The Unintended Consequences of Investing for the Long Run: Evidence from Target Date Funds

Massimo Massa, Rabih Moussawi, Andrei Simonov †

Abstract

We study how managers of funds created for the long run behave when shielded from their investors' short-term needs. We focus on Target Date Funds (TDFs) for which investors' horizons change deterministically over time and are not due to unobservable fund characteristics. Our evidence suggests that asset managers exploit reduced investor attention to deliver lower performance. Due to this behavior, an average investor who holds the fund for 50 years faces a hypothetical cumulative return loss of 21%. This underperformance is driven by fund families using TDFs to smooth the flow shocks of affiliated open-end funds and to boost fees by investing in the affiliated expensive share classes. We use the Pension Protection Act of 2006 as an exogenous shock that made TDFs the default investment option within 401(k) retirement plans.

Keywords: Mutual Funds, Target Date Funds, Retirement Savings, Mutual Fund Families, Open Architecture, Flow-Performance Sensitivity.

JEL Classification: D12, D14, D91, G41, G51, J32

† Massimo Massa, INSEAD, 1 Ayer Rajah Avenue, 138676, Singapore; massimo.massa@insead.edu; Rabih Moussawi, Villanova University 800 Lancaster Ave Bartley 2051 Villanova, PA 9085 USA, Rabih.Moussawi@villanova.edu; Andrei Simonov, Eli Broad Graduate School of Management, Michigan State University, and CEPR, 316 Eppley Center, East Lansing, MI 48824, USA, simonov@msu.edu.

This is — you're sort of dealing with the basic conundrum here, which is that these Target Date Funds are designed for people who really don't want to pay attention, don't want to manage, don't want to read the information. And so how do you get information to people who really aren't that interested in information?

David Certner, Legislative Counselor and Legislative Policy Director at AARP, during testimony at the DOL/SEC Public Hearing on Target Date Funds, June 18, 2009 (DOL, 2009).

A phenomenon has become prominent over the last decades: the need to "invest for the long run," a need made even more pressing by the demise of the defined-benefit retirement system and an aging population. Investing for the long run critically changes investor behavior by reducing "attention" and raising questions about the incentives to monitor the asset manager. A typical product in which horizon plays a significant role is target date funds (TDFs). They have been set up precisely to address the fact that many pension plan participants lack the necessary knowledge and are known to make suboptimal investment choices. TDFs provide a dynamic asset allocation that does not require active participation. While monitoring is still possible, a significant share of investors in TDFs chooses to be inattentive.

TDFs have proven to be extremely popular, making them the most common default investment in defined contribution plans. J.P. Morgan estimates that 88% of new retirement plan contributions went into TDFs in 2019.[1] Moreover, 55% of pension plan participants in 2019 invested their entire portfolio in a single TDF, with roughly six out of ten investors defaulting into TDFs (Vanguard, 2020). However, while the longer investment horizon allows asset managers to choose whether to exploit the higher degree of freedom to further the interests of investors without the constraints of short-term considerations, it also allows them to engage in opportunistic behavior. The latter feature has become even more critical as TDF managers do mostly belong to large investment groups ("fund families") and tend to invest the assets in the underlying funds that are either part of the same family or part of a few other very large families ("closed architecture"). This raises the question of whether such an approach, while facing potential conflicts of interest due to the fund management family investing in its own managed funds, provides clients with potential long-run investment benefits arising from, for instance, informational advantage and related economies of scale.

Starting from an empirical premise that a longer TDF horizon is associated with lower investor attention, we entertain two alternative hypotheses. The first is that fund managers fully exploit decreased investor attention due to a longer horizon in the interest of their investors and, in doing so, take advantage

[1] Mark Avallone, "Why Target Date Funds Dominate The 401(k) Market," Forbes, June 30, 2018, https://www.forbes.com/sites/markavallone/2018/06/30/why-target-date-funds-dominate-the-401k-market/?sh=165dc0785868.

of the synergistic benefits of family affiliation. This implies that lower attention/longer horizon allows fund managers to outperform. The alternative hypothesis is that agency-prone managers abuse long-term investors' lack of attention due to the long horizon and employ a closed-end architecture to the detriment of their investors. This implies that lower attention/longer horizon allows fund managers to underperform. In that case, investment in affiliated funds helps fund managers at the expense of their investors.

TDFs are ideally suited to test those two hypotheses as they are created to invest for the long run and cater to long-horizon investors' needs at the onset of their investments. They gradually become more short-term over time as they approach the fund's target date. This provides a mapping of the expected horizon of TDF investors, which we argue and document to be highly correlated with their degree of attention. In other words, the change in the horizon is not due to specific idiosyncratic characteristics of the fund – e.g., performance, fees, risk-taking – that can affect demand by investors and spuriously link the horizon of investors and unobservable fund characteristics.

TDFs typically do not invest directly in individual securities but instead in underlying pooled investment vehicles such as index funds, active mutual funds, and exchange-traded funds (ETFs).[2] Most TDFs are constructed entirely with affiliated funds from their own organization. For example, the T. Rowe Price Retirement Fund Series consists of 15 equity and up to 10 different fixed-income T. Rowe Price mutual funds (Table 1). The average TDF in our sample allocates 50.3% of its portfolio to actively managed mutual funds, with the rest split between index funds, ETFs, cash, and individual securities (stocks, bonds, etc.). These underlying investment vehicles are managed primarily by the same family. In 2019, around 58% of the TDFs only invested in their family's funds, while another 20% invested more than half of their assets in their family's funds. Only 10.6% of the TDFs did not invest in their own family funds.

We exploit three key features of TDFs. The first is that TDFs provide a clear identification of the horizon of the investors and, therefore, of their degree of attention. Indeed, fund families offer many TDFs with *different target horizons* within the same offering ("series"). This allows them to discriminate fund selection choice and fund investment as a function of the *degree of investor attention*. Second, there

[2] While many TDFs used to invest directly in individual stock and bond securities before 2004, most switched to investing in underlying funds. Out of all the TDF funds in 2019, only 25, all affiliated with a single family, Wells Fargo (TDF series: Wells Fargo Target Date and Wells Fargo Dynamic Target Date Funds), invest directly in individual securities.

is a considerable cross-sectional variation in the degree by which TDFs, even funds within the same series, invest in different affiliated funds of the same family.

Third, an important change in regulation provides an exogenous increase in demand by inattentive investors: the passage of the Pension Protection Act of 2006 (PPA). The introduction of the PPA allowed a subset of balanced funds that had specified the horizon defined in their names (i.e., TDFs) to effectively become the default option in pension portfolios. As a result, the PPA exogenously allocated many new inattentive long-term investors to invest in this default option, resulting in "captive" investments effectively independent of the fund's performance.[3] And indeed, we document that TDFs attracted relatively more inflows to funds with longer horizons after the adoption of PPA (Figure 2). Most importantly, we find that investor sensitivity to both high and low TDF performance decreased substantially after the PPA's introduction relative to the flow-performance sensitivity before 2008 (Figure 3). This allows us to exploit the PPA adoption to compare the behavior change, including fund investments and fund performance, of the funds that were already catering to long-term investment needs but did not become the default option — that is, non-TDF balanced funds – with the balanced funds that became the default option — that is, TDFs.

It is worth noting that while the menu of the TDFs is selected by plan sponsors that identify the TDFs available to plan participants, the investor's choice of the specific fund within the menu is linked to his horizon. Therefore, exploiting cross-sectional variation among funds with different horizons offered by the same family helps to control for the role of the sponsors.[4]

We exploit these three TDF features to test the following hypotheses. The first hypothesis posits that fund managers exploit the lower sensitivity of flow to performance due to longer horizons to optimize

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[3] "Participants who use a default option are generally less involved," says Mark Painter, founder of EverGuide Financial Group in Berkeley Heights, New Jersey. "If they are less involved, then they tend not to focus on the short-term fluctuations. Given that retirement is years away and saving will continue, the defaulters will usually keep the investments on autopilot." For more information, see Christopher Carosa, "Recent Market Volatility Has Revealed This about Target Date Funds," FiduciaryNews.com, January 15, 2019, https://fiduciarynews.com/2019/01/recent-market-volatility-has-revealed-this-about-target-date-funds/.

[4] Indeed, sponsors typically select only one series of TDFs as the default option from each family, and therefore family fixed effects control for their choice. While some families offer multiple series of TDFs, our communication with industry practitioners reveals that it is never the multiple series that is offered within the same pension plan. In addition, in the overwhelming majority of the cases, the additional series are small. For example, BlackRock has three different series, but their flagship BlackRock LifePath Index AUM represents 95.7% of Black Rock TDF assets. Similarly, T. Rowe Price Retirement TDF series accounts for 98.7% of its TDF assets, while T. Rowe Price Target Retirement represents 1.2% and T. Rowe Price Retirement Income only accounts for less than 0.1% of the TDF assets of T. Rowe Price (Morningstar, 2019). Moreover, when sponsors reshuffle the menu, the default option (TDFs) are unaffected. The only situation when the default option changes is when the pension plan moves to another fund management company.

their clients' portfolios. As pointed out in the literature, a short-term horizon prevents managers from fully exploiting profitable investment opportunities (e.g., Shleifer and Vishny, 1997) and requires them to maintain expensive liquidity buffers (E.g., Edelen, 1999). In particular, the bulk of the literature has established that performance-based flows resulting from investors' attention are associated with frictions due to potential withdrawals following bad performance (e.g., performance-based arbitrage in Shleifer and Vishny (1997), Chevalier and Ellison (1997), Stein (2005)). Lower attention translates into lower sensitivity to short-term performance, and, therefore, more freedom for managers to exploit investment opportunities with less concern for short-term withdrawals. Managers would therefore exploit the power of the group they belong to, selecting to invest in the funds of the group that is more suited to optimize the performance of their TDFs in terms of return, risk, and fees. These considerations suggest our first hypothesis, the "performance hypothesis."

H1a: Longer investment horizon allows fund managers to outperform.

H1B: TDF fund managers exploit the synergies provided by the joint offer at the family level of other investment vehicles to optimize the performance of the TDFs in terms of return, risk, and fees charged.

The second hypothesis posits that the absence of attention leads to what amounts to moral hazard by fund families. Agency-prone managers exploit long-term investors' lack of attention and invest in affiliated funds to maximize group profits – e.g., subsidize other funds and/or invest in affiliated more expensive funds.

. These considerations suggest our second hypothesis, the "agency hypothesis."

H2a: Longer investment horizon allows fund managers to underperform.

H2B: TDF fund managers exploit the synergies provided at the family level to optimize the group profits.

We test these hypotheses using the complete sample of TDFs between 2000 and 2019. We investigate the first question: whether a longer horizon implies decreased attention to performance. We first document the strong dependence of flow performance sensitivity for TDFs with different horizons. These differences are especially dramatic for sensitivity to high performance. It is essentially flat for long-horizon funds, the default choice for less-attentive investors who are farther from retirement, and very strong for short-horizon funds, typically the default choice for investors with larger portfolios and who are approaching retirement. Then, we use the PPA experiment and compare TDFs to other balanced funds that were already catering to long-term investment needs but did not become the default option following the PPA introduction. We document significant differences in standard flow-performance sensitivity (Sirri and Tufano, 1998) between TDFs and other balanced funds. PPA led to a dramatic decrease in the flow-performance sensitivity of TDFs.[5]

Building on these results, we investigate whether this behavior has implications for performance. Using the Fama-French-Carhart four-factor model augmented with two fixed income risk factors (e.g., Fama and French, 1993, Gebhardt, Hvidkjaer, and Swaminathan, 2005, Cici, Gibson, and Merrick, 2011), we find that TDFs underperform with respect to traditional balanced funds. The annual performance of the TDFs is 77-88 (39-46) basis points (bps) lower than the performance of the balanced funds in terms of the net-of-fee (gross-of-fee) alpha. The effect is concentrated in the period after the passage of the PPA, where the annual performance of the TDFs is lower than that of the balanced funds by 103 (66) bps in terms of the net-of-fee (gross-of-fee) alpha. These results are consistent with Sandhya (2011) during the early period of the sample and Brown and Davies (2020) but are different from Elton et al. (2015).

Next, we investigate the link between TDFs' performance and their respective horizons. Both multivariate and portfolio analyses document a robust negative correlation between risk-adjusted performance and horizon. An increase in the horizon of 10 years translates, on average, into a 29 bps lower net-of-fee annual performance. Again, the effect is concentrated after the PPA regulatory change. An increase in the horizon of 10 years is related to a 45 bps (42 bps) lower net-of-fee (gross-of-fee) annual performance in 2008-2012 and 26 bps for 2013-2019.

The next question is whether we can relate these adverse effects to TDF's investing in affiliated funds offered by the same family. We start by documenting that the family's size and expertise in investing in equity, proxies for "better investment skills and expertise," reduce the negative drag of the horizon on performance. In contrast, proxies for "family commitments," such as higher incentives to use the TDFs as providers of stable demand for the family's funds (i.e., the flow volatility of family funds), increase the horizon's negative effect on performance. Overall, these results suggest that the negative effect of the horizon is reduced by the characteristics related to family affiliation but is increased by its constraints.

