains, we match each sorting fund to its benchmark values within AMF, IMF, and ETF types, and compute value-weighted averages across all sorting fund-years, then report the time series averages below. IMF represents Index Mutual Fund, AMF stands for Active Mutual Fund, and ETF means Exchange-Traded Fund.

| **Realized Cap Gains Yield Quintile** | Average # of Funds | Total Net Flow, last 12 months, % | | | | Realized Cap Gains Yield | | | | Cap Gains Distributions Yield | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Sorting AMF* | Benchmark Funds in Same Lipper Class | | | *Sorting AMF* | Benchmark Funds in Same Lipper Class | | | *Sorting AMF* | Benchmark Funds in Same Lipper Class | | |
| | | *Fund* | *AMF* | *IMF* | *ETF* | *Fund* | *AMF* | *IMF* | *ETF* | *Fund* | *AMF* | *IMF* | *ETF* |
| 1 - Low | 1,271 | 2.92% | -6.47% | 1.68% | 9.43% | 0.82% | 6.11% | 3.50% | 3.18% | 1.33% | 2.92% | 0.70% | 0.06% |
| 2 | 1,583 | -1.35% | -6.73% | 1.09% | 9.72% | 3.29% | 6.16% | 3.53% | 3.53% | 2.63% | 3.58% | 0.84% | 0.03% |
| 3 | 1,857 | -5.67% | -7.07% | 1.52% | 8.93% | 5.88% | 6.61% | 3.81% | 3.34% | 3.25% | 3.37% | 0.80% | 0.03% |
| 4 | 1,387 | -10.37% | -7.36% | 0.90% | 11.52% | 9.05% | 7.14% | 4.16% | 4.06% | 4.43% | 4.14% | 1.06% | 0.02% |
| 5 - High | 1,334 | -22.76% | -7.50% | 0.82% | 10.38% | 16.01% | 7.13% | 4.17% | 4.03% | 6.28% | 4.07% | 1.01% | 0.02% |



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## Table VIII: ETF Asset Growth due to High-Net-Worth Individuals

The table reports the assets under management and ETF allocations of investment advisors that advise various levels of high-net-worth clients. ETF ownership by investment advisors is determined using 13F holdings data from Thomson-Reuters Global Ownership Database (OP), while the exposure to high-net-worth clients (HNW) is based on data reported on Form ADV. Advisors are determined to have high exposure to high-net-worth individuals if more than 25% of their AUM comes from high-net-worth clients (if assets are unavailable, the determination is made using a client count). In Panel A, two measures of total assets of institutions are used to scale ETF allocations. Panel B presents ETF allocation numbers scaled by total ETF assets. Averages are constructed using institutional assets as weights, and the (high – none) difference in Panel A represents a *t*-test with unequal variances where ***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

### Panel A: ETF Allocation by Institutional Advisors

| | **Total 13F Assets ($m)** | | | **Allocation to ETFs (relative to 13F AUM)** | | | **Allocation to ETFs (relative to ADV AUM)** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Exposure to HNW Individual Accounts: | | | Exposure to HNW Individual Accounts: | | | Exposure to HNW Individual Accounts: | | | |
| Year | *None* | *Low* | *High* | *None* | *Low* | *High* | *None* | *Low* | *High* | *High – None* |
| 2000 | $3,437 | $32,466 | $102,841 | 0.00% | 0.02% | 0.09% | 0.00% | 0.02% | 0.02% | *0.02%* |
| 2001 | $1,097,358 | $615,241 | $502,569 | 0.09% | 0.26% | 0.22% | 0.05% | 0.18% | 0.11% | *0.06%* ** |
| 2002 | $875,512 | $488,400 | $404,853 | 0.20% | 0.40% | 0.21% | 0.12% | 0.25% | 0.08% | *-0.04%* |
| 2003 | $1,222,940 | $868,698 | $485,193 | 0.13% | 0.51% | 0.32% | 0.07% | 0.34% | 0.21% | *0.14%** |
| 2004 | $1,457,222 | $951,480 | $676,848 | 0.14% | 0.81% | 0.80% | 0.08% | 0.54% | 0.44% | *0.36%**** |
| 2005 | $1,648,191 | $1,332,052 | $640,431 | 0.18% | 1.19% | 0.94% | 0.08% | 0.74% | 0.49% | *0.41%**** |
| 2006 | $1,896,248 | $1,226,210 | $753,864 | 0.17% | 1.44% | 1.47% | 0.08% | 0.93% | 0.81% | *0.73%**** |
| 2007 | $1,409,672 | $1,339,750 | $777,660 | 0.68% | 1.61% | 2.19% | 0.25% | 0.98% | 1.08% | *0.83%**** |
| 2008 | $828,799 | $845,995 | $460,667 | 1.22% | 3.28% | 3.71% | 0.37% | 1.18% | 1.18% | *0.81%**** |
| 2009 | $1,092,737 | $1,020,152 | $622,993 | 1.62% | 3.68% | 3.22% | 0.56% | 1.79% | 1.58% | *1.02%**** |
| 2010 | $1,272,242 | $1,001,092 | $807,321 | 2.61% | 4.08% | 3.42% | 1.11% | 2.14% | 1.74% | *0.63%** |
| 2011 | $1,086,307 | $921,973 | $829,502 | 3.42% | 4.52% | 5.03% | 1.40% | 2.10% | 2.03% | *0.63%** |
| 2012 | $1,210,147 | $1,608,382 | $391,751 | 4.33% | 3.99% | 14.52% | 1.87% | 1.90% | 6.94% | *5.07%**** |
| 2013 | $1,677,017 | $2,113,444 | $501,785 | 5.48% | 3.61% | 16.87% | 2.69% | 1.90% | 8.67% | *5.98%**** |
| 2014 | $1,821,796 | $2,237,770 | $629,039 | 6.03% | 4.41% | 20.00% | 2.86% | 2.13% | 11.08% | *8.22%**** |
| 2015 | $1,761,030 | $2,117,604 | $674,582 | 6.23% | 5.62% | 26.83% | 2.96% | 2.57% | 15.06% | *12.10%**** |
| 2016 | $1,879,681 | $2,190,739 | $714,990 | 6.25% | 7.76% | 26.38% | 3.16% | 3.99% | 15.51% | *12.35%**** |
| 2017 | $2,525,969 | $2,257,215 | $944,237 | 9.25% | 8.32% | 32.43% | 5.81% | 4.87% | 21.31% | *15.50%**** |



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**Panel B: Aggregate Institutional Ownership of ETFs**

| | | ETF Holdings by Institutions as % of Total ETF Assets | | | | |
|---|---|---|---|---|---|---|
| | | All Institutions | Investment Advisors | Advisors with High-Net-Worth Individual Accounts | | |
| Year | # of ETFs | | | *None* | *Low* | *High* |
| 2000 | 96 | 30.90% | 10.88% | 0.00% | 0.01% | 0.14% |
| 2001 | 121 | 35.44% | 10.17% | 1.02% | 1.94% | 1.17% |
| 2002 | 131 | 30.97% | 10.70% | 1.60% | 1.97% | 0.81% |
| 2003 | 158 | 40.89% | 8.98% | 0.99% | 2.81% | 1.00% |
| 2004 | 178 | 44.79% | 12.97% | 0.88% | 3.37% | 2.32% |
| 2005 | 231 | 48.58% | 13.00% | 0.98% | 5.13% | 1.96% |
| 2006 | 426 | 52.34% | 14.84% | 0.77% | 4.13% | 2.63% |
| 2007 | 637 | 52.57% | 13.33% | 1.58% | 3.55% | 2.80% |
| 2008 | 803 | 59.96% | 17.27% | 1.98% | 5.64% | 3.28% |
| 2009 | 889 | 49.85% | 17.85% | 2.32% | 4.92% | 2.73% |
| 2010 | 1,010 | 52.87% | 19.66% | 4.43% | 4.21% | 2.79% |
| 2011 | 1,164 | 53.29% | 19.18% | 3.57% | 3.98% | 4.04% |
| 2012 | 1,281 | 53.41% | 20.00% | 3.97% | 4.77% | 4.26% |
| 2013 | 1,353 | 56.70% | 22.38% | 5.44% | 4.53% | 5.06% |
| 2014 | 1,487 | 58.43% | 24.72% | 5.65% | 4.95% | 6.37% |
| 2015 | 1,676 | 59.26% | 27.40% | 5.29% | 5.63% | 8.57% |
| 2016 | 1,812 | 58.88% | 27.49% | 4.68% | 6.71% | 7.49% |
| 2017 | 1,981 | 59.47% | 30.09% | 6.86% | 5.51% | 9.00% |
| Average | | 56.17% | 23.51% | 4.65% | 5.10% | 5.98% |



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## Table IX: Quasi-Natural Experiment using 2013 Tax Law Changes

The table reports the AUM and Flows of investment advisors that advise various levels of high-net-worth clients. ETF ownership by investment advisors is determined using 13F holdings data from Thomson-Reuters Global Ownership Database (OP), while the exposure to high-net-worth clients (HNW) is based on data reported on Form ADV. Advisors are determined to have high exposure to high-net-worth individuals if more than 25% of their AUM comes from high-net-worth clients (if assets are unavailable, the determination is made using a client count). We use total 13F assets of institutions to scale ETF allocations, as well as the overall institution assets reported on form ADV. Panel A reports the increase in allocations to ETFs by different advisors with tax-sensitive clients using various fixed effects. Panel B focuses on the sensitivity of mutual fund outflows to tax burden before and after the 2013 tax law change to increase capital gains taxes. Standard errors are clustered by fund (institution) and date in Panel A (Panel B). ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

### Panel A: Change in ETF Allocation by Institutional Advisors with Tax-Sensitive Investors due Capital Gains Tax Increase

| | ETF, % of *13F* AUM | ETF, % of *ADV* AUM | *ETF Flows, Quarter, %* | ETF, % of *13F* AUM | ETF, % of *ADV* AUM | ETF, % of *13F* AUM | ETF, % of *ADV* AUM | ETF, % of *13F* AUM | ETF, % of *ADV* AUM | *ETF Flows, Quarter, %* |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| With HNW Clients Dummy | 0.092*** | 0.042*** | 0.014*** | 0.042*** | 0.017*** | -0.007 | -0.008 | | | |
| | (5.85) | (5.57) | (3.89) | (3.80) | (3.25) | (-0.84) | (-1.46) | | | |
| x Year >= 2012 | | | | 0.097*** | 0.048*** | 0.015* | 0.012** | | | |
| | | | | (5.96) | (5.22) | (1.89) | (2.37) | | | |
| HNW >=75% of AUM Dummy | | | | | | | | -0.006 | -0.004 | -0.005 |
| | | | | | | | | (-1.14) | (-1.42) | (-1.23) |
| x Year >= 2012 | | | | | | | | 0.012* | 0.011*** | 0.011** |
| | | | | | | | | (1.85) | (3.03) | (2.25) |
| log (13F AUM) | -0.021*** | | | -0.021*** | | -0.002 | | -0.002 | | |
| | (-6.71) | | | (-6.74) | | (-0.84) | | (-0.83) | | |
| log (ADV AUM) | | -0.013*** | 0.001 | | -0.013*** | | -0.009*** | | -0.009*** | -0.002 |
| | | (-4.96) | (1.29) | | (-4.92) | | (-4.07) | | (-4.05) | (-0.96) |
| Fixed Effects | | Date | | Date | | Institution & Date | | Institution & Date | | |
| Observations | 23,491 | 23,642 | 20,307 | 23,491 | 23,642 | 23,048 | 23,218 | 23,048 | 23,218 | 19,944 |
| R-squared | 0.145 | 0.130 | 0.015 | 0.150 | 0.133 | 0.911 | 0.875 | 0.911 | 0.875 | 0.250 |