Next, we drill further into the paper's central question: why does the performance change within a given TDF fund as the target horizon changes? We detail the analysis in three sub-questions: whether

[5] Our results differ from the results of Sandhya (2011), who used a rather small sample of TDFs before 2009, thus, mixing periods before and after PPA introduction.

families make TDFs to invest in their worst affiliated funds, whether families change the investment in these funds as a function of the horizon of the TDF, and whether this behavior was exacerbated by the adoption of the new PPA law that has induced the influx of inattentive investors. We explore the choice of the TDF series to invest in and overweight certain affiliated family funds relative to other family funds as relevant counterfactuals by exploiting the cross-sectional heterogeneity within the series to assess how the horizon affects this choice. Specifically, we focus on within-family and family/series variations to assess the impact of the horizon on the family's behavior, exploiting the variation that comes from comparing TDFs with different target dates in the same series – e.g., T. Rowe Price Retirement 2020 vs. T. Rowe Price Retirement 2060 fund.

In line with the agency hypothesis, our results document that worse-performing and more expensive funds are more likely to be selected by long-horizon TDF funds. This behavior is more pronounced after the passage of the PPA Act. Being a low-performing fund translates into a 6.4% - 8.3% higher probability of being selected by the TDF than the unconditional probability of being chosen. Such probability increases by 7.5%-14.9% of the unconditional mean for the long-horizon funds. Moreover, this effect is concentrated after the passage of the PPA Act. If we look at the fees charged by the underlying funds, we see that while, generally, lower-fee funds are selected (consistent with Elton et al. (2015)), this is less so in the case of long-horizon TDFs. Indeed, for such long-horizon TDFs, the fees of the underlying selected funds are between 6.0% and 6.4% higher with respect to the unconditional probability of being chosen. Moreover, after the new law's passage, there is a higher tendency to select more expensive underlying funds for longer-horizon TDF portfolios.

To better identify this relationship, we focus on how the investment changes with the horizon in funds *within the same series,* allowing us to address the issue of whether, all else equal, the family changes investment behavior with the change of investors' horizon. Consistent with the agency hypothesis, we find that the TDF family tilts more towards the worse-performing funds, and this tilt is stronger for long-horizon TDFs within the series. A low-performing fund translates into between 5% and 20% higher tilt. Moreover, this effect is concentrated after the passage of the PPA Act.

Next, we investigate the source of such underperformance. We entertain two possibilities. The first is *outflow buffering*: the fund family deliberately exploits the less flow-sensitive TDFs to buffer the other funds' outflows in the same family. The second is *fee skimming*: the family exploits the longer horizon TDFs to charge higher fees by investing in more expensive affiliated funds. We start with *outflow* *buffering* and document a strong negative relation between the outflows of the family's underlying funds and the performance of the TDFs. Such a negative relationship is reinforced if the family's funds in which the TDF invests have high outflows. Every ten years of the horizon translate on average into an 11–12 bps lower net-of-fee annual performance for each standard deviation of outflows of the family's funds. A tilt of investment toward the same family funds of one standard deviation leads to a 58 bps annual underperformance for every ten years of the horizon. Portfolio analysis confirms these results and documents a tilt toward investing in affiliated funds when they experience significant outflows, specifically in the same family active funds. Overall, these results suggest that TDFs deliver worse performance in general and even more so at longer horizons when they invest in affiliated active funds that face outflows.

We then examine the *fee-skimming* explanation. Given that 74% of TDFs' assets under management (AUM) are invested in affiliated funds, families may lure in investors with low fees on the TDFs — the ones more directly observable — and charge higher fees on the less observable underlying funds. Indeed, we find that the longer the horizon, the higher the fees of the affiliated underlying funds after controlling for the fees of the average affiliated funds. We also find this relation is most significant in the third period after the PPA introduction and the influx of inattentive investors. In particular, we find that a horizon that is ten years longer is associated with a 3.3-3.8 bps higher underlying fund fees. In contrast, the headline expense ratio of the TDF is not the function of the horizon.

Finally, we document the risk implications of this behavior. We document a robust positive correlation between fund risk-taking and deliberately investing in affiliated funds when their volatility of flows is high. For an incremental ten years of the target horizon, a one standard deviation increase in both the tilt toward the family funds and the outflows of funds of the same family translates on average to a 1.9% (2.3% and 1.6%) higher drawdown (volatility and beta, respectively). Again, the effect is primarily concentrated in the third period after the PPA introduction. Overall, these results confirm that the goal of maximizing the overall group profits has negative implications regarding the risk-taking to which they expose the investors.

Our paper proceeds as follows. In the next section, we present the pertinent institutional details about TDFs and the multi-phased adoption of the PPA, as well as a review of the recent literature. Section 2 provides the data description and variable construction, in addition to the baseline results that document a surge in investors' flows and the lower sensitivity to performance after the PPA adoption, especially for TDFs with longer horizons. Then, we present the results of the underperformance of TDFs proportional to investors' horizons in Section 3, followed by an overview of the sources of such underperformance in Section 4. Next, Section 5 provides detailed empirical evidence on the first source of TDF underperformance: the selection and overweighting of underperforming underlying funds. Section 6 presents the second source of underperformance by documenting how families allocate more underlying funds in the TDF portfolios to affiliated active funds that experienced recent outflows, resulting in further underperformance for TDF. Section 7 explores the fee skimming explanation by finding that underperforming TDFs, especially with longer horizons, invest in expensive affiliated active funds and more expensive share classes of the underlying funds. Section 8 presents the high risk-taking outcome of this opportunistic behavior by TDFs, and the last section concludes.

1. Institutional Background and Link to the Literature

TDFs have been created to invest for the long term. They rebalance investor portfolios as they approach retirement to safer conditions, away from riskier equities and into safer bonds. In particular, TDFs allocate most of the portfolio to equity investments when the target date is far away. Then, as the target date approaches, they lower the portion allocated to equity securities and shift more assets to bonds and money market securities, reducing the TDF's overall risk exposure. This rebalancing is almost automatic and takes the form of a "glide path." The same fund with the same clientele transits over several different horizons through the years. The simplicity and intuitiveness of this approach have been crucial to the success of TDFs.[6] The number of TDFs grew from 63 in 2000 to 2,778 in 2019, with a total market capitalization surpassing $1.4 trillion by the end of 2019 (Figure 1).[7]

We argue that TDF investors are less attentive than typical mutual fund investors. In general, this is due to three sets of reasons. The first is that TDFs are for the long horizon, and it has been documented

[6] "What explains this exponential increase? 'One word: "simplicity,"' says Francesca E. Federico, Principal and Co-Founder of Twelve Points Wealth Management in Boston, Massachusetts. 'Participants in 401k plans choose TDFs for simplicity. "When do you want to retire?" Ok, boom here pick this fund and you are done. It makes it simple and easy to participate in the 401k. Most participants, especially those not familiar with finance and the markets, get overwhelmed easily. So, sifting through 25-100 funds (sometimes hundreds) is tedious and daunting and they would rather not participate. TDFs make it easy to participate and manage your 401k." See Christopher Carosa, "Are Target Date Funds a Ticking Time Bomb?" FiduciaryNews.com, February 10, 2015, https://fiduciarynews.com/2015/02/target-date-funds-ticking-time-bomb/.

[7] This figure does not include collective investment trusts (CIT) assets in TDFs. Beside TDF mutual fund assets, there are additional assets in TDFs by CITs, which are not reported in the CRSP database. For example, Vanguard TDF assets, including both mutual funds and CITs, were $862 billion in 2019. The overall TDF market was $2.3 trillion in 2019, after including CIT investments: Emile Hallez, "Vanguard Cements Its Hold on the Target-Date Marketplace," InvestmentNews, March 4, 2020, https://www.investmentnews.com/vanguards-target-date-market-growing-189419.

(e.g., Laibson, 1997) that investors are less attentive to performance the further the fund is from the retirement age.[8] The second reason is that long-horizon TDFs are typically the default investment choice for inexperienced young investors that recently joined the labor force and are farther from retirement. These investors typically accumulate more investment experience as their nest egg grows and they approach retirement, naturally resulting in more attentive investors in short-horizon TDFs. The third reason is the way TDFs report information to their investors, making it difficult to properly and fully understand and benchmark the performance implications of asset allocation decisions. J.P. Morgan's research noted, "The absence of standard performance benchmarks, coupled with the wide and varied landscape of target date funds, makes comparing the performance of TDFs challenging."[9] There is, however, an even stronger reason for the case of TDFs: a regulatory change in 2008 significantly weakened the link between new flows and performance, effectively creating a "captive" market for the providers of TDFs – the PPA adoption.[10]

The PPA changed the incentives to have TDFs in pension plans and induced the changeover from balanced funds into TDFs. First, the PPA removed the potential liability of plan sponsors for investment losses by offering a safe harbor provision for pension plan sponsors who design their plan with the default option.[11] The goal was to increase the investments in more "optimal portfolios" (i.e., portfolios more loaded on risky assets) by automatically enrolling investors in TDFs and therefore "nudging" their choices (e.g., Benartzi and Thaler, 2001; Madrian and Shea, 2001; Agnew et al., 2003).[12] To qualify for the default option, the fund should fit one of the following "qualified default investment alternatives"

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[8] Hyperbolic discount functions are characterized by a relatively high discount rate over short and relatively low discount rates over long horizons. For example, from today's perspective, the discount rate between two far-off periods, t and $t + 1$, is the long-term low discount rate. However, from the time t perspective, the discount rate between t and t+1 is the short-term high discount rate. This suggests that an investor would require higher performance for a short-term investment relative to the same long-term-investment delayed in the future. In other words, the discount rate gradually increases as the delay gets smaller (Laibson, 1997).

[9] Emily Cao and Dan Notto, "Choosing Target Date Funds: What Is Most Appropriate for Your Participants?" J.P. Morgan, https://am.jpmorgan.com/us/en/asset-management/adv/insights/retirement-insights/defined-contribution/choosing-target-date-funds-a-suitability-assessment/

[10] In line with our discussion, we argue and document that inattentiveness changes with the horizon. That is, in 2010, pension investors enrolling in the 2020 funds were less inattentive than those enrolling in the 2030 funds.

[11] The Vanguard's "How America Saves" survey reports that in 2014 (2019), 69% (78%) of pension plan participants invested in TDFs. Among them, 61% (70%) invested their entire account balance in a single TDF. So, the entire growth of investors in TDFs is driven by investors who invest in a single TDF fund. In the latter group, the mean (median) account balance was $10,913 ($41,596). In this group, the median age is 39 years, 53% are male, and 57% of this group *defaulted in TDFs under automatic enrollment*. In the group with multiple holdings, the median age is 49, 60% are males, and the mean (median) account balance is $195,634 ($80,132) (Vanguard, 2020).

[12] Robert Powell, "Behavioral Economist Richard Thaler on the Key to Retirement Savings," *Wall Street Journal,* November 29, 2015,
https://www.wsj.com/articles/behavioral-economist-richard-thaler-on-the-key-to-retirement-savings-1448852602.

(QDIA): life-cycle funds, target retirement date funds, balanced funds, and professionally managed accounts[13].

However, TDFs quickly became the favored choice. Indeed, managed accounts were too expensive and too complex in terms of information requirements for most plans. While cheaper than managed accounts, balanced funds were less flexible, marginally more expensive, and less well-suited than target-date funds due to the absence of age-based risk matching. Specifically, balanced funds do not have a structure explicitly based on the horizon. As Morningstar noted, the glide path feature of the TDFs "allowed younger participants to take more equity risk and older participants to take less equity risk. This meant that for the same or lower cost, you could have a more personalized investment solution."[14]

The changes around the PPA developed in two steps: between 2009 and 2013 and the period after 2013. Guided by the new PPA, the Employee Benefits Security Administration issued the rule that provides a safe harbor to a plan sponsor if the default is set as a TDF. The rule was published on October 24, 2007, and went into effect on December 24, 2007, so we use the period before December 31, 2007, as the pre-PPA period. By 2010, the US Securities and Exchange Commission (SEC) considered revisiting the law. The dramatic variation in the performance of seemingly similar TDFs in 2008–2009 brought new attention to the difference in the underlying risk level. In 2010, the SEC offered for public discussion its proposal on the naming and marketing of TDFs.[15]

In 2012, the Investor Advisory Committee, newly formed under the Dodd-Frank Act, issued recommendations on target-date mutual funds that suggested several new disclosure policies. The final version was published in April 2013.[16] While those policies were mere suggestions, Commissioner Luis

[13] The QDIA rules provide certain limited fiduciary protection to plan fiduciaries when a plan participant fails to provide investment direction with respect to the amounts held in the plan. If such amounts are invested in a QDIA, such as a target date fund, the plan fiduciary will not be liable for any loss that is the direct and necessary result of investing a participant's account in the QDIA.

[14] Dan Bruns, "Why Using Target-Date Funds as a QDIA Is Outdated," Morningstar, January 17, 2018, https://www.morningstar.com/insights/2018/01/17/qdia-target-date .

[15] SEC Release No. 33-9126, "Investment Company Advertising: Target Date Retirement Fund Names and Marketing" June 16, 2010 (S7-12-10), http://www.sec.gov/rules/proposed/2010/33-9126.pdf.

[16] Recommendation of the Investor Advisory Committee, "Target Date Mutual Funds," April 11, 2013, http://www.sec.gov/spotlight/investor-advisory-committee-2012/iac-recommendation-target-date-fund.pdf. Specifically, the committee made the following five recommendations: First, that TDF prospectuses clearly explain the policies and assumptions used to design and manage the desired level of risk over the life of the fund. Second, that the marketing materials for TDFs include warnings that the funds are not guaranteed and that losses are possible, including at or after the target date. Third, that TDFs provide better information about fees and their likely impact on investors' final returns. Fourth, that the commission develop a glide path illustration for TDFs that is based on a standardized measure of fund risk. Fifth, that the commission adopt standard methodologies for both the risk-based and asset allocation glide path illustrations.

Aguilar noted an improvement in the disclosure policies observed past this decision, even in the absence of a formal SEC rule.[17] This suggests that, as of this period, more transparency — and therefore potentially less wrongdoing on the side of the TDFs — started. We, therefore, use April 2013 as the second breakpoint.

Overall, these events increased the offering of TDFs. The number of providers grew from about 7 in 2003 to 46 in 2008 (with most of the growth happening before 2008; Morningstar, 2019) and stayed almost constant at around 40 after the financial industry's M&A wave of 2008-2010. More than a decade later, balanced funds and managed accounts, both of which offer the same safe harbor fiduciary protections as target-date funds, have become afterthoughts in the QDIA selection process and are now only used by 5% and 4% of plans, respectively. TDFs are now being used by 76% of plans. Mitchell and Utkus (2020) report that the share of 401(k) plans offering TDFs increased from 33% in 2005 to 80% in 2015. These considerations provide the foundations for our approach. We will rely on the structural shift in attention over the long horizon investment induced by the law to assess how the fund families deal with investors' lower attention. In doing this, we rely on the existing literature on TDFs.

There has already been important literature on the behavior of TDFs (e.g., Sandhya, 2011, Ameriks et al., 2011, Agnew et al., 2012, Elton et al., 2015, Mitchell and Utkus, 2012, 2020). In particular, Balduzzi and Reuter (2019) document heterogeneity among TDFs in terms of risk and returns. This heterogeneity may result from either the fund family's desire to increase its risk exposure to increase market share or an effort to exploit clientele effects in the defined contribution plan market. Brown and Davies (2020) present evidence of the underperformance of TDFs resulting from fund-of-funds fees and cash drag. On the contrary, Elton et al. (2015) do not find evidence of underperformance. We contribute by relating heterogeneity in fund behavior to the distance from the fund's horizon.

We also link to the literature on agency issues in asset management. Also, in this case, it reached contrasting results (e.g., Sandhya,2011, Bhattacharya et al.,2013; Elton et al., 2015). We build on this literature to assess the role of the horizon. Our results show that absent the feature of the long-term horizon, investor attention would not allow fund families to engage in agency-related games.

[17] Commissioner Luis A. Aguilar, "Advocating for Investors Saving for Retirement," speech at the American Retirement Initiative's Winter 2015 Summit, Washington, DC, US Securities and Exchange Commission, February 5, 2015, https://www.sec.gov/news/speech/advocating-for-investors-saving-for-retirement.html.

More generally, we contribute to the literature on TDFs along multiple dimensions. The academic literature and policymakers have focused mainly on the difference between TDFs and standard open-end funds (e.g., Sandhya, 2011; Balduzzi and Reuter, 2019), their fees and costs (Elton et al., 2015; Chalmers and Reuter, 2014), drivers of TDFs' performance (e.g., Ameriks et al., 2011; Morrin et al., 2012; Agnew et al., 2012), the role played by the pension plan structure (Mitchell and Utkus, 2012), and the TDFs' role in 401(k) plans (e.g., Yamaguchi et al., 2007; Park and VanDerhei, 2008; Park, 2009; Mitchell et al., 2009; Pagliaro and Utkus, 2011; Mitchell and Utkus, 2012). More recently, Chalmers and Reuter (2014), Ameriks et al. (2011), and Agnew et al. (2012) assessed the cost-effectiveness of TDFs. We contribute by showing the effect of long-horizon investment on investors. In doing this, we also contribute to the literature on family affiliation, subsidization, and help against temporary liquidity shocks (e.g., Bhattacharya et al., 2013).

2. Data

2.1 Main Sources and Key Variables

We get the data on TDFs primarily from the CRSP Mutual Fund database, which is the source of our overall sample consisting of all US-domiciled mutual funds, balanced funds, and target date funds identified using the CRSP Investment Objective code and Lipper Fund Classifications code. The TDF sample is defined using Lipper Fund Classifications (*Lipper_Class* variable in CRSP), with values *MATA-MATM* representing various fund target dates, in years, as listed in Internet Appendix Table A1. The fund target date is when the fund investors are expected to retire. A crucial key focus variable is *Target Horizon,* defined as the difference, in years, between the fund's target date and the current date. In this way, *Target Horizon* will automatically classify a 2030 fund in 2010 and a 2040 fund in 2020 similarly in terms of clientele and portfolio structure. Balance funds are identified using Lipper Classifications: B, FX, B, I BT, MTAC, MTAG, MTAM, and MTRI, many of which were the historical Lipper Classifications of TDFs which existed before Lipper introduced the MATA-MATM classifications in 2006. All the fund characteristics, returns, expense ratios, assets under management, and holdings are extracted from CRSP.[18]

We use Bloomberg Barclays bond indices from FactSet to construct our fixed-income risk factors. Since TDFs typically hold optimized equity and fixed-income funds portfolios, we use a six-risk-factor

[18] Holdings data in CRSP are only reliable after June 2010. We map the TDF portfolios of underlying funds to their CRSP_FUNDNO identifier when analyzing the characteristics and performance of TDF portfolios.

model to benchmark the TDF portfolios' overall performance. We follow Fama and French (1993) and Gebhardt, Hvidkjaer, and Swaminathan (2005) by expanding the Fama and French (1993) and Carhart (1997) four-factor model with two fixed income risk factors. The first fixed income risk factor is the default factor, DEF, constructed as the difference between the returns of a value-weighted portfolio of investment-grade corporate bonds with at least ten years to maturity (using Bloomberg Barclays US Aggregate Corporate Long (BAA or higher) index) and a portfolio of long-term Treasury bonds (using Bloomberg Barclays US Government Long index). The second fixed income risk factor, TERM, is the difference between the returns of a portfolio of long-term Treasury bonds (Bloomberg Barclays US Government: Long index) and a portfolio of one-month Treasury bills (using Fama and French's one-month Treasury bill rate). Since factor exposures of TDFs are likely to change with the periodic rebalancing and allocation changes, we run a rolling 52-week regression model that allows for dynamic factor exposures when assessing the performance of TDFs. Therefore, at each quarter-end, we compute alpha as the intercept from the rolling regressions of weekly fund excess returns over the last 52 weeks on our six equity and bond risk factors.[19]

We report the descriptive statistics in Table 2. Panel A focuses on the entire sample of US equity funds categorized by style, including the TDFs. Panel B reports the descriptive statistics for the TDF subsample. Figure 1 presents the number of TDFs and AUM during the sample period (numerical data are presented in Appendix Table A1). In 20 years, from 2000 to 2019, the number of TDFs has grown from 63 to 2,778, with AUM rising from less than $10 billion to $1.28 trillion by the first quarter of 2019. It is important to note that, despite this increase, the providers' set of TDFs has been relatively stable since 2007 (Morningstar, 2019).

2.2 Preliminary Results: Flow-Performance Sensitivity

We provide a graphical view of the TDF flows in Figure 2. Panel A of Figure 2 provides the distribution of annual flows of target-date funds, by the horizon, before and after the introduction of the Pension Protection Act. We compute the relative annual flows represented by N-SAR’s new subscriptions (or inflows) in blue and redemptions (or outflows) in orange. We first calculate the dollar annual inflows and outflows scaled by total assets at each fund's beginning of the period. Then, we take the weighted average of all the funds within each horizon bucket using the total assets as weights. The vertical bars represent

[19] Using daily returns to compute daily alphas yields similar results.

the average inflows (outflows) figures for each bucket standardized by the first bucket's (outflows) level, corresponding to short-horizon funds. The chart reflects the relative magnitude of flows in longer-horizon TDFs relative to short-horizon funds. In Panel A, we use discrete target year cutoffs in constructing the five buckets by collapsing the mid-decade (2015, 2025, 2035, 2045) with the end-of-decade funds (2010, 2020, 2030, 2040, and 2050), which provides a clear idea of the average horizon in each bucket. The 2050 bucket also includes 2055+ target-date funds. In Panel B, we sort on target horizon (the difference between the fund's target date and the current date) every year to classify target date funds into five horizon buckets.

Two features stand out. First, as expected, the new money flowing in as a percentage of assets is mainly concentrated at the long maturity, while outflows are concentrated at the short maturity. Second, inflows significantly increase for the long-horizon funds after 2008. This suggests that the change in regulation that made TDFs the default option drastically increased the percentage inflows (i.e., increased the amount of money allocated for reasons independent of performance). These results hint at the evidence we will discuss next: the lower sensitivity of flows to performance after 2008. Indeed, the fact that TDFs became the default-induced choice increases the probability that the allocation is independent of performance.

We perform a more formal investigation of the flow-performance sensitivity using the piecewise linear specification of Sirri and Tufano (1998). We exploit flow-performance sensitivity in the same spirit as Sialm, Starks, and Zhang (2015), who use it to analyze investors' flows into defined contribution assets. We regress the annual fund flows on three performance rank variables of the fund's prior year annual return within its Lipper style, a consolidated style categorization based on the Lipper Class variable and CRSP objective code information.[20] *Low*, *Mid*, and *High-Performance Rank* variables represent the fund's ranked annual return performance constructed using the percentile rank of the prior year's annual return for the fund within its Lipper Style. We split the performance percentile ranks into three equal groups to capture the non-linearity in the flow performance sensitivity. *Low Performance Rank* is defined as the min(*Annual Return Percentile Rank*, 0.33), *Mid* = min(*Annual Return Percentile Rank – Low*, 0.33), and *High* = (*Annual Return Percentile Rank – Low – Mid*). We include *Family*Date*

[20] Lipper Style is constructed for US equity funds using CRSP objective code sector classifications and Lipper Class cap-based and value/growth/code classifications. For funds without historical Lipper classification, we use CRSP objective codes to map to corresponding Lipper styles. We include target fund classifications from Lipper Class, and we group all foreign funds into one category. Balanced funds have in their own separate group, and we also group foreign bond funds, US corporate bond funds, and US government bond funds into their own group.

and style fixed effects and cluster the errors at *Fund* and *Date* level. We include various controls such as the aggregate flows by all funds in the same style or category, the fund's expense ratio, turnover ratio, return volatility, and a retail share class dummy. We report the results in Figure 3. We provide a more detailed definition of the various variables in Appendix A.

In Figure 3A, we report the flow-to-performance sensitivity for TDFs after the introduction of the PPA ("the experiment"). We run a difference-in-differences analysis on the flow-to-performance sensitivity of target-date funds after the adoption of the PPA by looking at the universe of all the balanced funds from which TDFs were spun off from in June 2006 (balanced fund Lipper styles in CRSP: B, FX, B, I BT, MTAC, MTAG, MTAM, and MTRI). As we have argued, TDFs were preferred to other balanced funds as a default option after introducing PPA due to risk-matching by the investor's distance to retirement, even though some could potentially have similar portfolios and risk characteristics. They were assigned to the same Lipper holdings–based styles as other balanced funds. While the main characteristics of the TDFs and the non-TDF balanced funds in terms of size, performance, and equity investments are comparable,[21] the selection of TDFs as QDIAs is just based on the convenience and intuitiveness of the link between the investor's horizon (based on the target date, which defaults to the year closest to the investor potential retirement year) and the investor's risk profile.

Figure 3 A reports the flow-to-performance sensitivity (FPS) for TDFs before (solid line) and after (dashed line) the introduction of the PPA. The left (right) graph represents TDFs (Balanced Funds). We notice several points. First, before 2008, TDFs had a steep FPS for low performance. It was five times higher than the balanced funds (the difference is statistically significant on a 5% level). There were no statistical or economic differences for Medium and High-Performance Ranks. However, after 2008 the picture changed drastically. The target-date funds' sensitivity to low performance dropped by almost 82%) and is no longer statistically distinguishable from zero. At the same time, FPS for Balanced funds increased in comparison to the pre-PPA period by about 80%. For High Performance Rank, the situation is qualitatively the same as for Low-Performance Rank. Target Date Funds' sensitivity dropped by 85% and is no longer statistically different from zero. On the contrary, for Balanced Funds, we observe a modest increase of 43%. This is consistent with a "default-based" allocation to the TDFs as opposed to a "performance-based" one triggered by the PPA becoming effective. Those changes are dramatic

[21] In December 2005, there were 2,079 balanced funds and 84 target date funds with an average size of $459 million and $374 million, alphas of -.06% and -0.004%, *R*-squared of 90% and 85%, percentage of equity in the portfolio of 76% and 77%, and expense ratio averages of 1.2% and 0.5%, respectively.

compared to the balanced funds' pre-PPA period and the control group. We must note that our results differ from Sandhya (2011), who used both pre-and post-PPA periods for estimating FPS.

In Figure 3B, we report the three-dimensional plot of FPS for TDFs as a function of both performance rank and horizon. We see some weak dependence in Low- and Medium Ranks. However, the most drastic result is for High-Performance Rank. There, for every ten years of Horizon, FPS is reduced by about 20%. Thus, High-Performance FPS for 40-50 years horizon funds is essentially flat.

3. Do TDFs Underperform?

We now focus on performance to investigate the implications for the investors with low attention. A summary perspective of the main results is provided in Figure 4. It shows that the longer the horizon, the more TDFs underperform. As we mentioned, this result contradicts the conventional wisdom that TDFs are more constrained when close to maturity. Moreover, despite the widespread belief that the underperformance was concentrated during the financial crisis, the performance decay was worse in 2013-2019, when the demand had become even more captive because of the regulation changes.