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**Panel B: Change in Tax-Sensitivity of Mutual Fund Outflows due to Capital Gains Tax Increase**

| | Outflows, (%) | | Outflows, FYE to End of Year (%) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Annual Excess Return (*stdd*) | -0.015*** | -0.015*** | -0.002*** | -0.002** |
| | (-7.84) | (-7.81) | (-2.83) | (-2.74) |
| Fee Gap (*stdd*) | 0.006*** | 0.006** | -0.003** | -0.002 |
| | (3.22) | (2.39) | (-2.53) | (-1.50) |
| x Year >= 2012 Dummy | | -0.000 | | -0.003 |
| | | (-0.14) | | (-1.49) |
| Tax Burden Gap (*stdd*) | 0.019*** | 0.013** | 0.010*** | 0.008*** |
| | (4.61) | (2.74) | (5.90) | (3.79) |
| x Year >= 2012 Dummy | | 0.017*** | | 0.005** |
| | | (3.53) | | (2.18) |
| Log TNA | -0.003*** | -0.004*** | 0.001 | 0.001 |
| | (-3.15) | (-3.26) | (0.85) | (0.82) |
| Style Flows | -0.111*** | -0.105*** | -0.047*** | -0.045*** |
| | (-3.12) | (-2.96) | (-3.04) | (-2.85) |
| Return Volatility | 1.576*** | 1.599*** | 0.354** | 0.353** |
| | (4.75) | (4.81) | (2.47) | (2.44) |
| Retail Dummy | 0.012*** | 0.012*** | 0.011*** | 0.011*** |
| | (3.63) | (3.68) | (5.71) | (5.69) |
| Log Age | -0.016*** | -0.016*** | -0.005** | -0.005** |
| | (-4.42) | (-4.38) | (-2.72) | (-2.62) |
| Observations | 919,284 | 919,284 | 62,511 | 62,511 |
| R-squared | 0.113 | 0.114 | 0.067 | 0.068 |



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# The Role of Taxes in the Rise of ETFs

# Internet Appendix

The Internet Appendix includes additional Figures and Tables along with analyses and results that are referenced in the main text.

## *A. Sample Construction*

To identify U.S. equity funds, we rely on classification variables included in the CRSP Mutual Fund database. Mainly, we require the first two text characters to be 'ED' in the *crsp_obj_cd* column. We also exclude short and hedge ETFs from this list (objective codes 'EDYS' and 'EDYH', as well as ETFs that do not have U.S. equity holdings (that hold commodities, swaps, and other instruments). ETFs that invest in derivatives (instead of physical securities) are not likely to engage in in-kind redemptions which are essential to take advantage of the capital gains distribution exemption under Section 852(b)(6) of the Internal Revenue Code.

CRSP Objective Codes (*CRSP_OBJ_CD*), which are based on Lipper Objective codes, are self-reported and assigned "based on the language that the fund uses in its prospectus to describe how it intends to invest." However, they can be misleading to use when classifying funds by style. For this purpose, we find Lipper Class codes to be more reliable, because they are assigned by Lipper after running the actual holdings of the fund through their internal classification model.[51]

The total number of U.S. equity funds (portfolios and share classes) are shown over time in Figure A.I. Most recently, CRSP reports over 3,750 actively-managed mutual funds, more than 600 index funds, and nearly 1,200 ETFs. Table A.I shows the number of funds that are included in our sample over time, before and after merging with Form N-SAR data, which is described in the next section.

[51] For example, the SPDR S&P 500 Value ETF (SPYV) is classified by CRSP Objective Code as a U.S. Equity Growth fund (EDYG) and similarly by Lipper Objective Code as a Growth (G) fund. Lipper Class (or Classification) code, on the hand, more accurately classifies SPYV as a Large-Cap Value Fund (LCVE) based on its holdings. These classification mismatches are pervasive in the data as there are more than 100,000 quarterly observations in CRSP's FUND_SUMMARY2 dataset with funds having "VALUE" in their names or Lipper Class codes, while being classified as growth funds by Lipper or CRSP.



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*B. N-SAR Data*

Our data on funds' realized capital gains and distributions, as well as monthly inflows and outflows, are extracted from the SEC's N-SAR filings. Form N-SAR is short for "Form N, Semi-Annual Report". During each fiscal year, a registered investment company must file the Form N-SAR twice. Form N-SARA covers a fund's operations for the first six months of its fiscal year, while form N-SARB covers the entire fiscal year. These filings are available electronically at the SEC's EDGAR database. SEC's recent Investment Company Reporting Modernization Rules[52] mandated that Form N-CEN would replace Form N-SAR effective on June 1, 2018. Therefore, our sample period ends at the end of 2017.

Each N-SAR filing is at the registrant level identified by a Central Identification Key (CIK). A registrant usually is not a registered investment company (a fund) but represents a group of funds that belong to the same fund family. In each N-SAR filing, a registrant can report up to 99 funds due to organizational limitations of the form.[53] Item 7C in the N-SAR form reports the list of funds and assigns each fund a series ID that could be used to identify the same fund in past and future filings.[54] We use this series ID to build a historical record for each reported fund.

From the N-SAR filings, we collect funds' realized capital gains and distributions during each fiscal year. Realized capital gains (item 72AA) and realized capital losses (item 72BB) are reported as an aggregate dollar amount, while distributions are reported as both aggregated dollar amounts (item 72EE) and per-share amount (item 73B). We compute net realized capital gains as the difference between realized gains and losses. A fund could report non-zero net realized capital gains but zero distributions. Possible explanations would be that the fund had loss carryovers that offset the realized capital gains, or the fund realized the gains through redemption-in-kind that were reclassified as paid-in capital (Agarwal, Ren, Shen, & Zhao (2020)).

N-SAR filings are not the only data source on funds' distributions. In the CRSP mutual fund database, the *Fund_Summary* and *Dividends* datasets supply data on capital gains distributions on

[52] https://www.sec.gov/divisions/investment/guidance/secg-investment-company-reporting-modernization-rules.htm

[53] For example, ProShares Trust (CIK 1174610), which exceeded the 99-fund limit, listed sixty additional funds in an addendum to its N-SAR filings. https://www.sec.gov/Archives/edgar/data/1174610/000117152018000350/ex99-77q1_7c.htm. No data was reported for these additional funds exceeding the 99-fund limit in ProShares N-SAR filings.

[54] Because management companies are instructed not to reuse fund series identifiers, often data on fewer than 99 funds can be obtained from each form N-SAR.



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per-share basis and various other types of distributions as well. The data on realized and unrealized capital gains is mostly missing in CRSP, and for this reason we rely primarily on the N-SAR data to collect the total realized and unrealized capital gains/losses at the end of each fiscal year, which are important to understand the effectiveness of heartbeat trades in washing away realized capital gains.[55]

We also use N-SAR data to construct accurate monthly flow measures for mutual funds and ETFs. Net Flows are first constructed from CRSP following Carhart (1997) by inferring monthly flows from total net assets and monthly returns. For more accurate inflow and outflow information, we rely on the monthly new sales (inflows) and redemptions (repurchases or outflows) information in item 28 on Form N-SAR filings, which we supplement using the N-SAR-based data in CRSP on monthly fund redemptions and new subscriptions. Various flow variables are measured over one year and scaled by total net assets at the beginning of the year.[56]

### *C. Comparison of N-SAR and CRSP Coverages*

To link the funds reported in N-SAR filings to the CRSP fund samples, we take the following steps. First, we use ticker symbols. Starting from 2006, the SEC requires each fund to report its ticker symbol if available and assigns a unique series ID to each fund. If a fund's ticker symbol is not available, we use its series ID to map with the CRSP fund samples.[57] If neither is available, we resort to name matching.

In Table A.I Panel A, we report the number of funds in our sample that we are able to link to their N-SAR filings. Coverage improved substantially after 1995, and in recent years there is more than 70% match rate for ETFs and more than 65% for mutual funds.[58] Table A.I Panel B presents

[55] We compare distributions data from N-SAR filings with the CRSP Dividends dataset. Our results show that 63% of the realized capital gains distributions are identical between N-SAR data and the CRSP *Dividends* data table. 25% of the realized capital gains distributions are within a difference of 5 cents per share between the two data sources.

[56] Net flows variable is theoretically equal to new sales minus redemptions plus other flows due to reinvestment of dividends and distributions. The N-SAR's redemptions and new sales information is reported at the portfolio level, and both variables are scaled with the total portfolio assets at the beginning of the period, then matched to individual share classes of ETFs and mutual funds.

[57] The *crsp_cik_map* table maps the series ID in N-SAR filings with the *crsp_fundno* column in the CRSP mutual fund database for mutual funds that are currently active.

[58] For example, at the end of 2017, there are 717 out of 1,029 ETFs linked with N-SAR filings, while 7,359 out of 13,884 active mutual fund share classes are linked with N-SAR filings. At the end of 2017, 807 out of 1,007 index fund share classes find matches in N-SAR filings, corresponding to 3,116 portfolios out of which there 317 index fund portfolios



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the total assets of the funds in our matched sample along with the breakdown of matched mutual fund portfolios into index and active mutual funds, showing a match rate for index funds of about 80%.[59] Table A.I Panel B also reports the growth of total assets under management (AUMs) for our samples of U.S. Equity ETFs, index funds and active mutual funds. ETFs show a significant growth trajectory since 1996 from having just $1 billion in AUM to close to $1.8 trillion at the end of 2017. Index funds also exhibit a fast growth trend since 1996 from $63 billion in AUM to $2,186 billion at the end of 2017. Compared to ETFs and index funds, the growth of active mutual funds is more subdued. Combined, the active mutual funds in our sample grew from $1.1 trillion in AUM at the end of 1996 to $4.1 trillion at the end of 2017. The Wall Street Journal reported that passive investment vehicles surpassed their active rivals in terms of AUM in September 2019 for the first time in history.[60]

Although the funds that are reported on N-SAR forms are only a subset of the CRSP mutual fund database, we are confident that the N-SAR data is of high quality. In Table A.II, we show that the combined short-term and long-term capital gains distribution yields from CRSP closely match with the total capital gains distribution yields from the N-SAR filings, for all types of funds. For example, capital gains distributions for ETFs from Form N-SAR are on average 0.07%, while CRSP reports 0.10% (0.07% ST + 0.03% LT). For active (index) mutual funds, N-SAR data shows an average capital gains distribution yield of 3.44% (1.76%) during our sample, compared to 3.19% (1.80%) based on data from CRSP. This reassures us of our inferences based on the realized capital gains figures from N-SAR, which are not available in CRSP.