To make these results more robust, we perform multivariate and portfolio analyses. We start by comparing the performance of TDFs with the other funds. The first issue to address is that TDFs have an equity component that is expected to decline over their lifetime. We consider multiple approaches. The first compares TDFs to balanced funds, and the second compares TDFs to all the CRSP open-end funds (i.e., the entire universe of US equity, balanced, and bond funds) but adjusts the factors to account for the bond loading. In the latter case, we define performance following Fama and French (1993), Gebhardt et al. (2005), and Cici et al. (2011) and by using a six-factor model: the four Fama-French-Carhart factors augmented with two fixed income risk factors.[22] The addition of the fixed income factors controls for the bond exposure. These results, reported in Table 3, confirm that the longer the horizon, the more TDFs underperform. The second approach relies on alternative specifications with Date*Family and Date*Lipper Class fixed effects. The results, consistent with the main ones, are reported in Table A2 in the Internet Appendix. Finally, we also consider a specification in which we restrict the set of TDFs to

[22] Since international equity factor is highly correlated with the US equity factor, we rely on the Fama-French-Carhart four factor model to capture risks related with various equity exposures, and on the bond default and term factors to capture risks related with fixed income exposures.

those with a sizable percentage of equity and compare them to the equity funds only.[23] The results are consistent with the main ones and are reported in Table A3 in the Internet Appendix.

Next, we address the issue that the factor exposures of TDFs are likely to change with periodic rebalancing and allocation changes. We, therefore, run a rolling 52-week regression model that allows for dynamic factor exposures when assessing the performance of TDFs. At each quarter-end, we compute alpha as the intercept from the rolling regressions of weekly fund excess returns over the last 52 weeks on our six weekly bond and equity risk factors described earlier. Alpha is our performance measure and is calculated on a rolling basis each quarter, using the previous year's data, allowing for different factor exposures every year.[24]

We regress the estimated performance on a *TDF Dummy* and a set of control variables. The *TDF Dummy* is a dummy equal to one for the TDF and zero otherwise. The control variables are defined in Appendix A. We include fixed effects (family, date, and family*date) and cluster the errors at the fund family and date level. As we mentioned, we consider both the gross-of-fee and net-of-fee performance. We report the results in Table 3. In line with our flow-performance analysis, we consider the sample of all balanced funds before the PPA 2006 (Panel A; the sample selection is the same as in the analysis of the flows above). We also use all the CRSP funds (Panel B). Panel C reports the results for both samples with double interaction between *TDF Dummy* (short — less than eight years, medium — between 8 and 17 years, and long — over 17 years) and Period Dummies. *TDF Dummy* is a dummy equal to one if the fund is defined as a TDF and zero otherwise. Specifications 1 and 5 are panels with *Date* and *Family* fixed effects, while specifications 2-4 and 6-8 use *Date*Family* fixed effects. We report the *F*-statistics of the equality test between short and long horizons (specifications 3 and 7) and the difference between periods before PPA and post-PPA (specifications 4 and 8). In Panel C, we report the changes in performance before and after the introduction of PPA for short and long-horizon TDF funds.

Comparing the performance of balanced funds and TDFs, we see that TDFs underperform by 77-88 bps per annum for a net-of-fees alpha and 39-46 bps for a gross of fees alpha. The effect is strongest for the long funds, and the differential of underperformance between short and long funds varies from 84

[23] We consider two thresholds: 90% equity and 94% equity. Above such thresholds, we are left with so few funds that the statistical analysis suffers. Those fnds should be similar to long-horizon TDFs.
[24] Such an approach is different from the approach of Sandhya (2011) and Balduzzi and Reuter (2019), who used monthly data and whose estimates might be affected by pre-determined changes in the glide path.

bps per annum net-of-fees to 65 bps gross-of-fees. We also see that the underperformance did not exist before 2008 and suddenly increased from zero to 103 bps (66 bps) net-of-fees (gross-of-fees).

We see the same pattern when comparing TDFs with non-TDF open-end funds in Panel B. The performance of TDFs is lower than the other open-end funds. TDFs deliver a 10-104 bps lower annual performance than the other funds in terms of net-of-fee alpha (65-68 bps gross-of-fees). The effect is stronger for the long-horizon funds, with the net-of-fee (gross-of-fee) annual underperformance differential of 33 (26) bps for the long horizon. In the Appendix, Table A4 provides specifications with date, family, and style (Lipper Class) fixed effects as a robustness check. The results are similar.

When we break down the analysis in the different subperiods, we see that, while the effect of being a TDF is negative in all three periods, the impact is concentrated in the second period. Then, being a TDF is related to a lower annual performance of 115 (81) bps in terms of net-of-fee alpha (gross-of-fee) and 95 (55) bps in the third period. The negative effect is also there for gross-of-fee, suggesting that being a TDF changes the fund manager's actual performance and investment, not just what accrues to the investor. Overall, these results show that TDFs underperform the open-end funds in both gross- and net of fees, and the effect is stronger after the PPA came into force.[25]

Panel C compares TDFs and other funds by detailing the analysis by fund horizon and subperiods. We see that pre-2008, the underperformance concentrated mainly among the short-horizon funds. After the adoption of PPA, the picture changed drastically. In 2008-2012, long funds underperformed, in some comparisons as bad as 160 (123) bps net-of-fees (gross-of-fees). Interestingly, short-horizon funds improved their performance from 2008 to 2012. After 2012, the underperformance of long-horizon became smaller but is still very substantial, at 101-109 (57-66) bps net-of-fees (gross-of-fees).

Next, we zoom in on the TDFs and investigate the link between lower performance and horizons. We regress performance on *Target Horizon* and a set of control variables and report the results in Table 4. Columns 1–4 are based on net-of-fee performance, while columns 5–6 are based on gross-of-fee performance. We find a robust negative correlation between performance and horizon. This result holds across the different specifications and is economically relevant. An increase in the horizon of 10 years translates into a 29 bps lower performance net of fees. Again, if we split the analysis into different periods,

[25] We report in Table 3 only the results for comparison between TDFs and all funds and TDFs and balanced funds. As a robustness check, we estimate similar models for TDF and all non-TDF US equity funds with equity allocations in excess of 90% and 94%. The results are qualitatively similar to the ones reported and are included in the Internet Appendix.

we see that the effect starts in the second period. Indeed, within that period, the performance loss is almost twice as bad as in the third period. An increase in the horizon of 10 years is related to 45 (42) bps lower annual performance net-of-fee (gross-of-fee) in the second period and to just 26 (25) bps during the third period. Instead, the effect is either not sizable or is of the opposite sign during the first period.[26]

Finally, we consider a portfolio analysis. We construct portfolios rebalanced every month by ranking funds in quartiles as a function of the horizon. In particular, we first sort the funds as a function of *Target Horizon*. Then, we build portfolios for each group by equally weighing the fund'' performance in the groups.[27] We report the results in Table A5 of the Internet Appendix. In the portfolio analysis, similar to the multivariate one, we interact the alpha with the different TDF subperiods. We report the baseline results for the entire sample and the post-2008 sample. Columns 1–5 report the 2001–2019 sample results, while columns 6–10 report the 2008–2019 subsample results. Columns 5 and 10 report long-short strategies, where the long side corresponds to the long-horizon quartile of TDFs, and the short side represents the short quartile.[28]

We find that the effects of a long horizon are concentrated after 2008. It is non-existent before 2008, strong from 2008 to 2013, and marginally weaker after 2013. In particular, the difference in annual performance between the fourth and the first quartile is around -124 (125) bps for the period after 2008 and before 2013 and reaches -106 (121) bps after 2013 for the overall sample (from 2008 to 2019). This result is consistent with the underperformance of long-horizon TDFs becoming stronger after investing in TDFs has become the default option in retirement accounts.

To get a sense of the actual economic magnitude of these numbers, in Figure 5, we look at the investor's cumulative performance and compare it to what it should have been if the effect of the horizon we identify in this paper had not been there.[29] We compare the net-of-fees performance of TDFs with the underperformance related to the horizon effect (as derived from Table 5 in this paper) with a hypothetical

[26] In Appendix Table A4, Specifications 1-2, we report the specifications analogous to Specifications 1 and 2 of Table 5 with Date, Family, and Lipper Class fixed effects (column 1) or Family*Date and Lipper Class*Date fixed effects. The results are similar to our base results.

[27] Value-weighted portfolios that provide average performance figures on an asset-weighted basis produce similar results. We focus on equal-weighted portfolios as our objective is to document the average performance of typical TDF.

[28] TDFs are sorted into horizon quartile portfolios every period. Average horizons to target date in Q1, Q2, Q3, and Q4 are 3.4, 12.3, 23.7, and 37.5 years, respectively.

[29] We assume the standard glide path of 90% equity and 10% bonds for horizons above 20 years, 10% equity and 90% bonds for retirement (horizon 0), and linear in between a 20-year horizon and target date. We further assume that individuals start investing at age 18 (investing $1) and invest $1 each year for 50 years and that the real return for equity and bonds is 7% and 2% per year, respectively.

glide path ETF that does not have such underperformance built-in. The numbers are staggering: for an average investor who invests for 50 (20) years, the drag on performance induced by the behavior of the TDFs reduces their cumulated performance by 21.9% (6.3%) in the case of the net-of-fee performance and by 20.6% (5.9%) in the case of the gross-of-fee performance. This suggests that the underperformance is not just a result of the “fees-on-fees” effect but is also related to the inability of the TDFs to deliver better asset management skills relative to the other open-end funds. Therefore, we will later consider two channels in the analysis: one based on overcharging fees and one based on lower portfolio performance.

4. Why Do TDFs Underperform?

The previous findings make one key point: the underperformance of TDFs is concentrated in longer-horizon funds and during periods when demand becomes more captive due to the new regulations. The next question is whether we can relate these effects to affiliation with the fund family. As argued, family affiliation provides skills and economies of scale to help TDFs. On the other hand, family affiliation also generates “obligations” as the investment choice may be constrained by the need to choose the family's funds to invest in.

We start by looking at the link between key family characteristics and TDF performance. We focus on characteristics that proxy for the potential benefits of investment skills related to family affiliation and characteristics that proxy for the constraints related to family affiliations. We expect that the negative impact of the horizon should be smaller for more “expert” families — that is, larger families and families with a high average percentage of investment by the family in equity. In contrast, the negative effect of the horizon on performance should be stronger for more “problematic” families — that is, families with higher flow volatility. Indeed, families with higher flow volatility may have a higher incentive to use TDFs as providers of stable demand for their funds. Also, TDFs sold to inattentive retail investors instead of attentive institutional investors should perform worse at a longer horizon.

We, therefore, define the following proxies: a *Retail Dummy,* defined using the retail fund flag in CRSP; *Family Flow Volatility*, defined as the average flow volatility in the underlying funds; *Family Equity as % of Family TNA*, defined as the percentage of family assets in equity funds; and a *Family TNA*, defined as the *log* (1+Family total assets). We then regress fund performance on *Target Horizon* and its interaction with our drivers. We include the control variables defined before and fixed effects in all the specifications, either *Date* and *Family* fixed effects or *Date*Family* fixed effects. We cluster the errors at the *Family* and *Date* levels. In Appendix Table A5, we also provide specifications with Family*Date and Lipper style*Date fixed effects as a robustness check[30]. The results are similar.

We report the results in Table 5. In the interest of brevity, we do not report the control variables. In Panel A [B], specifications (1–2) and (5–6) report the double interactions of *Target Horizon* and *Retail Dummy* or *Family Flow Volatility* [*Target Horizon* and *Family Equity's* defined as *% of Family TNA or log of Family TNA*]. Further, in specifications 3–4 (7–8), we triple-interact *Target Horizon* and *Retail Dummy* or *Family Flow Volatility (Family Equity as a % of Family TNA* or *log of Family TNA*) and period dummies. Specifications 1 and 5 are panel estimates with *Date* and *Family* fixed effects, while specifications 2–4 and 5–8 use *Date*Family* fixed effects. We report *t*-statistics, adjusted for clustering over fund and date, in parentheses.

In line with expectations, the horizon's negative impact is stronger for retail funds and funds that belong to families with higher volatility. Also, it is weaker for funds belonging to bigger families and families that specialize more in equity. In particular, if we focus on net-of-fee performance, we see that one standard deviation higher family flow volatility (being a retail fund) is related to 5.8 (1.4) bps lower annual performance for every ten years of the horizon. This represents 26% (5%) of the base effect of the horizon. In comparison, one standard deviation higher percentage invested in equity by the family (size of the family) is related to an increase in performance of 8.6 (5.2) bps for every ten years of the horizon — an improvement of 13% (8%). Again, the results are concentrated in the period 2008–2019. These results are consistent with our working hypothesis that TDFs that rely on the family's expertise (big family, higher family specialization in the equity products) deliver better performance. In contrast, the funds that belong to families with more unstable flows can rely less on this expertise.

As for the case of the baseline results, we confirm the multivariate results using a portfolio approach. We apply the same portfolio construction technique as defined before. We double-sort: first, we sort the focus variable into two buckets based on several determinants, namely, Institutional/Retail, family flow volatility, family equity assets as a percentage of total family assets, and family size, and then we sort within each bucket into *Target Distance* quartiles. The results in Table A7 in the Internet Appendix confirm our previous conclusions.

[30] Specifications 3-6 in Table A5 mirror specifications 2 and 6 in both Panels A and B of Table 5.

Overall, these results show that the negative relation between performance and horizon is related to family characteristics. We now proceed to investigate where such a negative effect comes from. We will look at the choice of underlying funds and then entertain two possibilities. The first possibility is that the families deliberately exploit the less flow-sensitive TDFs to "help" the family's other funds by buffering their outflows shocks. The second possibility is fee skimming: the fund family exploits the longer horizon to charge higher fees.

5. Sources of TDF Underperformance: Underlying Fund Selection

One way to assess whether families deliberately “play games” is to investigate whether fund families responded to the influx of inattentive investors induced by the passage of the PPA Act by changing the set of underlying funds within their TDFs or by the behavior of the underlying funds. In particular, we ask whether families make TDFs invest in their worst affiliated funds, whether they changed the investment as a function of the horizon of the TDF, and whether this behavior has changed over time as a function of the PPA that has induced the influx of inattentive investors. For example, the first question asks whether the family chooses higher-fee, lower-quality underlying fund X over equally available underlying fund Y. The second question asks whether the choice of the worse underlying funds is related to the horizon of the TDF. The third question is whether TDFs’ choice change following the PPA. Answering these questions requires us to contrast the behavior of underlying funds to other available funds because these are the relevant counterfactuals – i.e., whether the TDFs would have performed better if the family had built the TDFs around a different group of underlying funds. This means investigating the choice, conditioning it on a set of otherwise similar underlying funds, and testing which funds are included within the available choices.

The fact that TDFs are offered in series helps us to design precise tests. Indeed, multiple funds are offered within a series with different retirement dates. While a few fund families offer multiple TDF series (e.g., Fidelity, BlackRock), most fund families that engage in this market offer only one series (e.g., Vanguard, American). Therefore, we can focus on within-family and family/series variation to assess the impact of the horizon on the family's behavior. In the latter case, we can exploit the variation by comparing TDFs with different target dates in the same series – e.g., Fidelity Freedom 2020 vs. Fidelity Freedom 2060.

First, we ask if there is a different selection of funds for different horizons within the same series of TDFs. Viceira (2008) provided an overview of the theories of the lifecycle funds and noted that in the first approximation, one could think of TDFs in the mean-variance framework as the combination of riskless assets and the market portfolio. He also noted that stock-return predictability or mean reversion might make it optimal for investors to strategically tilt their portfolio to equities in the long horizon. We also note that it is difficult to consider many variables related to individuals' labor and real estate risk exposures on a large-scale pension plan level. Such a difficulty is exaggerated by the default-option feature of TDFs within the pension plan. Thus, we probably do not expect the composition of the equity portfolio to differ significantly for different horizons.

Table 1 reports the example of T. Rowe Price Retirement TDFs. For the 2060 fund, 51.1% of the equity portion of the portfolio is allocated to three underlying funds: 10.3% S&P500 index fund (with an expense ratio of 0.889%), 19.4% Large Growth fund (with an expense ratio of 1.066%) and 21.4% T Rowe Price Value fund (with expense ratio 1.005%).[31] So, the combination of Growth and Value provides the same economic exposure as the S&P500 fund at a 0.13% extra expense ratio. For the 2025 fund, the combination of those three funds is similar (50.5%), but the weight of the S&P500 fund is higher by 8.6%, and Growth and Value funds are down by 4.4% and 4.8%, correspondingly. While we are aware of Jurek and Viceira's (2011) result of optimal overweight of growth (value) stocks on the long (short) horizon, we are not aware of any result that makes it optimal to tilt the portfolio to both growth and value in the long horizon. Among the remaining twelve equity funds, six have deviations, in absolute terms, above 0.1%.

In Figure 6, we report the histogram for the distribution of the sum of absolute deviations of equity weights with respect to average weight within the given TDF series. Figure 6, Panel A reports the distribution for the overall sample. In Figure 6B, we limit the sample to only series that invest in the same funds between the different series. As the different TDFs within the same series might report on somewhat different dates, for Figure 6B, we also imposed the condition that all funds within the series must report on the same date. In Figure 6A, we see that only about 14% of funds are within the strict "no-deviation" rule. Looking at the deviations below 5%, we are at about 29% of TDFs. Under more stringent requirements in Figure 6, Panel B, this number is 22%. These results suggest that most TDFs deviate from the "average" series holdings in a way that mechanical factors cannot explain.

Next, we provide a set of formal tests that address our three questions. First, we estimate the choice of the TDF in selecting its underlying equity funds. We condition on the "similar" funds of the same

[31] Interestingly, all three funds are about 15-20 bps more expensive than the average in the category.

family available to the TDF manager. These are defined as all the funds that belong to the same family, belong to the same 3- or 4-digit Lipper class and have the same Activity status (i.e., active or passive funds).[32] By passive funds, we understand both index funds and ETFs. While doing so, we take a conservative stance that the overall portfolio weights for each style are close to optimal, families do an excellent job building portfolios of TDFs, and only the choice of a particular fund among the set of otherwise similar funds within the same Lipper Class is questionable.

We estimate a Tobit specification in which we regress the share of underlying fund *i* in the equity share of a Target Date Fund *k* on the degree of underperformance of the underlying fund, its expense ratio, its interaction with the TDF's horizon, and a set of control variables. We choose the Tobit model over the binary model because we are interested both in choice and the weight assigned, and Tobit ideally allows us to determine both. We consider two alternative measures of underperformance: $Alpha_{-}=-min(0, Alpha)$ and a *Dummy(Alpha<-1% pa),* taking the value of one for the funds with alpha less than -1% p.a. and zero otherwise. We use CAPM *Alpha*, calculated using 36 monthly observations. *Log (N_pos)* is a logarithm of the number of positions the Target Date fund chooses to have. The other control variables are the logarithm of the size of underlying fund *i*, retail dummy, and *Active Fund Dummy*. We interact our variables of interest with *TDF Long Horizon*, where *TDF Long Horizon* is defined as one if Horizon (the difference between TDF Horizon date and today's date) is greater than 17 and zero otherwise. The errors are clustered for each Target-Date fund *k*. We also report several F-statistics (and corresponding p-values in parentheses) to test the difference between coefficients.

We report the results in Table 6 Panel A. Specifications 1, 2, 5, and 6 contain a three-digit Lipper class fixed effect, while Specifications 3, 4, 7, and 8 contain a four-digit Lipper class fixed effect. As a measure of agency problems, we use either $Alpha_{-}=-min(0, Alpha)$ (Specifications 1-4) or *Dummy(Alpha<-1% p.a.)* (Specifications 5-8). In specifications 2, 4, 6, and 8, we split the effect as pre-and-post 2008. We see that unconditionally (specifications 1 and 5 and 3 and 8), worst-performing funds are more likely to be selected, and this effect is stronger for long-horizon TDF funds. Being a low-performing fund translates into a 0.36% [0.47%] higher probability of being chosen (or 6.4% [8.3%] of the unconditional probability of being chosen) in the case of $Alpha_{-}$ *[Dummy(Alpha<-1% p.a.)].* This estimate increases to 0.43% [0.85%] or 7.5% [14.9%] of the estimated unconditional probability of

[32] We also did the estimates without the last condition. We also tried imposing the additional condition based on the Retail/Institutional class status. The results were similar.

choosing the given fund for the long-horizon TDFs. Generally, those results are consistent with the general result of Chan et al. (2017)[33].

In terms of the weight, one standard deviation higher Alpha_{-} increases the weight by about 0.95% or 10.1% of the mean (conditional on the weight being positive). For the long-horizon TDFs, this effect is further increased by 0.17-0.22%. (or 1.80-2.34% of the mean). For *Dummy(Alpha<-1% p.a.),* the base effect is between 0.81% and 1.23%, or between 8.6% and 13.1% of the mean. For the long-horizon TDFs, the effect almost doubled (by 0.98-1.04%, or 10.4-11.1% of the mean). Subperiod analysis shows that this effect is concentrated in the post-PPA period.

If we look at the fees, we see that while, in general, lower fees funds are selected, this is less so in the case of long-horizon TDF. The former result is consistent with Elton et al. (2015), who showed that TDFs choose cheaper funds and, unlike Chan et al. (2017), who showed the opposite. Neither of those papers looked at the horizon or PPA. Indeed, for the case of long-horizon TDFs, if the fees of the underlying selected funds are one standard deviation higher, the probability of selecting the fund is between 0.34% and 0.36% higher (that corresponds to 6.0-6.4% of unconditional probability). Similarly, the one standard deviation higher expense ratio corresponds to a 0.85%-0.94% higher weight (this corresponds to a 9.1%-10.1% increase of the mean conditional on the weight being above zero. Moreover, the effect of long-horizon is the decisively post-2008 effect.

Among other variables, there are a few interesting results. First, TDFs seem to like larger funds. Considering the AUM concentrated in TDFs and the desire to keep the number of holding reasonably small, this is understandable. Second, TDFs prefer the institutional share classes (consistent with Elton et al., 2015). Finally, TDFs prefer actively managed funds as opposed to passive ones.

Next, we focus on how the investment changes with the horizon within the same TDF series. This allows us to address the issue of whether, all else equal, the fund management company changes investment behavior as a function of the horizon. The critical difference between this specification and the previous one is that we condition on the series. This allows us to see whether, at a specific time, the 2020 and 2060 funds that are a part of the same series make different choices regarding the underlying funds they invest in. We, therefore, look at the difference between the weights of the specific underlying equity fund i in the given equity share of TDF k and the average of such a weight of fund i in all the

[33] Chan et al. (2017) used the probit regression to estimate the probability of the same family fund being chosen over all other funds that belong to the same family. Such a choice of an alternative group of underlying funds is questionable.

Target Date Funds that belong to the same series. In the example we showed in Table 1 for T. Rowe Price Equity Index 500 fund, the average share among all TDFs is 0.145, and the difference for the 2060 fund is 0.103-0.145 = -4.2%. We regress it on our underperformance and fees defined as before and a set of control variables. We estimate a panel regression with Lipper Class, Series and Year fixed effects and errors clustered over the TDF Series and Year. We interact our variables of interest with *TDF Long Horizon*. We report the results in Table 6, Panel B. The layout is the same as in Panel A.

In line with our working hypothesis unconditionally (specifications 1 and 5 and 3 and 8), we document that there is more weight in worse-performing funds within the series and this tilt towards underperforming funds is stronger for long-horizon TDF funds. Being a one-standard deviation worse-performing fund as measured by $Alpha_{-}$ (moving *Dummy(Alpha<-1% p.a.)* from zero to one) translates into a 0.12% (0.61%) higher weight of the long-horizon fund with respect to average TDF in the series. That represents 4.0% (20.0%) of the dependent variable's standard deviation[34]. Similarly, for the long-horizon TDF, one standard deviation higher *Expense Ratio* moves the dependent variable by 13.1-13.8% of its standard deviation. Looking at the subperiods, we see that the negative performance effect is concentrated in the post-PPA period, while the effect of the expense ratio existed even before 2008.

6. Sources of TDF Underperformance: Outflow Buffering

One possible explanation for why TDFs underperform is that they "subsidize" the family's underlying funds. One reason to help them is to buffer their liquidity shocks: as the family's funds face outflows that can induce fire sales, the TDFs are used to replace such outflows. To test this hypothesis, we first relate the performance of TDFs to some characteristics of the family with which they are affiliated. Then, we zoom in on the activities related to the link: outflow buffering.

We start by regressing performance on the TDF horizon, the outflows of the funds belonging to the same family that the TDFs invest in, and their interaction. The intuition is that the higher the outflows, the bigger the need to help. We define the outflows faced by the underlying funds in which the TDF invests (*Underlying Same Family Outflows*) as the sum of the monthly outflows over the prior year for all the underlying funds in which the TDFs invest and belong to the same family scaled by assets at the beginning of the year.

[34] As the mean of dependent variable here is zero by construction, the natural way of comparison is to use the standard deviation.

We report the results in Table 7, Panel A. We find that the higher the outflows of the family's underlying funds, the lower the performance of the TDFs. This finding holds across the different specifications. One standard deviation higher outflows of the family's funds in which the TDF invests is related to between 11.3 and 12.4 bps for every ten years of horizon lower annual performance (which represents 63.6% and 56.9% of the base effect, correspondingly).

This establishes a link between the underperformance of TDFs and the need to help other funds in the family. The next step is to ask whether this link is deliberate. Therefore, we construct a measure of the TDFs' tendency to invest in the same family's funds (*Family Tilt*). The idea is to measure whether the style allocation (e.g., US equity, foreign equity, US fixed income, and foreign fixed income) in the TDF is more disproportionately tilted to the same family funds than would be implied by the relative size of this family within this style. For example, is Vanguard allocating proportionally more assets in its TDF funds to US equity Vanguard funds? This measure is defined as the difference between the same family-style weight (e.g., the sum of all positions for US equity underlying funds managed by the same family and scaled by the TDF's total assets) in the TDF portfolio minus the allocation benchmark, which is defined as the average ratio of the family assets in the same style. Then, we interact with the horizon with this tilt measure and the outflows of the underlying funds.

The results, reported in Panel B, show that the negative relationship between performance and horizon is amplified by a higher tilt toward the family's funds and higher outflows of the family's funds in which the TDF invests. Increasing both *Underlying Same Family Fund Outflows* and *Family Tilt* by one standard deviation leads to an annual underperformance of between 47 and 58 bps for every ten years of the horizon. As in the previous analysis, we confirm the multivariate results with portfolio analysis based on sorting TDFs as a function of the outflows of the family's underlying funds in which they invest and their tilt.[35] In line with the multivariate results, the TDFs with high *Family Tilt* and high *Family Fund Outflows* deliver an annual performance of 101 bps lower than the TDFs with low *Family Tilt* and low *Family Fund Outflows.*

[35] Given that the greater freedom to act makes such TDF behavior more likely to occur in the long horizon, we concentrate on the "long-horizon TDFs," defined for every period as the funds in the top quartile ranked by the *Target Horizon*. Funds are sorted into two equal *High* and *Low Family Tilt* groups as a function of the difference between the same family-style weight in the TDF portfolio and the average ratio of family assets in the same style relative to total style assets. We construct portfolio returns by sorting TDFs within each of the *Family Tilt* groups on the *Family Fund Outflows*, where the top quartile group is compared to the rest. The important difference with the previous sort is that we only looked at long-horizon funds, ignoring the other funds. To avoid having very few funds per portfolio, we divide into "high" and "low" portfolios along both *Family Tilt* and *Family Funds Outflows*. We report the results in Table A7.