### *D. Time Series Patterns*

Figure A.II illustrates the declining patterns in average expense ratios for U.S. mutual funds. Index mutual funds currently have lower expense ratios than ETFs, likely due to the rise of more 'active' ETF styles (e.g., smart beta and thematic funds). Panel B of Figure A.II displays turnover

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and 2,122 active mutual fund portfolios. AUM-weighted match rate average is much higher and exceeds 90% in recent years.

[59] Capital gains data is also collected from N-SAR-U filings for ETFs organized as Unit Investment Trusts report. E.g. SPY https://www.sec.gov/cgi-bin/browse-edgar?action=getcompany&CIK=0000884394&type=NSAR-U and QQQ https://www.sec.gov/cgi-bin/browse-edgar?action=getcompany&CIK=0001067839&type=NSAR). Between 1993 and 1998, capital gains data for SPDR ETFs is collected from form N-30D, for Annual and Semi-Annual reports mailed to shareholders of investment companies.

[60] See for more illustration: https://www.wsj.com/articles/index-funds-are-the-new-kings-of-wall-street-11568799004.



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ratios by fund type, which are lowest for index mutual funds and ETFs and have declined over time, especially for active mutual funds.

Figure A.III illustrates the unrealized capital gains yield and dividend yield by fund type. Unrealized capital gains yields are shown to be comparable across fund type, with funds experiencing increased levels during bull market periods. Dividend yields are highest for ETFs during most years. Most recently, ETFs experienced dividend yields of 1.5% while active mutual funds saw dividend yields of 0.8%, relative to assets under management.

### *E. Heartbeat Trades*

Heartbeat trades are synthetic redemption requests characterized by a large inflow followed by a large outflow several days later. These heartbeat trades typically occur on reconstitution and rebalancing days but could be more frequent for ETFs with higher turnover strategies (e.g. smart-beta ETFs, active ETFs, etc.). The conditions that we use to identify heartbeat trades are described in Section III.B of the main paper.

In Figure A.IV, we highlight heartbeat trades as identified for three fund examples. In Panel A, we plot shares outstanding, in levels and percentage changes, over time, for the Vanguard Small-Cap Growth Index ETF (VBK), which is a share-class of a greater fund portfolio consisting of four other mutual fund share classes. As we discussed earlier, the chart with percentage changes of shares outstanding provides a clearer visualization for the heartbeat trades which resemble an ECG graph, hence the name. The fund utilizes heartbeat trades at regular frequencies that likely correspond with rebalance dates. In Panel B, we show the evolution of shares outstanding for the iShares MSCI USA Momentum Factor ETF (MTUM), a smart-beta fund that is likely to realize sizable short-term capital gains in addition to long-term gains. The fund has a shorter history but makes use of heartbeat trades up to two times per year. Finally, Panel C shows the fund flows for the First Trust Large Cap Value AlphaDEX Fund (FTA). This example highlights the substitution effect between ETF ordinary outflows and synthetic heartbeat trade flows. Namely, during years where the fund experienced outflows, it did not make use of heartbeat trades to avoid distribution of realized capital gains.

### *F. The Effects of Vanguard's Fund Structure on Tax Burden*

In Table A.III, we take a closer look at Vanguard's index mutual funds and find that they have near-zero capital gains distributions. Their patented share class structure allows Vanguard to



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use its ETF share class to wash away all realized capital gains for the entire fund portfolio, thereby allowing its index funds to benefit from the in-kind redemption exemption that the ETF share class optimally takes advantage of. Consequently, Vanguard index funds have tax burdens that are much below those of other index funds and instead are similar to those of ETFs, while other index funds have a much higher tax burden exceeding 1% per year.

### *G. The Effects of Fund Return Volatility on Tax Burden*

Table A.IV reports capital gains distributions, realized capital gains yields, and tax burdens by fund style for two subsamples of funds with relatively high and low volatility, respectively, using the median active mutual fund's volatility in a given year as the cutoff value. As expected, the realized capital gains yields are highest for more volatile funds. However, on average, more volatile ETFs have a lower tax burden than less volatile ETFs. As a result, the tax burden differential between active mutual funds and ETFs is largest for funds with higher volatility.

### *H. Sensitivity Horse Race using Annual Flows*

The baseline results of the determinants of active mutual fund flows using various robustness specifications are shown in Table A.V, where flows are constructed using a rolling 12-month window.

In Panel A, we use panel regressions in specifications (1) to (8) and Fama-MacBeth regressions with a Newey-West correction in specifications (9) to (12). Specifications (1) to (4) use rolling monthly observations with clustering of standard errors by fund and date, while specifications (5) to (8) use only annual data observed in December, with the same clustering. First, we use piecewise linear regressions based on funds' relative performance rank within its investment style following Sirri & Tufano (1998) to account for the flow-performance relationship. We then introduce reduced form specifications with performance quintile dummies, performance rank, and a continuous performance variable. In all specifications, we compute the expense ratio and tax burden variables as the difference between the fund level and the investment style average including ETFs (*fee gap* and *tax burden gap* variables, respectively). We control for fund size and age to account for returns to scale effects, style flows, return volatility, and different intercepts for each style and date. A retail dummy is included to capture differences across share classes, where tax-advantaged retirement accounts often have access to institutional share classes.



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The results show that performance, fees, and tax burden are all significant determinants of active mutual fund flows, and their economic and statistical significance is comparable and consistent across various specifications. We observe the non-linear flow-performance relationship documented in the literature, where funds in the highest performance quintile experience relatively higher net flows than similar-sized performance differences among the lowest performing funds. Examining the coefficients on the fee gap and tax burden gap variables, we observe that both variables are negatively and significantly related to fund flows. There is also evidence of a decreasing returns to scale effect, and younger funds tend to have higher inflows. The results are robust across different specifications and estimation methods.

In Panel B, we standardize the performance, fees, and tax burden variables to better understand their relative economic importance on fund flows. Additionally, we focus on the annual outflows of active mutual funds, measured using monthly outflows data from Form N-SAR. We expect that tax-sensitive investors are more inclined to withdraw their investments when a fund experiences a higher tax burden. In specification (1), we find that a one standard deviation increase in the tax burden gap (fee gap) is associated with a 5.7% (5.0%) decrease in overall annual fund flows. When looking at investors' outflows separately, we see that a one standard deviation increase in the tax burden gap (fee gap) increases outflows by 1.9% (0.6%). A one standard deviation decrease in performance is attributed to a 1.5% increase in outflows. Tax considerations seem to be stronger than performance and three times more powerful than fees in driving active mutual fund outflows.

In various specifications, tax burden appears to be the strongest determinant of mutual fund outflows suggesting that tax-sensitive investors played a significant role in the substantial outflows from active mutual funds during the sample period. We interpret this evidence as an indication on the importance of tax considerations for the bulk of mutual fund outflows during our sample period. This also suggests potential strategic complementarities (Chen, Goldstein, & Jiang (2010)) due to the negative externalities of outflows. Outflows are triggering early realization of capital gains that lead to future outflows. So, tax-sensitive investors might be better-off leaving the fund as soon as they observe any indications of higher realized capital gains.

To better understand the impact of tax burden on outflows, we decompose tax burden into its various components and include realized capital gains and unrealized cap gains yields. From specifications (3) and (4), we learn that the (standardized) realized capital gains yield is the strongest



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driver for fund outflows compared with other components of tax burden, with a coefficient of 5.1%. We also find that retail share classes, which are more likely to be used by tax-sensitive investors, are associated with higher fund outflows. Looking at the subsample of retail funds in particular, as in specifications (5) and (6), there is no relationship between fees and outflows, while the relationship between tax burden and outflows remains strong, again driven by the realized capital gains yield. The results confirm the role of tax-sensitive investors in explaining outflows from active mutual funds over the last two decades.

The remaining specifications indicate that for funds that experience significant outflows (specification 8) or have above median tax burden (specification 10), there is a stronger positive relationship between the fund's tax burden gap and the magnitude of the fund outflows, relative to funds with less significant outflows and lower tax burden. The economic significance of the relationship between fees and outflows is also much weaker when the tax burden influence is stronger.

### *I. ETF Flows by Advisors with High-Net-Worth Clients*

In this section, we document the trends in ETF flows across different types of institutions and advisors with varying levels of high-net-worth clients We provide evidence that flows by investment advisors with a tax-sensitive client base are relatively larger during years when active mutual funds experience higher realized capital gains. Table A.VI shows that ETF flows were the highest in the earliest years of the sample, when the ETF industry was still relatively small. On average, ETF flows have grown 15% per year during the sample period. Twelve percentage points of this growth in flows are driven by demand from institutions, half of which are from investment advisors (6%), while retail investors likely account for the remaining 3% of flow growth each year. Overall, we find that 1.85% of the growth comes from advisors that manage the most assets for tax-sensitive clients during the entire sample period, despite that the total assets managed by this group is the lowest. This is followed by advisors with some exposure to high-net-worth individuals at 1.55%. Investment advisors that do not have high-net-worth clients add 1% to the ETF asset base on average each year.