Overall, the results provide evidence that one component that reduces the performance of the TDFs, especially at a longer horizon, is their investment in the family funds that display outflows. Of course, this would suggest that families deliberately choose to invest in such funds. We, therefore, investigate the determinant of the tilt. As we have argued, TDFs may tilt their allocation in the funds of the family to help them out, mainly in case they show outflows. We test this hypothesis by relating the percentage invested in the same family's funds to their outflows and control variables. We consider two alternative measures of tilt. The first is the *Family Tilt,* while the second is defined as the fraction of AUM invested in actively managed funds belonging to the same family (*Actively Managed Funds in the Same Family*). *Family Tilt* allows us to capture the amount invested in the family's funds overall (i.e., active and passive). In contrast, *Actively Managed Funds in the Same Family* capture the investment in the active funds—that is, the ones that are more likely are in need of subsidization.

The results are shown in Table 8, Panel A for *Family Tilt,* and Panel B for *Actively Managed Funds in the Same Family*. We find a robust positive relationship between outflows and the family's choice to invest in such funds. The effect is also economically strong: one standard deviation higher for same family outflows is related to a 7.8%–10.6% (4.1%–9.5%) higher probability of investing in the family's funds (active funds of the family). Also, *Target Horizon*'s effect on *Actively Managed Funds of the Same Family* is concentrated after 2008. Although marginally significant, the results for *Family Tilt* also point toward a positive dependence of tilt on the horizon. These results are consistent with the view that, while in the initial selection, underlying funds' outflows might not play the role they do in determining the performance of the TDFs.

Overall, these results suggest that TDFs deliver worse performance in general and even more so at a longer horizon because they invest in the family funds that face outflows, which are likely to buffer the liquidity shocks. The funds are likely to be actively managed funds for which the effect of performance on outflows is more critical. The buffer against liquidity shocks helps deliver better performance because of the lessened need to hold liquid assets.

7. Sources of TDF Underperformance: Fee Skimming

The second possibility is a fee-skimming strategy. Two layers of fees are charged to the TDF investors: the fees that TDFs charge and the fees charged by the investment vehicles (mostly actively managed funds) the TDFs are investing in. Given that most TDFs invest in family funds, one possibility is for the families to charge low fees on the TDFs — the ones directly observable — and charge higher fees on the underlying funds — the ones less observable. Therefore, we regress the different fees (fees on the TDFs, fees on the underlying funds, overall fees) on whether the fund is a TDF and, conditioning on it being a TDF, on its horizon.

We report the results in Table 9, focusing on the *Underlying Expense Ratio*.[36] For example, the VFORX underlying expense ratio was calculated as 0.14% in 2018, which matched the Vanguard website. In Panel B of Table A8, we report the regression for the headline *Expense Ratio*. The horizon plays an important role: the longer the horizon, the higher the underlying fees. In particular, an increase in the horizon of 10 years is related to 3.3-3.8 bps higher annual total fees. Interestingly, after controlling for the share of the same family active funds directly, we see from specification (4) that the effect of Target Horizon can be split into the "base" horizon effect (representing approximately three-quarters of the effect in Specification 3 at 2.4 bps for ten years of *Horizon*), and *Actively Managed Funds* interactive effect. If we increase the horizon by ten years, increasing the *Same Family Actively Managed Funds* by one standard deviation, the underlying expense ratio increases by about 0.54 bps.[37] Looking at the subperiod, we see that the direct effect of the Horizon on hidden fees is concentrated after 2008.

Is it possible that the effect is driven by long-horizon funds having more equity? While we directly control for the share of equity in TDF in our specifications, still, to formally investigate this issue, in Panel B, we detail our analysis for the fees associated with two equity subcomponents (US Equity and Foreign Equity). We see that for both components, the direct effect of the horizon is strong and again is concentrated after 2008.

Comparing these results with the results for the headline *Expense Ratio*, we see that there is no effect of *Target Horizon* for the latter. However, we also see that even the headline expense ratio is higher for the TDFs with many active funds. One standard deviation increase of *Actively Managed Funds* increases the *Expense Ratio* by about 5 bps, most of this effect came after 2012. These results suggest that TDFs underperform at a longer horizon because of the fund family's desire to use them to exact higher fees on the underlying funds.[38]

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[36] In Table A8, Panel A, we report the *Expense Ratio* regression for the overall sample of mutual funds. We document a robust negative relationship between TDF and fees: TDFs command lower fees than an average non-TDF. The lower fees range between 40 and 50 bps per year. This result is expected as the TDFs are supposed to be just funds of funds and should have lower fees than the average actively managed fund. A look at the subperiods reveals that between early 2000 and today, the *Expense Ratio* differential shrank by about 10 bps. This is consistent with the results reported by Elton et al. (2015).

[37] This comes in addition to direct effect of Actively Managed Funds. A one standard deviation increase leads to 13 bps higher hidden fees.

[38] In unreported results, we also show that TDFs tend to invest in more expensive classes of same-family funds.

8. The Effects on Risk-Taking by TDFs

The previous findings suggest that TDFs engage in behavior that, at the overall level, helps the group – i.e., outflow buffering and fee skimming. The outcome is lower performance. The question is whether this behavior also takes the form of higher risk-taking. To address this issue, we regress various proxies for risk-taking on *Target Horizon*, the volatility of flows of the underlying invested funds — the main driver of subsidization — and a proxy for the degree by which the TDF invests in the funds of the family as well as a set of control variables.

We consider volatility in the daily return of the fund over the previous three months as our measure of risk-taking. In Appendix Table A9, we report the results for drawdown (defined as the maximal loss in the previous three months and a fund beta (defined as a market beta in the six-factor model we use). The other variables are defined as before.

We report the results in Table 10. In specifications 1–4, we interact with *Target Horizon*, *Underlying Same Family Fund Outflows,* and *Family Tilt*. In specifications 5–8, we interact *Target Horizon*, *Underlying Same Family Fund Outflows,* and actively managed funds by the same family (defined as a fraction of AUM invested in actively managed funds, same family, *AMF Same Family*). We interact with Target Horizon with period dummies in specifications 2, 3, 6, and 7.

In all the specifications and alternative definitions of risk, we find a strong positive correlation between fund risk-taking and investment in the family's funds when their volatility of flows is high. This result holds across the different specifications and is economically relevant. For every ten years of the horizon, an increase of both tilt toward family funds and same family outflows by one standard deviation translates into a 2.3% higher volatility. The number for the case of one standard deviation of the same family's actively managed funds is 1.1%. If we split the analysis into different periods, the effects are primarily concentrated in the third period. Indeed, within that period, risk-taking arising from subsidization peaks. The results for drawdown and systematic risk (beta) are similar.

Overall, these results show that the process of subsidization that the TDFs engage in has negative implications regarding the risk-taking to which they expose the investors. Notably, this effect comes from risk-adjusted underperformance as measured by alpha.

Conclusion

We study whether asset managers shielded from liquidity constraints and investors' short-term needs invest in the long-term portfolios that are in their investors' best interest. We argue that extending the horizon seems beneficial for investors in terms of optimal portfolio allocation. However, it also allows asset managers to use such a shield to engage in behaviors that are detrimental to their investors.

We test this argument by focusing on a specific set of funds —TDFs — created to invest for the long run and for which the investment horizon for the investors is well-defined and deterministically changing over time. We first confirm the conjecture that, in TDFs, investor attention is lower when the fund is still far from the target date than when it is closer to it. Given the investors' relative inattention, the fund manager finds himself privileged to invest in the long run without the investor's pervasive short-term scrutiny.

Our analysis confirms that TDFs deliver lower performance than the other comparable US balanced or equity funds and that TDF performance is worse the further the TDF is from its maturity date — that is, at the very time in which the literature and practitioners suggest that performance ability is higher, thanks to the ability to invest in equity with no constraints.

Next, we investigate the channel by which this happens. The primary reasons are related to the selection of funds that were initially not very good (as measured by alfa) and catering to the funds with recent high outflows. It is also related to charging higher fees and being used to subsidize the family's other funds. The overall effect for the investors results not only in lower performance but also in higher risk.

Our results underline the importance of an open-architecture structure at the fund level. In 2017, Andrew Arnott, president and CEO of John Hancock Investment Management, called for an open architecture for TDFs: "Today, plan-level best practices call for an open-architecture, or multimanager, lineup of investment offerings, but that line of thinking rarely extends to target-date portfolio construction. If open architecture is important, more target-date funds should be open, incorporating a variety of specialized teams based on their merits."[39] We can only second this sentiment. Another takeaway is the importance of transparency in the risk level that TDFs take for short and long horizons.

[39] Quoted in "White Paper: Target-Date Funds: Embracing Open Architecture in Retirement's Most

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Appendix A: Variable Descriptions

Variable	Description
Target Horizon	Difference between the target date (target year, or horizon), defined in the Lipper Class code variable, and the current year. See Internet Appendix Table A1 for the list of the various Lipper Class codes of target-date funds.
Expense Ratio	*Exp_Ratio* variable from CRSP. For TDFs, it reports the TDF fees and does not include the expense ratios of the underlying funds themselves (e.g., CRSP reports a zero-expense ratio for Vanguard's 2040 TDF (ticker: VFORX)).
Expense Ratio, Underlying Funds	For TDFs, it is computed as the average expense ratio of underlying funds in the TDF portfolio, weighted by the position in each underlying fund (e.g., the VFORX underlying expense ratio is calculated as 0.1442% in 2018, which matches the data reported on the Vanguard website).
Market Risk Factor	MKTRF is defined as the CRSP value-weighted market return minus the risk-free rate, defined as the one-month Treasury bill rate, from Ken French's website.
Size Factor	SMB is defined as the size (small minus big) risk factor from Ken French's website.
Value Factor	HML is defined as the value (value minus growth) risk factor from Ken French's website.
Momentum Factor	UMD is defined as the momentum (winners minus losers) risk factor from Ken French's website.
Default Factor	The default risk factor is constructed as the difference between the returns of a value-weighted portfolio of investment-grade corporate bonds with at least ten years to maturity (using Bloomberg Barclays US Aggregate Corporate Long (BAA or higher) index) and a portfolio of long-term Treasury bonds (using Bloomberg Barclays US Government: Long index).
Term Factor	Term or duration risk factor is defined as the difference between the returns of long-term Treasury bonds (Bloomberg Barclays US Government: Long index) and a portfolio of one-month Treasury bills using Fama and French's one-month Treasury bill rate.
Alpha	Constructed as the intercept from the 52-week rolling regression of the weekly fund returns minus the risk-free rate on the six weekly risk factors described above. Gross alpha is the intercept resulting in the regression using gross returns of the fund (after adding back the fees to weekly net returns). Alphas are then annualized.
Net Flows	Net monthly flows are inferred from monthly total net assets and net returns data in CRSP, scaled by the assets at the beginning of the period (or end of the previous period).
Outflows	N-SAR-based monthly total redemptions extracted from CRSP's Fund_Flows dataset scaled by fund assets at the beginning of the period.

Inflows	N-SAR-based monthly total new subscriptions extracted from CRSP's Fund_Flows dataset and scaled by fund assets at the beginning of the period.
Total Flows, Style	Aggregate flows for all funds in the same style, scaled by the total assets, using Lipper Class style definitions, including detailed TDF horizon styles.
Return Volatility	Total return volatility using the last 12 monthly returns.
Quarterly Drawdown	Maximum possible quarterly loss is computed as the largest decline in cumulative daily returns (peak-to-trough return, in absolute value) during a quarter.
Equity, % of TNA	For TDFs, it represents the fraction of the equity fund assets of the fund. When holdings data are not available, we use the sum of the CRSP variables: per_com and per_eq_oth.
Underlying Same Family Fund Assets %	Sum of underlying fund assets associated with the same family as the TDF family, divided by TDF assets.
Underlying ETF Assets, %	Sum of the assets of underlying funds classified as ETFs (et_flag), divided by TDF assets.
Underlying Index Mutual Fund Assets, %	The Sum of the assets of underlying funds classified as index mutual funds (index_fund_flag and et_flag is missing) is divided by TDF assets.
Underlying Active Mutual Fund Assets, %	Sum of the assets of underlying funds that are not classified as index mutual funds or ETFs, divided by TDF assets.
Family TNA ($mil)	Total assets of all funds in the family.
Family Equity, % of TNA	Sum of all US equity funds of a family divided by total family assets.
Same Family Fund Outflows	Sum of monthly outflows over the last year for all underlying funds managed by the same family, scaled by assets at the beginning of the year.
Turnover Ratio	Portfolio turnover ratio, from CRSP.
Total Net Assets ($ mil)	Total net assets.
Retail Share Class	Retail share class dummy, from CRSP.
Underlying Same Family Outflows	Sum of monthly outflows over the last year for all underlying funds managed by the same family, scaled by assets at the beginning of the year.
Family Tilt, US Equities	Difference between the same family-style weight (e.g., the sum of all positions for US equity underlying funds managed by the same family) in the TDF portfolio minus the allocation benchmark defined as the average ratio of family assets in the same style relative to total style assets.
Active Share	Active share is computed for each underlying US equity fund in the TDF portfolio as the sum of the absolute deviation of equity security holdings weights from the CRSP value-weighted market index. The TDF's active share is computed as the average active shares of the TDF portfolio's underlying equity funds.