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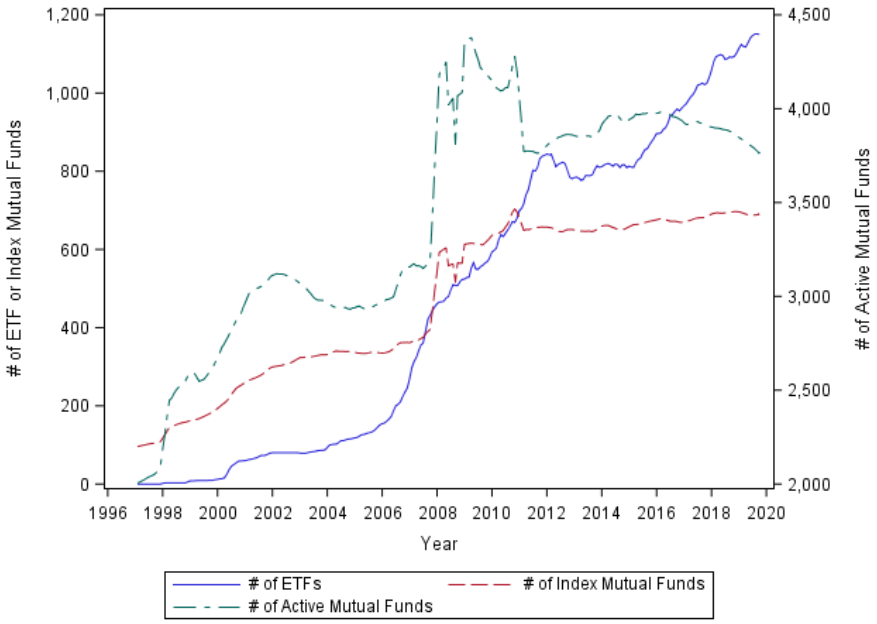
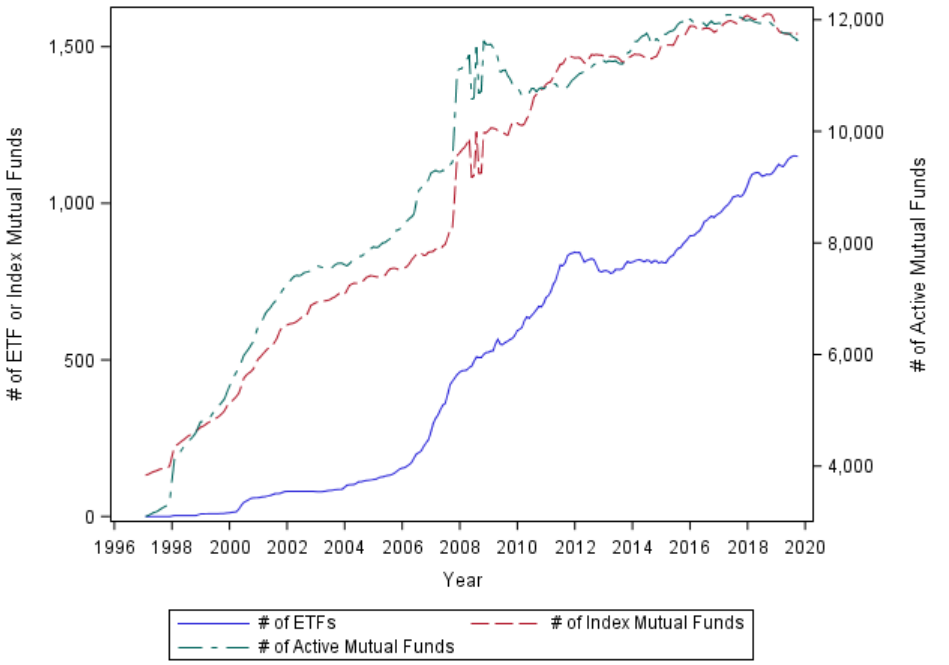
## Figure A.I: Growth of Equity ETFs and Mutual Funds – Flows, Assets, and Number of Funds

Panel A illustrates the growth in the number of portfolios of ETFs, Index Mutual Funds, and Active Mutual Funds during our sample period using the CRSP Mutual Fund Database. Panel B represents the growth in the number of fund share classes (CRSP_FUNDNO) as a robustness for the first chart. CRSP portfolio identifiers, CRSP_PORTNO and CRSP_CL_GRP, exhibit changes and inconsistencies in the period between 2008 to 2010 due to CRSP's transition to different data providers.

**Panel A: Number of U.S. Equity Fund Portfolios (CRSP Universe)**




**Panel B: Number of U.S. Equity Fund Share Classes (CRSP Universe)**



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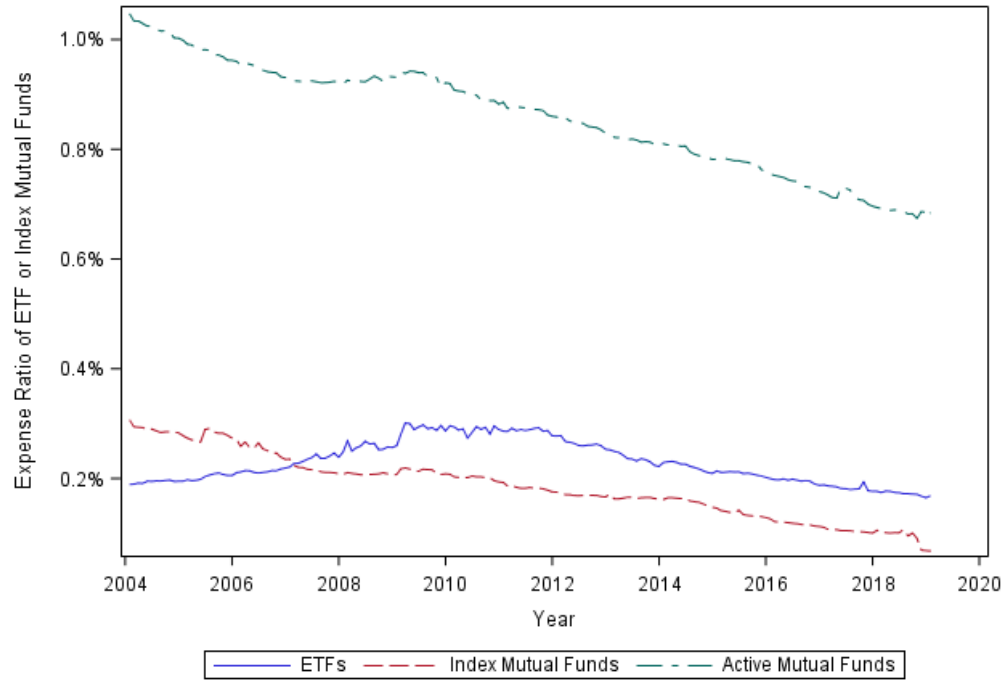
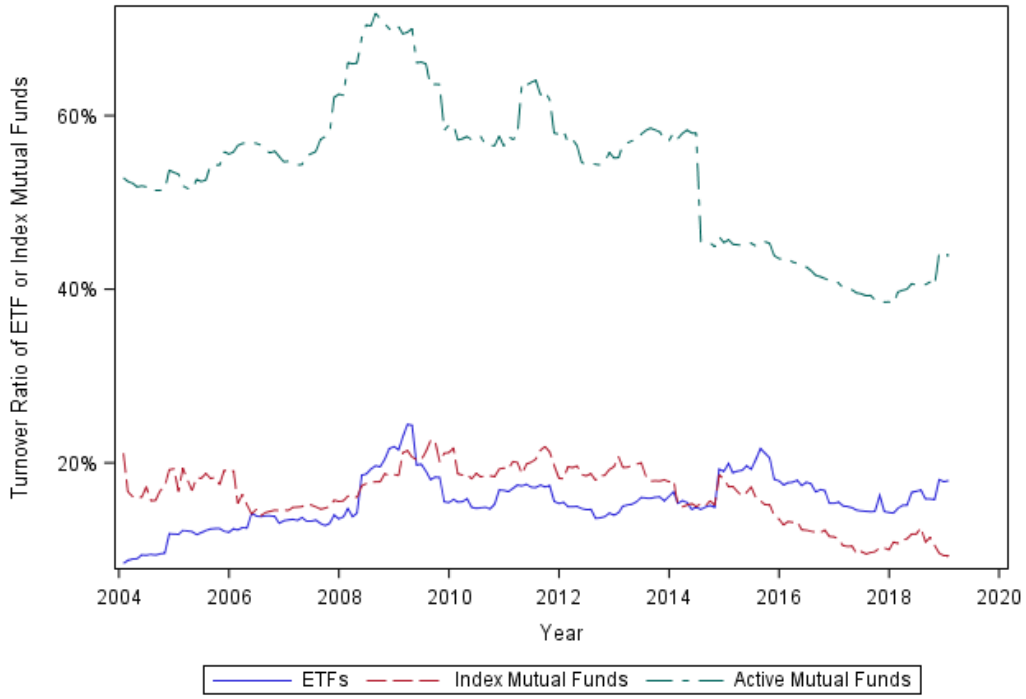
## Figure A.II: Average Expense and Turnover Ratios for Equity ETFs and Mutual Funds

The figures in Panels A and B illustrate the average expense ratios and turnover ratios of ETFs, Index Mutual Funds, and Active Mutual Funds during our sample period. Data is obtained from CRSP.

**Panel A: Expense Ratios of Equity Funds (CRSP Universe), weighted by AUM**




**Panel B: Annual Turnover Ratios of Equity Funds (CRSP Universe), weighted by AUM**



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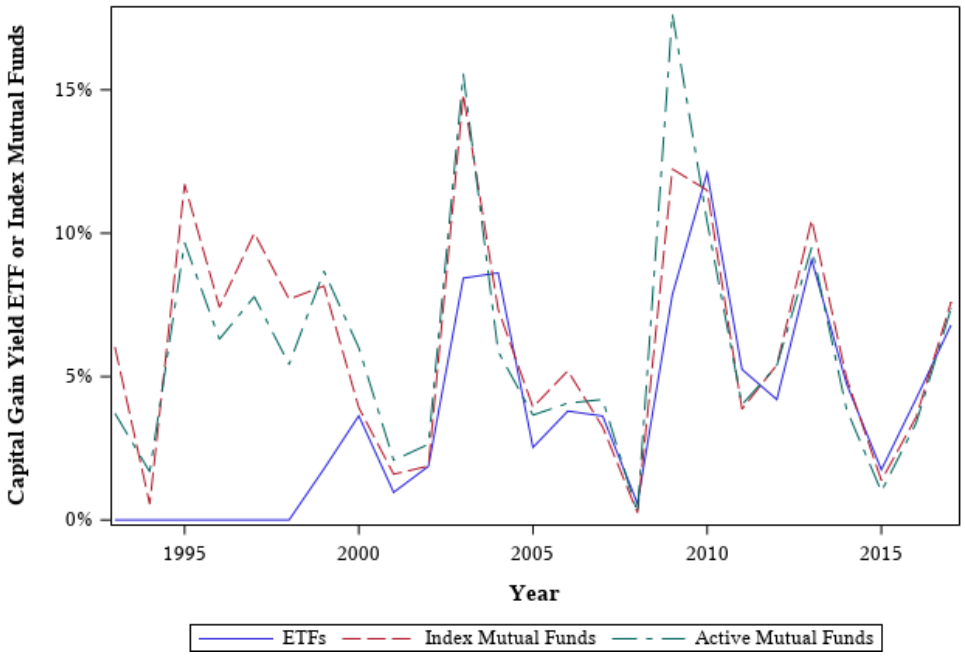
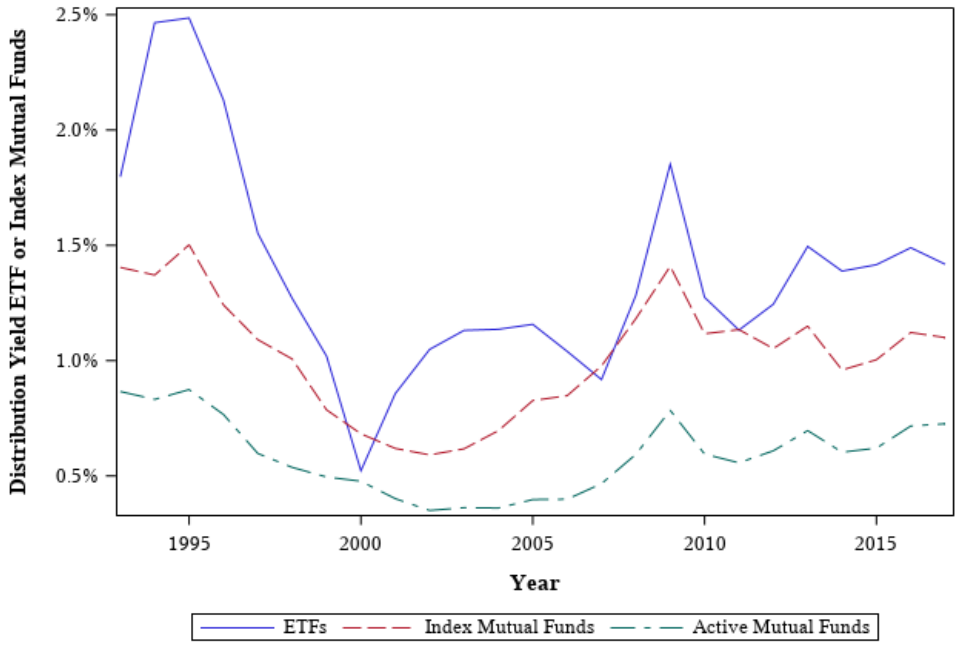
## Figure A.III: Unrealized Capital Gains and Dividend Yields

Panel A illustrates the unrealized capital gains yields (relative to AUM) for ETFs, Index Mutual Funds, and Active Mutual Funds as collected from the N-SAR data. Panel B represents the dividend distribution yield by each type of fund.