Table 1: Example of the Ownership Structure Variation for TDFs in the Same Series

This table reports the weights for the funds inside the T. Rowe Price Retirement Fund Series as of September 2021. To illustrate the deviation in the holdings' weights across TDFs with different horizons in the same series, we report the portfolio weights of the equity subgroup in Panel A and the weights within the overall portfolio of equity and bonds subgroups in Panel B. Our historical holdings data is extracted from CRSP and Morningstar, but the holdings of T. Rowe Price Retirement Funds can also be accessed from the SEC using NPORT-P filings: https://www.sec.gov/edgar/browse/?CIK=0001177017

Panel A: Equity Holdings of T. Rowe Price Retirement Funds

	Weights, as % of Total Equity, by Target Date:												
Equity Funds	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**	**2065**
T Rowe Price Value Fund	17.0%	17.1%	16.4%	16.7%	16.7%	17.9%	19.7%	21.2%	21.4%	21.3%	21.4%	21.4%	21.8%
T Rowe Price Equity Index 500 Fund	19.5%	19.4%	19.2%	18.9%	18.9%	16.7%	13.4%	10.4%	10.4%	10.3%	10.3%	10.3%	10.5%
T Rowe Price Growth Stock Fund	14.3%	14.3%	14.4%	14.8%	15.0%	16.1%	18.0%	19.5%	19.5%	19.5%	19.4%	19.4%	18.9%
T Rowe Price International Value Equity Fd	8.4%	8.4%	8.4%	8.2%	8.2%	8.3%	8.1%	8.3%	8.2%	8.2%	8.1%	8.1%	8.6%
T Rowe Price Overseas Stock Fund	7.7%	7.8%	8.2%	8.1%	8.0%	8.0%	7.7%	7.7%	7.7%	7.7%	7.7%	7.7%	7.9%
T Rowe Price International Stock Fund	7.1%	7.1%	7.1%	7.0%	7.0%	7.0%	7.1%	7.1%	7.1%	7.1%	7.2%	7.2%	7.2%
T Rowe Price Mid-Cap Growth Fund	4.1%	4.2%	4.1%	4.1%	4.1%	4.0%	4.0%	4.0%	4.0%	4.1%	4.1%	4.1%	3.7%
T Rowe Price Mid-Cap Value Fund	4.0%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	4.0%	3.9%	4.0%	3.9%
T Rowe Price Emerging Markets Stock Fd	3.7%	3.7%	3.6%	3.6%	3.6%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	2.6%
T Rowe Price Small-Cap Stock Fund	2.8%	2.8%	3.1%	3.1%	3.0%	3.0%	3.0%	2.9%	2.9%	2.9%	2.8%	2.8%	2.6%
T Rowe Price Small-Cap Value Fund	2.8%	2.8%	3.1%	3.1%	3.0%	2.9%	2.7%	2.7%	2.7%	2.7%	2.6%	2.6%	2.5%
T Rowe Price Real Assets Fund	2.7%	2.7%	2.8%	2.8%	2.7%	2.7%	2.7%	2.7%	2.7%	2.6%	2.6%	2.6%	2.7%
T Rowe Price New Horizons Fund	2.4%	2.4%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.1%
T Rowe Price Emerg Markets Discv Stk Fd	2.2%	2.2%	2.1%	2.1%	2.1%	2.1%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	3.3%
T Rowe Price US Large-Cap Core Fund Inc	1.2%	1.2%	1.1%	1.2%	1.2%	1.3%	1.4%	1.5%	1.5%	1.5%	1.5%	1.6%	1.7%

Panel B: All Holdings of T. Rowe Price Retirement Funds

	Portfolio Weights, by Target Date												
	2005	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**	**2065**
Equity Funds													
T Rowe Price Value Fund	6.74%	7.57%	7.89%	8.86%	10.32%	13.07%	16.16%	18.99%	20.05%	20.24%	20.33%	20.33%	21.16%
T Rowe Price Equity Index 500 Fund	7.73%	8.62%	9.25%	10.05%	11.70%	12.18%	10.96%	9.33%	9.72%	9.81%	9.79%	9.79%	10.19%
T Rowe Price Growth Stock Fund	5.67%	6.32%	6.93%	7.90%	9.26%	11.78%	14.72%	17.43%	18.30%	18.46%	18.44%	18.37%	18.34%
T Rowe Price International Value Equity Fd	3.33%	3.71%	4.02%	4.37%	5.07%	6.04%	6.64%	7.40%	7.68%	7.73%	7.71%	7.70%	8.29%
T Rowe Price Overseas Stock Fund	3.06%	3.45%	3.95%	4.30%	4.96%	5.82%	6.33%	6.86%	7.20%	7.28%	7.33%	7.33%	7.61%
T Rowe Price International Stock Fund	2.81%	3.15%	3.42%	3.73%	4.35%	5.14%	5.83%	6.38%	6.65%	6.72%	6.79%	6.80%	6.95%
T Rowe Price Mid-Cap Growth Fund	1.63%	1.84%	1.97%	2.17%	2.55%	2.94%	3.31%	3.61%	3.76%	3.85%	3.86%	3.87%	3.59%
T Rowe Price Mid-Cap Value Fund	1.58%	1.75%	1.90%	2.09%	2.44%	2.86%	3.22%	3.52%	3.70%	3.75%	3.74%	3.75%	3.75%
T Rowe Price Emerging Markets Stock Fd	1.45%	1.63%	1.74%	1.89%	2.22%	2.56%	2.86%	3.12%	3.27%	3.32%	3.34%	3.35%	2.53%
T Rowe Price Small-Cap Stock Fund	1.10%	1.23%	1.48%	1.64%	1.88%	2.18%	2.42%	2.62%	2.75%	2.76%	2.63%	2.61%	2.51%
T Rowe Price Small-Cap Value Fund	1.11%	1.25%	1.47%	1.64%	1.87%	2.12%	2.25%	2.41%	2.53%	2.52%	2.50%	2.50%	2.44%
T Rowe Price Real Assets Fund	1.08%	1.21%	1.34%	1.49%	1.70%	1.97%	2.19%	2.38%	2.49%	2.51%	2.50%	2.50%	2.61%
T Rowe Price New Horizons Fund	0.94%	1.08%	1.18%	1.33%	1.54%	1.80%	2.03%	2.24%	2.35%	2.38%	2.39%	2.41%	2.04%
T Rowe Price Emerg Markets Discv Stk Fd	0.87%	0.97%	1.03%	1.13%	1.31%	1.55%	1.77%	1.94%	2.03%	2.04%	2.05%	2.04%	3.21%
T Rowe Price US Large-Cap Core Fund Inc	0.49%	0.54%	0.54%	0.62%	0.73%	0.94%	1.16%	1.34%	1.41%	1.44%	1.45%	1.48%	1.63%
Total Equity	***39.6%***	***44.3%***	***48.1%***	***53.2%***	***61.9%***	***72.9%***	***81.8%***	***89.6%***	***93.9%***	***94.8%***	***94.8%***	***94.8%***	***96.8%***
Non-Equity Funds													
T Rowe Price New Income Fund	17.5%	16.2%	15.3%	14.2%	12.4%	9.6%	6.4%	3.4%	2.2%	1.7%	1.8%	1.8%	0.9%
T Rowe Price US Treasury Money Fund	3.4%	3.6%	4.0%	3.8%	3.6%	3.2%	3.0%	2.2%	2.0%	1.9%	1.7%	1.7%	1.6%
T Rowe Price Intern. Bond Fd USD Hgd	5.9%	5.5%	5.2%	4.7%	4.1%	3.1%	2.0%	1.1%	0.6%	0.5%	0.6%	0.5%	0.3%
T Rowe Price Dynamic Global Bond Fund	4.1%	3.8%	3.7%	3.4%	3.0%	2.3%	1.6%	0.8%	0.5%	0.4%	0.4%	0.4%	0.2%
T Rowe Price Lim. Durat. Inflation Foc Bd	17.3%	15.3%	13.0%	10.6%	6.3%	2.2%	0.8%	0.8%					
T Rowe Price US Treasury LT Index Fund	1.5%	1.6%	1.6%	1.6%	1.9%	2.1%	1.8%	1.2%	0.9%	0.7%	0.7%	0.8%	0.5%
T Rowe Price Emerg. Markets Bond Fund	4.4%	4.0%	3.7%	3.4%	2.7%	1.7%	0.9%	0.3%	0.0%	0.0%	0.0%	0.0%	
T Rowe Price High Yield Fund	4.1%	3.7%	3.4%	3.2%	2.5%	1.7%	1.0%	0.5%	0.0%	0.0%	0.0%	0.0%	
T Rowe Price Floating Rate Fund	2.2%	2.0%	1.9%	1.8%	1.5%	1.1%	0.7%						
T Rowe Price Reserve Investment Fund	0.0%	0.0%	0.0%		0.0%		0.0%						
T Rowe Price Transition Fund				0.0%		0.0%		0.0%					
Other Assets less Liabilities	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.4%
Total	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***

Table 2: Descriptive Statistics

This table reports the descriptive statistics for our sample extracted from the CRSP mutual fund database between Q1 2000 and Q1 2019. We use Lipper Class to identify TDFs (MATA – MATM). Panel A represents the descriptive statistics for the entire sample of all equity, fixed income, and balanced funds defined using the CRSP Objective Code variable for the asset class and style information and the Lipper Class variable for TDFs identification. Panel B reports the descriptive statistics for the TDF subsample. All variables are from the CRSP fund summary and holdings datasets. Variables based on target date holdings are averaged first at the portfolio level using holding weights. Underlying *Active Share* is computed for each underlying fund as the sum of absolute deviations between the portfolio equity holding weights and stocks' weights in the CRSP value-weighted market index. Underlying *Same Family Fund Outflows* represents the sum of monthly outflows over the last year for all underlying funds managed by the same family, scaled by assets at the beginning of the year. *Family Tilt* is constructed as the difference between the same family-style weight (e.g., the sum of all positions for US equity underlying funds managed by the same family) in the TDF portfolio minus the allocation benchmark, which is defined as the average ratio of family assets in the same style relative to total style assets.

Panel A: All Funds

		N	mean	sd	p1	p50	p99
All Funds	Expense Ratio	4,487,748	0.012	0.006	0.000	0.011	0.028
	Turnover Ratio	4,458,463	0.833	1.118	0.000	0.500	7.350
	Total Net Assets ($ mil)	5,385,144	$480	$3,010	$0.1	$34	$7,704
	Retail Share Class	5,536,629	0.503	0.500	0.000	1.000	1.000
	Equity, % of TNA	5,258,529	0.656	0.415	0.000	0.922	1.000
	Age	5,522,331	13.174	11.918	0.167	10.500	64.833
	Flow Volatility	4,688,993	0.073	0.110	0.002	0.030	0.563
	Family Flow Volatility	4,824,922	0.050	0.047	0.006	0.037	0.260
	Family Equity, % of TNA	5,485,526	0.620	0.206	0.004	0.648	0.995
	Family TNA ($mil)	5,490,020	$175,717	$414,357	$26	$53,701	$1,871,176
Equity Funds	Expense Ratio	2,634,979	0.013	0.006	0.000	0.013	0.028
	Turnover Ratio	2,611,617	0.808	0.991	0.004	0.550	6.550
	Total Net Assets ($ mil)	3,154,217	$487	$3,206	$0.1	$34	$7,480
	Retail Share Class	3,245,940	0.497	0.500	0.000	0.000	1.000
	Equity, % of TNA	3,245,940	0.929	0.155	0.000	0.971	1.000
	Age	3,245,940	12.932	12.347	0.167	10.000	67.333
	Flow Volatility	2,724,796	0.076	0.113	0.002	0.031	0.563
	Family Flow Volatility	2,785,008	0.052	0.051	0.007	0.038	0.282
	Family Equity, % of TNA	3,223,492	0.658	0.197	0.084	0.675	1.000
	Family TNA ($mil)	3,224,343	$158,715	$400,417	$15	$43,105	$1,823,759
Fixed Income Funds	Expense Ratio	1,269,018	0.010	0.005	0.001	0.009	0.022
	Turnover Ratio	1,250,180	1.048	1.458	0.000	0.510	7.350
	Total Net Assets ($ mil)	1,461,579	$463	$2,529	$0.1	$44	$7,392
	Retail Share Class	1,499,235	0.563	0.496	0.000	1.000	1.000
	Equity, % of TNA	1,266,993	0.006	0.045	0.000	0.000	0.135
	Age	1,499,235	15.058	10.442	0.250	13.917	42.250
	Flow Volatility	1,289,589	0.070	0.105	0.003	0.030	0.560
	Family Flow Volatility	1,310,341	0.048	0.041	0.005	0.037	0.212
	Family Equity, % of TNA	1,489,489	0.536	0.223	0.000	0.578	0.925
	Family TNA ($mil)	1,492,871	$172,345	$405,638	$105	$57,592	$1,836,944
Balanced Funds	Expense Ratio	326,970	0.010	0.006	0.000	0.009	0.024
	Turnover Ratio	325,490	0.615	0.717	0.000	0.390	3.510
	Total Net Assets ($ mil)	430,971	$539	$2,843	$0.1	$37	$9,623
	Retail Share Class	444,811	0.470	0.499	0.000	0.000	1.000
	Equity, % of TNA	423,780	0.542	0.219	0.000	0.574	1.000
	Age	444,811	13.968	14.675	0.167	10.333	78.833
	Flow Volatility	382,049	0.055	0.095	0.002	0.020	0.515
	Family Flow Volatility	403,656	0.045	0.038	0.006	0.035	0.205
	Family Equity, % of TNA	440,530	0.622	0.153	0.177	0.638	0.942
	Family TNA ($mil)	440,787	$193,862	$413,479	$49	$62,258	$1,831,696