### Panel A: Unrealized Capital Gains Yields of ETFs and Mutual Funds




### Panel B: Dividends Yields of ETFs and Mutual Funds



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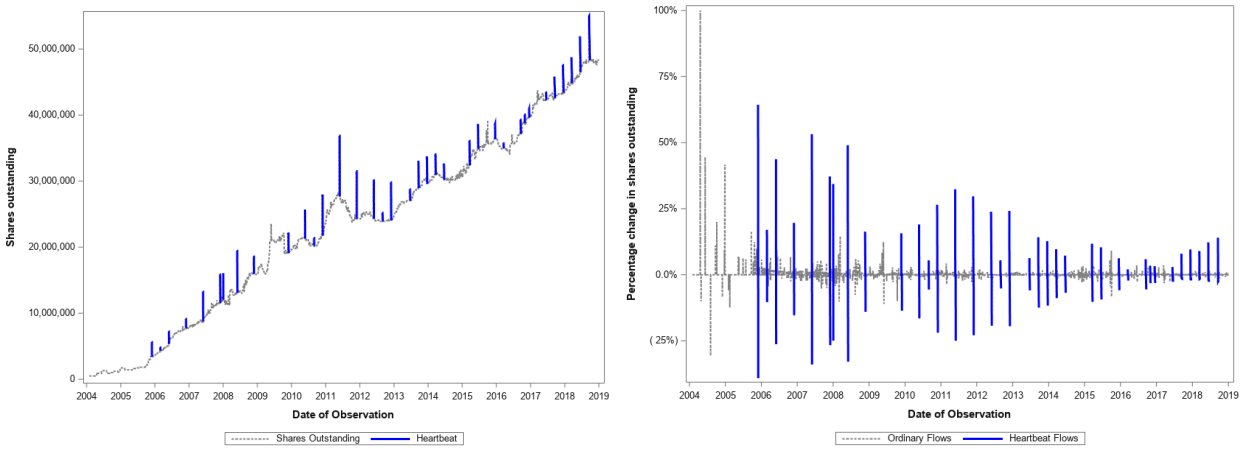
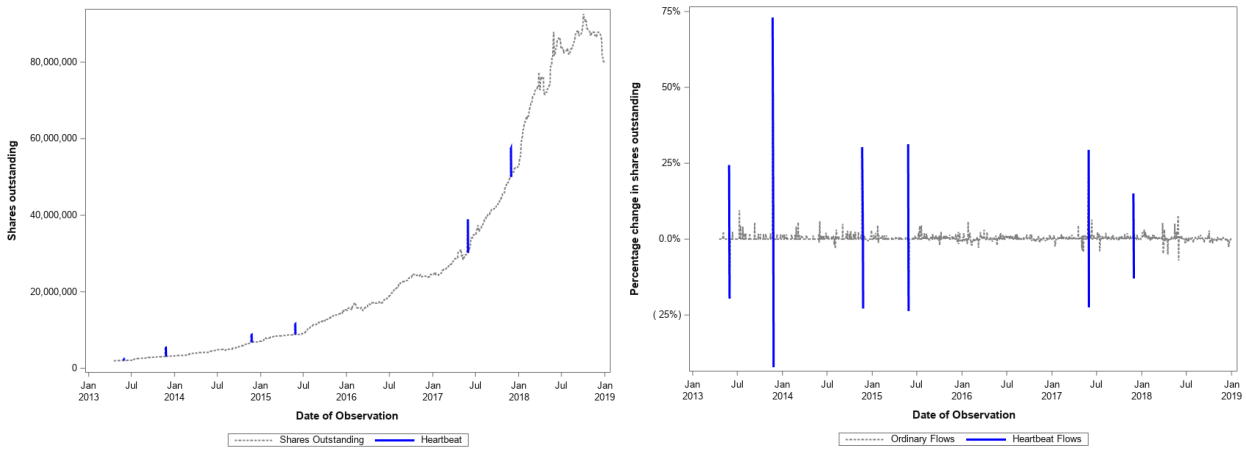
## Figure A.IV: Heartbeat Trade Examples

The figure shows three examples from the data of funds that make use of heartbeat trades. Blue markings indicate heartbeat trades as identified by the method described in Section III.B.

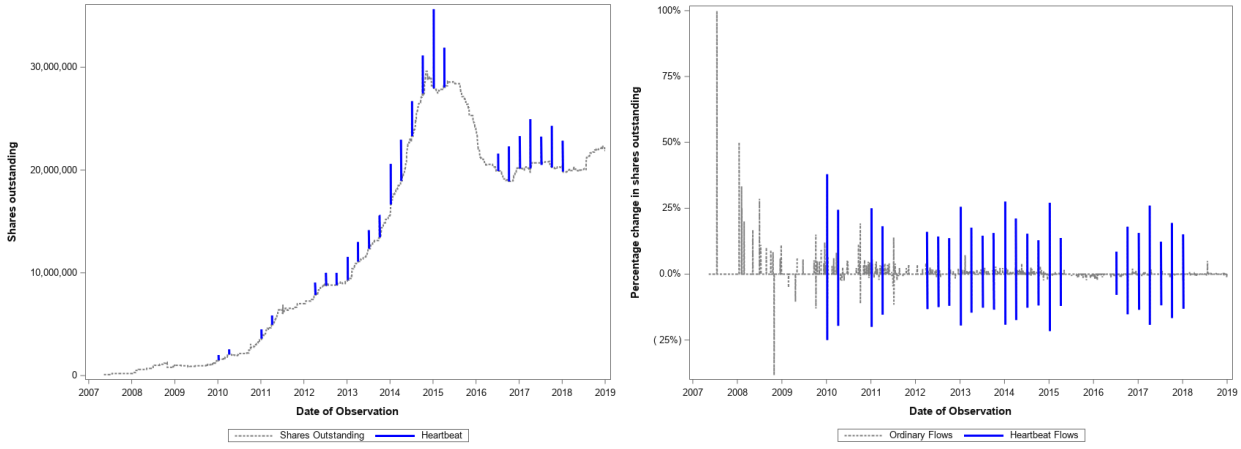
### Panel A: Vanguard Small-Cap Growth Index ETF (VBK)




### Panel B: iShares MSCI USA Momentum Factor ETF (MTUM)




### Panel C: First Trust Large Cap Value AlphaDEX Fund (FTA)



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## Table A.I: Sample Time Series Statistics

The table presents our sample coverage. Panel A compares the overall sample of U.S. equity mutual funds from CRSP with funds that file form N-SAR with the SEC, supplemented by ETF capital gains data collected from N-SAR-U and prospectuses for a few ETFs organized as Unit Investment Trusts (e.g. SPY and QQQ). Mutual funds often have multiple share classes per fund portfolio. We classify fund share classes into three groups: ETFs, index mutual funds, and active mutual funds. Panel B reports more details such as the number of portfolios and assets under management by fund type in our merged sample.

### Panel A: Coverage of N-SAR data

| | Overall Sample | | | | | with N-SAR Data | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **# of Fund Share Classes** | *# of ETFs* | *# of Index Mutual Funds* | *# of Active Mutual Funds* | **# of Fund Portfolios** | **# of Fund Share Classes** | *# of ETFs* | *# of Index Mutual Funds* | *# of Active Mutual Funds* | **# of Fund Portfolios** |
| 1993 | 1,834 | 1 | 58 | 1,776 | 1,438 | 433 | 1 | 22 | 410 | 239 |
| 1994 | 2,450 | 1 | 68 | 2,382 | 1,694 | 1,404 | 1 | 57 | 1,346 | 765 |
| 1995 | 2,643 | 1 | 73 | 2,570 | 1,759 | 2,326 | 1 | 91 | 2,234 | 1,163 |
| 1996 | 3,021 | 1 | 90 | 2,931 | 1,872 | 2,898 | 1 | 124 | 2,773 | 1,379 |
| 1997 | 3,854 | 1 | 125 | 3,729 | 2,242 | 3,669 | 1 | 173 | 3,495 | 1,653 |
| 1998 | 5,363 | 28 | 180 | 5,155 | 2,805 | 4,549 | 2 | 250 | 4,297 | 1,986 |
| 1999 | 6,152 | 31 | 254 | 5,867 | 2,883 | 5,354 | 10 | 325 | 5,019 | 2,284 |
| 2000 | 7,465 | 88 | 348 | 7,029 | 3,202 | 6,281 | 48 | 468 | 5,765 | 2,609 |
| 2001 | 8,262 | 114 | 405 | 7,743 | 3,278 | 7,244 | 61 | 549 | 6,634 | 2,835 |
| 2002 | 8,777 | 120 | 443 | 8,214 | 3,240 | 8,057 | 68 | 641 | 7,348 | 3,011 |
| 2003 | 9,006 | 129 | 463 | 8,414 | 3,180 | 8,478 | 80 | 683 | 7,715 | 3,064 |
| 2004 | 9,359 | 162 | 481 | 8,716 | 3,183 | 8,860 | 99 | 763 | 7,998 | 3,111 |
| 2005 | 9,760 | 211 | 474 | 9,075 | 3,210 | 9,299 | 145 | 760 | 8,394 | 3,224 |
| 2006 | 10,472 | 315 | 492 | 9,665 | 3,321 | 9,397 | 175 | 773 | 8,449 | 3,298 |
| 2007 | 11,374 | 412 | 545 | 10,417 | 3,526 | 9,708 | 324 | 807 | 8,577 | 3,456 |
| 2008 | 14,119 | 485 | 749 | 12,885 | 4,811 | 9,619 | 368 | 831 | 8,420 | 3,412 |
| 2009 | 13,454 | 526 | 744 | 12,184 | 4,539 | 9,211 | 370 | 819 | 8,022 | 3,226 |
| 2010 | 13,647 | 594 | 780 | 12,273 | 4,547 | 8,825 | 402 | 771 | 7,652 | 3,082 |
| 2011 | 14,133 | 678 | 874 | 12,581 | 4,674 | 8,750 | 493 | 841 | 7,416 | 3,107 |
| 2012 | 14,517 | 683 | 892 | 12,942 | 4,744 | 8,528 | 528 | 824 | 7,176 | 3,031 |
| 2013 | 14,811 | 723 | 892 | 13,196 | 4,794 | 8,492 | 515 | 803 | 7,174 | 2,986 |
| 2014 | 15,257 | 768 | 878 | 13,611 | 4,878 | 8,476 | 532 | 787 | 7,157 | 2,973 |
| 2015 | 16,036 | 877 | 934 | 14,225 | 4,981 | 8,696 | 587 | 789 | 7,320 | 3,076 |
| 2016 | 15,845 | 953 | 951 | 13,941 | 4,851 | 8,912 | 654 | 807 | 7,451 | 3,170 |
| 2017 | 15,920 | 1,029 | 1,007 | 13,884 | 4,793 | 8,883 | 717 | 807 | 7,359 | 3,116 |



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**Panel B: Sample coverage after merging N-SAR data with ETF and Mutual Fund data from CRSP MFDB**

| | # of Fund Portfolios | | | Total Assets, $ billion | | |
|---|---|---|---|---|---|---|
| **Year** | **# of Fund Portfolios** | *# of Index Mutual Funds* | *# of Active Mutual Funds* | *ETFs* | *IMF* | *AMF* |
| 1993 | 239 | 15 | 223 | $0 | $12 | $112 |
| 1994 | 765 | 36 | 729 | $0 | $19 | $442 |
| 1995 | 1,163 | 62 | 1,102 | $1 | $37 | $812 |
| 1996 | 1,379 | 78 | 1,303 | $1 | $63 | $1,063 |
| 1997 | 1,653 | 98 | 1,558 | $4 | $114 | $1,505 |
| 1998 | 1,986 | 136 | 1,854 | $8 | $210 | $1,878 |
| 1999 | 2,284 | 174 | 2,107 | $17 | $318 | $2,399 |
| 2000 | 2,609 | 235 | 2,336 | $35 | $334 | $2,790 |
| 2001 | 2,835 | 260 | 2,526 | $43 | $308 | $2,300 |
| 2002 | 3,011 | 300 | 2,657 | $76 | $271 | $1,932 |
| 2003 | 3,064 | 304 | 2,696 | $95 | $358 | $2,229 |
| 2004 | 3,111 | 324 | 2,709 | $143 | $450 | $2,699 |
| 2005 | 3,224 | 318 | 2,787 | $185 | $508 | $3,069 |
| 2006 | 3,298 | 328 | 2,827 | $238 | $594 | $3,288 |
| 2007 | 3,456 | 344 | 2,821 | $330 | $677 | $3,603 |
| 2008 | 3,412 | 354 | 2,724 | $335 | $496 | $2,535 |
| 2009 | 3,226 | 341 | 2,552 | $311 | $585 | $2,317 |
| 2010 | 3,082 | 323 | 2,392 | $419 | $710 | $2,646 |
| 2011 | 3,107 | 344 | 2,308 | $502 | $767 | $2,761 |
| 2012 | 3,031 | 336 | 2,207 | $618 | $890 | $2,893 |
| 2013 | 2,986 | 326 | 2,185 | $820 | $1,206 | $3,508 |
| 2014 | 2,973 | 311 | 2,170 | $1,055 | $1,459 | $3,882 |
| 2015 | 3,076 | 319 | 2,210 | $1,188 | $1,530 | $3,791 |
| 2016 | 3,170 | 321 | 2,235 | $1,324 | $1,750 | $3,685 |
| 2017 | 3,116 | 317 | 2,122 | $1,752 | $2,186 | $4,126 |



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## Table A.II: Capital Gains Yield Comparison of N-SAR and CRSP Data

The table reports yearly averages regarding capital gains distributions for U.S. equity mutual funds using the merged sample based on information from the CRSP Mutual Fund database that has valid data in N-SAR forms. ETF means Exchange-Traded Fund, IMF represents an Index Mutual Fund, and AMF stands for Active Mutual Fund. The sample ranges between January 1993 and December 2017.

| | | ***Source: CRSP MFDB Database*** | | | | | | ***Form N-SAR Data*** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **# of ETFs** | **ST Cap Gains Dist. Yield** | | | **LT Cap Gains Dist. Yield** | | | **Cap Gains Dist. Yield** | | |
| | | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* |
| 1993 | 1 | 0.00 | 0.24 | 0.71 | 0.00 | 0.55 | 2.17 | 0.00 | 1.03 | 3.63 |
| 1994 | 1 | 0.06 | 0.44 | 0.65 | 0.00 | 0.81 | 2.11 | 0.00 | 1.39 | 3.09 |
| 1995 | 1 | 0.00 | 0.26 | 0.62 | 0.00 | 1.11 | 2.06 | 0.00 | 1.60 | 2.9 |
| 1996 | 1 | 0.00 | 0.68 | 1.15 | 0.00 | 1.81 | 2.58 | 0.00 | 2.40 | 3.94 |
| 1997 | 1 | 0.11 | 0.65 | 1.55 | 0.05 | 1.78 | 3.34 | 0.00 | 2.04 | 5.18 |
| 1998 | 2 | 0.00 | 0.99 | 1.97 | 0.00 | 1.67 | 3.49 | 0.00 | 2.38 | 5.94 |
| 1999 | 10 | 0.09 | 0.59 | 1.02 | 0.13 | 2.39 | 3.78 | 0.00 | 2.20 | 4.23 |
| 2000 | 48 | 0.06 | 0.7 | 1.65 | 0.01 | 1.8 | 4.07 | 0.00 | 2.48 | 5.32 |
| 2001 | 61 | 0.15 | 0.67 | 1.43 | 0.01 | 1.82 | 3.14 | 0.16 | 2.82 | 6.29 |
| 2002 | 68 | 0.18 | 0.06 | 0.22 | 0.01 | 0.59 | 0.7 | 0.03 | 0.68 | 1.01 |
| 2003 | 80 | 0.01 | 0.09 | 0.09 | 0.03 | 0.23 | 0.29 | 0.01 | 0.33 | 0.35 |
| 2004 | 99 | 0.07 | 0.22 | 0.22 | 0.01 | 0.33 | 0.46 | 0.02 | 0.53 | 0.58 |
| 2005 | 145 | 0.05 | 0.29 | 0.44 | 0.04 | 0.85 | 1.51 | 0.05 | 1.06 | 1.72 |
| 2006 | 175 | 0.01 | 0.27 | 0.70 | 0.07 | 1.09 | 2.69 | 0.12 | 1.28 | 3.26 |
| 2007 | 324 | 0.10 | 0.34 | 0.91 | 0.01 | 1.71 | 3.61 | 0.10 | 2.20 | 4.61 |
| 2008 | 368 | 0.21 | 0.48 | 1.22 | 0.01 | 2.39 | 3.93 | 0.26 | 3.63 | 8.12 |
| 2009 | 370 | 0.07 | 0.10 | 0.13 | 0.00 | 1.38 | 0.99 | 0.05 | 1.28 | 1.01 |
| 2010 | 402 | 0.17 | 0.12 | 0.05 | 0.00 | 0.10 | 0.07 | 0.04 | 0.17 | 0.09 |
| 2011 | 493 | 0.10 | 0.18 | 0.13 | 0.01 | 0.41 | 0.4 | 0.12 | 0.55 | 0.44 |
| 2012 | 528 | 0.05 | 0.18 | 0.16 | 0.04 | 0.88 | 1.27 | 0.12 | 1.03 | 1.28 |
| 2013 | 515 | 0.04 | 0.33 | 0.27 | 0.01 | 1.10 | 1.79 | 0.06 | 1.25 | 1.83 |
| 2014 | 532 | 0.07 | 0.90 | 0.84 | 0.04 | 2.12 | 3.84 | 0.11 | 2.81 | 4.51 |
| 2015 | 587 | 0.09 | 0.88 | 0.89 | 0.06 | 3.15 | 5.52 | 0.18 | 4.04 | 6.81 |
| 2016 | 654 | 0.06 | 0.32 | 0.40 | 0.08 | 2.65 | 4.98 | 0.23 | 3.04 | 6.22 |
| 2017 | 717 | 0.06 | 0.26 | 0.29 | 0.03 | 1.96 | 3.18 | 0.09 | 1.71 | 3.53 |
| *Avg.* | *247* | *0.07* | *0.41* | *0.71* | *0.03* | *1.39* | *2.48* | *0.07* | *1.76* | *3.44* |



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## Table A.III: Tax Burden for ETFs vs. Index Funds

The table provides additional robustness for the results in Table IV by comparing ETF distribution, realized and unrealized capital gains yields to those of index funds. We separate Vanguard index funds from index funds of other families. Since Vanguard ETFs have a unique feature, backed by a patent, that they are structured as a share class in the main fund portfolio, thus essentially benefiting all share classes, ETFs and mutual funds, from the in-kind redemption distribution exemption. Lipper Class represent the fund investment objective and it is inferred by Lipper from fund holdings. SPSP corresponds to S&P 500 Index Objective Funds, EIEI to Equity Income Funds, and the remaining Lipper Class codes correspond to: first two codes indicating large cap (LC), mid cap (MC), small cap (SC), and multi cap (ML), and last two codes for core (CE), growth (GE), and value (VE) funds.

| | | | | Cap Gains Dist. Yield (%) | | | Realized Cap Gains Yield (%) | | | Unrealized Cap Gains Yield (%) | | | Tax Burden (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lipper Class | # of ETFs | Vanguard IMFs | Other IMFs | ETFs | Vanguard IMFs | Other IMFs | ETFs | Vanguard IMFs | Other IMFs | ETFs | Vanguard IMFs | Other IMFs | ETFs | Vanguard IMFs | Other IMFs |
| SPSP | 4 | 5 | 144 | 0.00 | 0.02 | 2.18 | 2.16 | 2.26 | 4.48 | 4.17 | 9.34 | 7.25 | 0.43 | 0.48 | 0.87 |
| LCCE | 40 | 7 | 61 | 0.07 | 0.00 | 2.92 | 4.21 | 2.00 | 6.32 | 4.93 | 9.37 | 5.34 | 0.39 | 0.44 | 1.12 |
| LCGE | 23 | 5 | 28 | 0.05 | 0.00 | 2.35 | 2.80 | 3.17 | 6.82 | 4.05 | 8.50 | 6.27 | 0.28 | 0.32 | 0.91 |
| LCVE | 19 | 5 | 18 | 0.14 | 0.00 | 1.46 | 3.30 | 3.21 | 4.15 | 4.73 | 7.82 | 4.42 | 0.48 | 0.58 | 0.87 |
| MCCE | 21 | 8 | 62 | 0.21 | 0.00 | 4.70 | 5.70 | 4.09 | 7.27 | 5.26 | 8.51 | 6.00 | 0.32 | 0.30 | 1.43 |
| MCGE | 10 | 2 | 10 | 0.08 | 0.00 | 1.58 | 6.05 | 4.49 | 9.25 | 6.57 | 7.04 | 3.02 | 0.18 | 0.17 | 0.52 |
| MCVE | 8 | 2 | 1 | 0.19 | 0.00 | 0.00 | 6.19 | 3.69 | 2.06 | 5.56 | 8.02 | 0.00 | 0.50 | 0.41 | 0.00 |
| SCCE | 29 | 7 | 88 | 0.09 | 0.00 | 4.71 | 5.51 | 3.74 | 6.37 | 5.12 | 9.22 | 6.40 | 0.30 | 0.31 | 1.51 |
| SCGE | 13 | 3 | 11 | 0.09 | 0.00 | 4.45 | 7.02 | 4.67 | 10.47 | 5.94 | 7.62 | 4.20 | 0.21 | 0.21 | 1.24 |
| SCVE | 17 | 5 | 18 | 0.13 | 0.00 | 2.68 | 6.56 | 4.57 | 10.99 | 4.62 | 6.39 | 4.47 | 0.43 | 0.42 | 0.92 |
| MLCE | 33 | 8 | 65 | 0.13 | 0.06 | 2.96 | 5.17 | 1.40 | 4.98 | 5.35 | 10.37 | 5.94 | 0.36 | 0.46 | 1.35 |
| MLGE | 16 | 0 | 31 | 0.39 | | 7.51 | 6.19 | | 9.71 | 4.60 | | 4.81 | 0.23 | | 1.66 |
| MLVE | 13 | 1 | 34 | 0.17 | 0.00 | 2.51 | 5.76 | 3.48 | 7.53 | 4.90 | 3.97 | 4.32 | 0.62 | 0.59 | 1.41 |
| EIEI | 31 | 3 | 7 | 0.11 | 0.00 | 4.28 | 3.14 | 3.99 | 6.95 | 3.57 | 6.35 | 3.70 | 0.66 | 0.52 | 1.83 |
| Sector | 255 | 13 | 18 | 0.12 | 0.03 | 0.63 | 4.70 | 4.28 | 2.38 | 5.19 | 5.73 | 5.56 | 0.37 | 0.60 | 0.44 |
| *Avg.* | | | | 0.13 | 0.01 | 2.99 | 4.96 | 3.50 | 6.65 | 4.97 | 7.73 | 4.78 | 0.39 | 0.41 | 1.07 |



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## Table A.IV: Tax Burden by Fund Return Volatility

The table reports average capital gains distribution yields as well as realized and unrealized capital gains yields for ETFs, index mutual funds and active mutual funds by style and year. Furthermore, the tax burden is computed for each of the three fund types. The final two columns display the difference between the tax burden of index mutual funds (IMF) and active mutual funds (AMF) relative to the tax burden of ETFs, respectively. Panel A displays average statistics for funds that have a return volatility above the median return volatility for active mutual funds in each year. Panel B focuses on funds with lower volatility than the median active mutual fund each year. The capital gains data come from Form N-SAR. Tax rates are obtained from Sialm & Zhang (2020).

**Panel A: High Volatility**

| **Year** | **# of Funds** (# ETFs) | Cap Gains Dist. Yield (%) | | | Realized Cap Gains Yield (%) | | | Unrealized Cap Gains Yield (%) | | | Tax Burden (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *IMF Diff* | *AMF Diff* |
| 2013 | 4,128 (378) | 0.03 | 1.26 | 2.17 | 6.89 | 7.81 | 9.51 | 9.53 | 8.78 | 9.18 | 0.28 | 0.57 | 0.62 | 0.29 | 0.35 |
| 2014 | 4,024 (337) | 0.08 | 3.41 | 5.80 | 10.70 | 11.83 | 11.15 | 4.26 | 3.44 | 3.54 | 0.31 | 1.24 | 1.74 | 0.93 | 1.43 |
| 2015 | 4,140 (291) | 0.10 | 3.48 | 7.44 | 6.16 | 6.38 | 8.28 | 2.00 | 0.93 | 0.89 | 0.35 | 1.08 | 2.01 | 0.73 | 1.66 |
| 2016 | 4,201 (374) | 0.32 | 3.03 | 7.29 | 3.59 | 3.44 | 4.37 | 5.01 | 3.66 | 3.83 | 0.40 | 1.03 | 1.72 | 0.63 | 1.32 |
| 2017 | 4,291 (439) | 0.12 | 1.78 | 3.34 | 6.45 | 10.36 | 8.67 | 7.26 | 6.76 | 7.34 | 0.38 | 0.78 | 0.98 | 0.40 | 0.61 |
| *Avg.* | | 0.13 | 2.59 | 5.21 | 6.76 | 7.96 | 8.40 | 5.61 | 4.71 | 4.96 | 0.34 | 0.94 | 1.42 | 0.60 | 1.07 |

**Panel B: Low Volatility**

| **Year** | **# of Funds** (# ETFs) | Cap Gains Dist. Yield (%) | | | Realized Cap Gains Yield (%) | | | Unrealized Cap Gains Yield (%) | | | Tax Burden (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *ETF* | *IMF* | *AMF* | *IMF Diff* | *AMF Diff* |
| 2013 | 3,749 (93) | 0.18 | 1.18 | 1.60 | 5.40 | 5.47 | 8.99 | 9.80 | 12.70 | 10.27 | 0.34 | 0.53 | 0.57 | 0.20 | 0.23 |
| 2014 | 3,861 (151) | 0.12 | 2.34 | 3.57 | 4.95 | 5.17 | 9.24 | 6.64 | 6.45 | 4.27 | 0.52 | 1.07 | 1.28 | 0.55 | 0.76 |
| 2015 | 3,984 (224) | 0.33 | 4.96 | 6.54 | 5.77 | 6.34 | 8.16 | 1.54 | 2.03 | 1.09 | 0.54 | 1.77 | 1.90 | 1.22 | 1.36 |
| 2016 | 4,129 (191) | 0.14 | 3.15 | 5.65 | 2.58 | 3.70 | 3.83 | 3.37 | 3.68 | 2.83 | 0.52 | 1.10 | 1.50 | 0.58 | 0.99 |
| 2017 | 4,068 (184) | 0.08 | 1.67 | 3.72 | 4.03 | 4.74 | 7.95 | 7.43 | 8.35 | 7.31 | 0.47 | 0.94 | 1.19 | 0.47 | 0.72 |
| *Avg.* | | 0.17 | 2.66 | 4.22 | 4.54 | 5.08 | 7.64 | 5.76 | 6.64 | 5.15 | 0.48 | 1.08 | 1.29 | 0.60 | 0.81 |



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## Table A.V: Determinants of Flows

This table reports regression analyses of flows on various fund characteristics within the sample of active mutual funds. Panel A shows results on the flow-performance relationship controlling for differences in funds' fees and tax burdens relative to the style average. Net flows are computed over 12 months and scaled by total net assets at the beginning of the period. Performance Rank is a fractional rank variable based on the fund's relative performance within its style at a given point in time. Perf. Rank: Low, Mid, and High together make up a piecewise linear regression following Sirri & Tufano (1998). Performance Quintile 1 and 5 are dummy variables. Annual Excess Return is a fund's excess return relative to the Fama-French four factors, compounded over the last twelve months. Flows and performance variables are computed on a rolling 12-month window, and all performance variables, fees and assets are as of the end of the previous year before flows are observed. Specifications (1) to (4) represent panel regressions with fixed effects and standard errors clustered by fund and year. Observations are at the share class-year level. Specifications (5) to (8) use observations from December only to mitigate any time series dependencies between observations. Specifications (1) to (8) include date and style fixed effects and standard errors are clustered by fund and year. Specifications (9) to (12) show results from a Fama-MacBeth regression using monthly data available for each share class, using Newey-West standard errors with twelve lags to compute *t*-statistics. ***, **, * represent statistical significance at the 1%, 5%, and 10% levels, respectively. Panel B builds on specification (4) from Panel A by analyzing outflows, the components of tax burden, and various subsamples with different expected sensitivities to taxes. In Panel B, Annual Excess Return, Fee Gap, and Tax Burden Gap, as well as the components (Dividend yield, Capital Gains Distribution, Realized Capital Gains and Unrealized Capital Gains) are standardized to have zero mean and unit standard deviation (suffix *stdd*). Outflows in Panel B represent the cumulative monthly redemptions extracted from Form N-SAR filings and scaled by total net assets at the beginning of the period.



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**Panel A: Flow-Performance Relationship Augmented with Fee and Tax Burden Gap**

| Sample & Dependent Variable | Net Flows (%) – Pooled Sample | | | | Net Flows (%) – December Observations Only | | | | Net Flows (%) – Fama-MacBeth, with Newey West | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Perf. Rank: Low | 0.455*** | | | | 0.444*** | | | | 0.475*** | | | |
| | (6.84) | | | | (5.04) | | | | (10.03) | | | |
| Perf. Rank: Mid | 0.299*** | | | | 0.302*** | | | | 0.317*** | | | |
| | (17.11) | | | | (13.21) | | | | (16.45) | | | |
| Perf. Rank: High | 1.064*** | | | | 0.947*** | | | | 1.089*** | | | |
| | (14.87) | | | | (10.06) | | | | (16.12) | | | |
| Perf. Quintile 1 | | -0.130*** | | | | -0.129*** | | | | -0.135*** | | |
| | | (-14.40) | | | | (-10.04) | | | | (-17.86) | | |
| Perf. Quintile 5 | | 0.197*** | | | | 0.187*** | | | | 0.202*** | | |
| | | (17.39) | | | | (14.75) | | | | (18.25) | | |
| Performance Rank | | | 0.004*** | | | | 0.004*** | | | | 0.004*** | |
| | | | (17.93) | | | | (14.07) | | | | (19.07) | |
| Annual Excess Return | | | | 1.492*** | | | | 1.365*** | | | | 1.587*** |
| | | | | (13.21) | | | | (11.49) | | | | (21.61) |
| Fee Gap | -8.658*** | -8.783*** | -8.405*** | -8.425*** | -8.428*** | -8.599*** | -8.192*** | -8.468*** | -9.170*** | -9.421*** | -8.955*** | -9.559*** |
| | (-7.65) | (-7.64) | (-7.43) | (-7.16) | (-7.09) | (-7.18) | (-6.84) | (-6.92) | (-7.87) | (-8.25) | (-7.82) | (-8.42) |
| Tax Burden Gap | -4.104*** | -4.006*** | -4.102*** | -3.889*** | -5.551*** | -5.477*** | -5.579*** | -5.277*** | -4.080*** | -3.805*** | -3.988*** | -3.390*** |
| | (-9.22) | (-8.79) | (-9.17) | (-8.83) | (-10.41) | (-10.28) | (-10.35) | (-9.87) | (-7.35) | (-6.58) | (-6.96) | (-5.39) |
| Log TNA | -0.038*** | -0.037*** | -0.038*** | -0.034*** | -0.037*** | -0.036*** | -0.037*** | -0.033*** | -0.047*** | -0.046*** | -0.047*** | -0.043*** |
| | (-10.16) | (-9.95) | (-10.03) | (-9.47) | (-8.74) | (-8.74) | (-8.63) | (-8.20) | (-11.69) | (-11.51) | (-11.45) | (-11.71) |
| Style Flows | 1.066*** | 1.067*** | 1.070*** | 0.900*** | 1.071*** | 1.065*** | 1.070*** | 0.916*** | 0.871*** | 0.874*** | 0.878*** | 0.717*** |
| | (11.82) | (11.77) | (11.99) | (11.80) | (9.15) | (9.17) | (9.18) | (10.13) | (9.16) | (9.42) | (9.30) | (9.21) |
| Return Volatility | -0.158 | -0.086 | -0.056 | 0.376 | 0.289 | 0.344 | 0.407 | 0.654 | 0.127 | 0.366 | 0.297 | 1.265** |
| | (-0.28) | (-0.15) | (-0.10) | (0.63) | (0.41) | (0.50) | (0.58) | (0.92) | (0.20) | (0.57) | (0.46) | (2.05) |
| Retail Dummy | 0.037*** | 0.036** | 0.038*** | 0.027** | 0.031** | 0.030* | 0.031* | 0.022 | 0.075*** | 0.075*** | 0.075*** | 0.069*** |
| | (2.83) | (2.73) | (2.84) | (2.07) | (2.07) | (2.02) | (2.06) | (1.52) | (4.91) | (4.84) | (4.88) | (4.44) |
| Log Age | -0.200*** | -0.203*** | -0.201*** | -0.193*** | -0.198*** | -0.201*** | -0.199*** | -0.195*** | -0.183*** | -0.187*** | -0.184*** | -0.180*** |
| | (-24.35) | (-24.06) | (-24.42) | (-21.18) | (-22.04) | (-21.81) | (-22.04) | (-21.78) | (-22.64) | (-22.48) | (-22.75) | (-20.20) |
| Observations | 1,119,685 | 1,119,685 | 1,119,685 | 1,100,330 | 98,175 | 98,175 | 98,175 | 95,856 | 1,119,685 | 1,119,685 | 1,119,685 | 1,100,330 |
| R-squared | 0.19 | 0.181 | 0.188 | 0.166 | 0.193 | 0.185 | 0.191 | 0.169 | 0.204 | 0.193 | 0.2 | 0.178 |
| FE (# of Groups) | Fixed Effects: Date & Style | | | | | | | | (288) | (288) | (288) | (288) |



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**Panel B: The Effect of Tax Burden and Its Components on Flows and Outflows**

| | Net Flows (%) | Outflows (%) | Net Flows (%) | Outflows (%) | | | Outflows (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Annual Excess Return (*standardized*) | 0.093*** | -0.015*** | 0.084*** | -0.017*** | -0.014*** | -0.015*** | -0.001 | -0.010*** | -0.016*** | -0.015*** |
| | (13.57) | (-7.84) | (12.95) | (-7.68) | (-6.13) | (-6.47) | (-1.32) | (-5.87) | (-7.22) | (-6.25) |
| Fee Gap (*stdd*) | -0.050*** | 0.006*** | -0.047*** | 0.009*** | 0.005* | 0.004 | 0.006*** | -0.006** | 0.005** | 0.007*** |
| | (-6.95) | (3.22) | (-5.05) | (3.11) | (2.00) | (1.29) | (4.87) | (-2.36) | (2.18) | (2.88) |
| Tax Burden Gap (*stdd*) | -0.0565*** | 0.019*** | | | 0.016*** | | -0.000 | 0.014*** | -0.028*** | 0.047*** |
| | (-8.97) | (4.61) | | | (3.95) | | (-0.05) | (3.60) | (-5.36) | (8.34) |
| Dividend Yield (*stdd*) | | | -0.013** | 0.012*** | | 0.007** | | | | |
| | | | (-2.18) | (3.75) | | (2.40) | | | | |
| Capital Gains Distribution Yield (*stdd*) | | | -0.034*** | 0.009*** | | 0.008** | | | | |
| | | | (-6.37) | (2.91) | | (2.39) | | | | |
| Realized Capital Gains Yield (*stdd*) | | | -0.074*** | 0.051*** | | 0.048*** | | | | |
| | | | (-10.08) | (10.79) | | (9.91) | | | | |
| Unrealized Capital Gains Yield (*stdd*) | | | -0.010 | 0.009*** | | 0.006* | | | | |
| | | | (-1.28) | (3.45) | | (1.93) | | | | |
| Log TNA | -0.034*** | -0.003*** | -0.033*** | -0.005*** | -0.004** | -0.007*** | 0.004*** | -0.011*** | -0.002* | -0.003 |
| | (-9.64) | (-3.15) | (-8.73) | (-4.52) | (-2.46) | (-3.98) | (7.23) | (-9.95) | (-1.78) | (-1.64) |
| Style Flows | 0.904*** | -0.111*** | 0.794*** | -0.182*** | -0.089** | -0.149*** | 0.000 | -0.031 | -0.070* | -0.134*** |
| | (12.44) | (-3.12) | (10.69) | (-4.71) | (-2.57) | (-3.76) | (0.03) | (-0.94) | (-2.01) | (-4.15) |
| Return Volatility | 0.394 | 1.576*** | 0.801 | 0.497 | 1.831*** | 0.578* | 0.128 | 0.721*** | 1.675*** | 1.462*** |
| | (0.666) | (4.75) | (1.51) | (1.68) | (5.00) | (1.91) | (1.48) | (3.06) | (4.54) | (5.25) |
| Retail Dummy | 0.026* | 0.012*** | 0.023* | 0.017*** | | | 0.001 | 0.014*** | 0.010*** | 0.013*** |
| | (2.05) | (3.63) | (1.87) | (4.15) | | | (0.86) | (4.14) | (2.87) | (3.39) |
| Log Age | -0.192*** | -0.016*** | -0.166*** | -0.023*** | -0.021*** | -0.028*** | -0.004*** | 0.003 | -0.011** | -0.022*** |
| | (-21.12) | (-4.42) | (-17.94) | (-6.79) | (-5.06) | (-6.33) | (-2.84) | (0.84) | (-2.59) | (-4.52) |
| Observations | 1,100,330 | 919,284 | 636,962 | 596,406 | 586,481 | 365,222 | 460,069 | 459,215 | 457,605 | 461,679 |
| R-squared | 0.166 | 0.113 | 0.165 | 0.171 | 0.133 | 0.195 | 0.123 | 0.131 | 0.133 | 0.116 |
| *Sample Subset* | | | | | *Retail* | *Retail* | *< Median Outflows* | *Significant Outflows* | *< Median Tax Burden* | *> Median Tax Burden* |



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## Table A.VI: ETF Flows by Advisors with High-Net-Worth Clients

The table reports the flows of investment advisors that advise various levels of high-net-worth clients. ETF flows by investment advisors are determined using 13F holdings data from Thomson-Reuters Global Ownership Database (OP), while the exposure to high-net-worth clients (HNW) is based on data reported on Form ADV. Advisors are determined to have high exposure to high-net-worth individuals if more than 25% of their AUM comes from high-net-worth clients (if assets are unavailable, the determination is made using a client count). ETF flows are scaled by total ETF assets. Capital gains information over time is provided as well.

| | **ETF Flows (t), as % of Total ETF Assets (t-1)** | | | | | | | **Active Mutual Funds: Capital Gains** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total ETF Flows | All Institutions | Investment Advisors | Advisors with High-Net-Worth Individual Accounts | | | | CG Distribution Yield | Realized CG Yield | Unrealized CG Yield |
| Year | Growth | | | *None* | *Low* | *High* | *High as %* | | | |
| 2001 | 38.14% | 19.34% | 3.75% | 0.72% | 1.00% | 1.04% | 37.68% | 5.48% | 2.10% | 2.32% |
| 2002 | 46.36% | 12.89% | 4.84% | 0.97% | 0.68% | 0.11% | 6.25% | 1.01% | 0.55% | 1.81% |
| 2003 | 14.01% | 19.18% | 1.22% | 0.18% | 1.00% | 0.68% | 36.56% | 0.35% | 1.51% | 14.14% |
| 2004 | 31.12% | 20.28% | 8.39% | 0.04% | 2.02% | 1.80% | 46.63% | 0.61% | 6.61% | 6.10% |
| 2005 | 23.05% | 19.43% | 4.18% | 0.25% | 2.10% | 1.01% | 30.06% | 1.85% | 6.83% | 3.69% |
| 2006 | 17.44% | 16.80% | 5.42% | -0.05% | 0.23% | 1.37% | 88.39% | 3.34% | 7.23% | 3.77% |
| 2007 | 29.44% | 22.71% | 4.79% | 1.22% | 0.70% | 1.12% | 36.84% | 4.55% | 8.25% | 4.04% |
| 2008 | 30.81% | 23.76% | 8.80% | 0.94% | 3.59% | 1.54% | 25.37% | 7.72% | 2.32% | 0.24% |
| 2009 | 14.11% | 10.04% | 6.56% | 0.77% | 0.86% | 0.55% | 25.23% | 1.01% | 0.14% | 17.40% |
| 2010 | 11.37% | 11.48% | 5.69% | 1.48% | 1.50% | 0.58% | 16.29% | 0.09% | 6.89% | 10.23% |
| 2011 | 11.54% | 9.64% | 3.76% | 0.61% | 0.54% | 1.75% | 60.34% | 0.46% | 9.27% | 3.71% |
| 2012 | 13.83% | 9.54% | 5.23% | 1.11% | 1.75% | 1.25% | 30.41% | 1.37% | 5.28% | 5.51% |
| 2013 | 14.42% | 13.13% | 6.56% | 2.08% | 1.49% | 1.44% | 28.74% | 1.94% | 9.26% | 9.84% |
| 2014 | 12.89% | 10.49% | 6.51% | 1.28% | 1.51% | 2.24% | 44.53% | 4.72% | 10.19% | 3.77% |
| 2015 | 10.72% | 9.13% | 6.78% | 0.33% | 1.78% | 3.35% | 61.36% | 6.96% | 8.20% | 0.89% |
| 2016 | 12.14% | 8.45% | 4.38% | 0.99% | 1.81% | 0.19% | 6.35% | 6.72% | 4.14% | 3.41% |
| 2017 | 14.78% | 12.21% | 8.53% | 1.36% | 1.69% | 3.51% | 53.51% | 3.83% | 8.39% | 7.61% |
| Average | 14.97% | 11.90% | 6.25% | 1.07% | 1.55% | 1.85% | | | | |



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