Panel B: Target Date Funds

	N	mean	sd	p1	p50	p99
Expense Ratio, TDF Level	301,641	0.006	0.003	0.000	0.006	0.017
Expense Ratio, Underlying Funds	227,439	0.005	0.002	0.000	0.005	0.010
Total Expense Ratio	225,304	0.010	0.005	0.000	0.011	0.019
Turnover Ratio	271,176	0.338	0.390	0.000	0.230	1.770
Total Net Assets ($ mil)	324,628	$279	$1,611	$0.10	$7	$6,638
Retail Share Class	332,345	0.352	0.478	0.000	0.000	1.000
Equity, % of TNA	321,816	0.619	0.264	0.000	0.677	1.000
Age	332,345	5.981	4.713	0.083	5.000	21.917
Flow Volatility	279,223	0.087	0.118	0.004	0.037	0.554
Family Flow Volatility	325,917	0.050	0.043	0.007	0.038	0.215
Family Equity, % of TNA	332,015	0.624	0.152	0.007	0.658	0.869
Family TNA ($mil)	332,019	$331,906	$536,116	$783	$95,928	$1,956,201
Underlying Same Family Fund Assets %	248,868	0.740	0.383	0.000	1.000	1.000
Underlying ETF Assets, %	248,868	0.091	0.204	0.000	0.000	0.989
Underlying Index Mutual Fund Assets, %	248,868	0.144	0.256	0.000	0.000	1.000
Underlying Active Mutual Fund Assets, %	248,868	0.503	0.335	0.000	0.552	1.004
Underlying Past 12-Month Outflows	244,986	0.125	0.116	0.003	0.096	0.529
Family Tilt, US Equities	228,932	0.729	0.392	-0.039	0.972	0.983
Underlying Active Share (CRSP Index)	240,884	0.737	0.172	0.159	0.753	0.998

Table 3: Performance of TDFs Relative to Non-TDF Funds

This table reports the results for the alpha of the six-factor model (where factors are *Excess Market Return, SMB, HML, UMD, Default*, and *Term* factors, defined in Appendix A). The returns are weekly returns net of all fees (columns 1–4) and gross of fees (columns 5–8). For each quarter, we calculated alphas using the previous year. Alphas are annualized and multiplied by 100. We report the sample of balanced funds (Panel A) and all CRSP funds (Panel B). Panel C reports the results for both samples with double interaction between *TDF Dummy* (short — less than 7 years, medium — between 7 and 17 years, and long — above 17 years) and Period Dummies. *TDF Dummy* is a dummy equal to one if the fund is defined as a TDF and zero otherwise. In columns 3 and 7, we report the results for short-, medium-, and long-horizon dummies. Columns 4 and 8 report the TDF dummy interaction results with period dummies. Other control variables are defined in Appendix A. Specifications 1 and 5 are panels with *Date* and *Family* fixed effects, while specifications 2-4 and 6-8 use *Date***Family* fixed effects. The *t*-statistics, adjusted for clustering over fund and date, are in parentheses. We report the *F*-statistics of the equality test between short and long horizons (specifications 3 and 7) and the difference between the periods before PPA and post-PPA (specifications 4 and 8). In Panel C, we report the changes in performance before and after the introduction of PPA for short and long TDF funds.

Panel A: TDFs and Balanced Funds

	Returns, Net of Fees, Six Factor Alpha						Returns, Gross of Fees, Six Factor Alpha	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TDF Dummy	-0.842***	-0.773***			-0.464***	-0.389***		
	(-9.19)	(-8.36)			(-5.22)	(-4.32)		
TDF Short Horizon			-0.284***				0.0595	
			(-4.27)				(0.89)	
TDF Medium Horizon			-0.732***				-0.353***	
			(-8.38)				(-4.15)	
TDF Long Horizon			-1.129***				-0.713***	
			(-7.90)				(-5.09)	
<= 2007				-0.142				0.0828
				(-0.69)				(0.41)
2008-2012				-1.033***				-0.658***
				(-8.29)				(-5.31)
>=2013				-0.707***				-0.289*
				(-4.49)				(-1.91)
Expense Ratio	-69.15***	-64.03***	-64.72***	-63.96***	27.32***	32.56***	31.94***	32.55***
	(-11.82)	(-11.59)	(-11.94)	(-11.60)	(4.73)	(5.94)	(5.92)	(5.94)
Turnover Ratio	0.013	0.028	0.016	0.039	0.019	0.030	0.019	0.038
	(0.24)	(0.48)	(0.28)	(0.66)	(0.33)	(0.52)	(0.33)	(0.64)
Log (TNA (t-1))	-0.002	0.010	0.007	0.010	-0.007	0.006	0.003	0.006
	(-0.16)	(0.75)	(0.48)	(0.74)	(-0.48)	(0.47)	(0.22)	(0.44)
Retail Dummy	-0.130***	-0.165***	-0.155***	-0.169***	-0.0961**	-0.136***	-0.127***	-0.139***
	(-2.85)	(-3.73)	(-3.602)	(-3.838)	(-2.113)	(-3.08)	(-2.94)	(-3.17)
Equity, % of TNA	-1.274***	-1.434***	-1.074***	-1.444***	-1.223***	-1.375***	-1.047***	-1.382***
	(-4.51)	(-4.72)	(-3.56)	(-4.77)	(-4.37)	(-4.57)	(-3.49)	(-4.610)
Log (Age)	0.165***	0.184***	0.166***	0.179***	0.181***	0.202***	0.186***	0.195***
	(3.64)	(3.83)	(3.45)	(3.675)	(3.98)	(4.18)	(3.89)	(4.01)
Family Eq., % TNA	0.716				0.616			
	(1.53)				(1.31)			
log (Family TNA)	-0.379***				-0.368***			
	(-4.01)				(-3.89)			
Family Flow Volatility	-0.597				-0.592			
	(-0.68)				(-0.67)			
Fixed Effects	Date, Family	Date*Family	Date*Family	Date*Family	Date, Family	Date*Family	Date*Family	Date*Family
Test			*TDF Short=TDF Long*	*TDF PER1=TDF PER2*			*TDF Short=TDF Long*	*TDF PER1=TDF PER2*
F-Statistics			35.09	13.51			29.36	9.49
(p-value)			(0.000)	(0.001)			(0.000)	(0.003)
Observations	133,273	132,094	132,094	132,094	133,273	132,094	132,094	132,094
R-squared	0.345	0.586	0.589	0.587	0.340	0.583	0.586	0.584

Panel B: TDFs and All Open-end Mutual Funds

	Returns, Net of Fees, Six Factor Alpha				Returns, Gross of Fees, Six Factor Alpha			
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TDF Dummy	-1.039***	-1.008***			-0.680***	-0.650***		
	(-12.56)	(-11.73)			(-8.08)	(-7.42)		
TDF Short Horizon			-0.795***				-0.471***	
			(-6.45)				(-3.82)	
TDF Medium Horizon			-1.043***				-0.704***	
			(-11.54)				(-7.42)	
TDF Long Horizon			-1.123***				-0.732***	
			(-11.78)				(-7.54)	
<= 2007				-0.829***				-0.639***
				(-5.67)				(-3.99)
2008-2012				-1.154***				-0.809***
				(-8.83)				(-5.49)
>=2013				-0.951***				-0.552***
				(-8.79)				(-5.20)
Expense Ratio	-90.70***	-88.42***	-88.65***	-88.40***	5.239	7.521	7.348	7.493
	(-4.82)	(-4.58)	(-4.60)	(-4.59)	(0.28)	(0.39)	(0.38)	(0.38)
Turnover Ratio	-0.059	-0.065*	-0.065*	-0.066*	-0.058	-0.064*	-0.064*	-0.065*
	(-1.58)	(-1.73)	(-1.72)	(-1.73)	(-1.55)	(-1.70)	(-1.69)	(-1.70)
Log (TNA (t-1))	-0.040*	-0.035	-0.0346	-0.035	-0.042*	-0.037	-0.037	-0.037
	(-1.70)	(-1.471)	(-1.48)	(-1.47)	(-1.79)	(-1.56)	(-1.56)	(-1.56)
Retail Dummy	0.067	0.070	0.070	0.069	0.079	0.082	0.083	0.082
	(0.68)	(0.72)	(0.73)	(0.71)	(0.82)	(0.84)	(0.85)	(0.84)
Equity, % of TNA	-2.286***	-2.310***	-2.303***	-2.311***	-2.278***	-2.302***	-2.296***	-2.302***
	(-5.627)	(-5.68)	(-5.66)	(-5.68)	(-5.61)	(-5.67)	(-5.64)	(-5.66)
Log (Age)	0.271***	0.275***	0.274***	0.274***	0.274***	0.279***	0.278***	0.277***
	(3.30)	(3.35)	(3.34)	(3.35)	(3.34)	(3.39)	(3.38)	(3.38)
Family Eq., % TNA	1.011***				1.003***			
	(3.52)				(3.48)			
log (Family TNA)	-0.405***				-0.403***			
	(-5.84)				(-5.85)			
Family Flow Volatility	1.417*				1.407*			
	(1.86)				(1.85)			
Fixed Effects	Date, Family	Date*Family	Date*Family	Date*Family	Date, Family	Date*Family	Date*Family	Date*Family
Test:			*TDF Short=TDF Long*	*TDF PER1=TDF PER2*			*TDF Short=TDF Long*	*TDF PER1=TDF PER2*
F-Statistics			6.56	2.65			4.11	0.58
(p-value)			(0.013)	(0.108)			(0.046)	(0.449)
Observations	886,529	886,215	886,215	886,215	886,529	886,215	886,215	886,215
R-squared	0.148	0.217	0.217	0.217	0.143	0.212	0.212	0.212

Panel C: TDFs vs. Control Groups: Split over Period and Horizon

	TDFs and Balanced Funds				TDFs and all OEF			
	Returns, Net of Fees, Six Factor Alpha		Returns, Gross of Fees, Six Factor Alpha		Returns, Net of Fees, Six Factor Alpha		Returns, Gross of Fees, Six Factor Alpha	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Short TDFs(t <= 2007)	-0.846***	-0.583***	-0.594***	-0.338*	-1.307***	-1.520***	-1.082***	-1.301***
	(-4.86)	(-3.20)	(-3.11)	(-1.73)	(-5.32)	(-5.37)	(-3.96)	(-4.22)
Medium TDFs(t <= 2007)	-0.475***	-0.192	-0.302*	-0.018	-0.862***	-1.025***	-0.735***	-0.901***
	(-2.76)	(-1.00)	(-1.74)	(-0.10)	(-4.26)	(-5.14)	(-3.44)	(-4.28)
Long TDFs(t <= 2007)	-0.339	-0.032	-0.064	0.238	-0.348*	-0.419**	-0.101	-0.176
	(-1.43)	(-0.11)	(-0.28)	(0.83)	(-1.73)	(-2.48)	(-0.49)	(-1.04)
Short TDFs(2008-2012)	-0.210	-0.225	0.080	0.080	-0.684***	-0.583***	-0.411**	-0.306*
	(-1.08)	(-1.30)	(0.44)	(0.49)	(-4.26)	(-3.29)	(-2.55)	(-1.75)
Medium TDFs(2008-2012)	-0.994***	-0.943***	-0.634***	-0.564***	-1.354***	-1.182***	-1.021***	-0.846***
	(-6.66)	(-7.15)	(-4.25)	(-4.14)	(-7.56)	(-7.26)	(-4.88)	(-4.48)
Long TDFs(2008-2012)	-1.637***	-1.597***	-1.234***	-1.180***	-1.590***	-1.479***	-1.199***	-1.088***
	(-10.53)	(-11.41)	(-7.78)	(-8.08)	(-9.60)	(-10.03)	(-6.42)	(-6.53)
Short TDFs(t> 2012)	-0.330***	-0.291***	0.0558	0.0910	-0.842***	-0.843***	-0.475***	-0.479***
	(-3.03)	(-2.72)	(0.52)	(0.88)	(-5.29)	(-5.08)	(-2.97)	(-2.88)
Medium TDFs(t> 2012)	-0.756***	-0.691***	-0.332**	-0.267*	-0.983***	-0.959***	-0.578***	-0.555***
	(-5.01)	(-4.64)	(-2.27)	(-1.88)	(-8.06)	(-8.42)	(-4.82)	(-4.96)
Long TDFs(t> 2012)	-1.094***	-1.010***	-0.656**	-0.571**	-1.025***	-1.025***	-0.602***	-0.604***
	(-4.19)	(-4.00)	(-2.55)	(-2.31)	(-6.27)	(-6.84)	(-3.75)	(-4.12)
Expense Ratio	-68.86***	-64.33***	27.47***	32.22***	-90.81***	-88.57***	5.140	7.383
	(-12.13)	(-11.98)	(4.87)	(6.02)	(-4.82)	(-4.59)	(0.27)	(0.38)
Turnover Ratio	0.005	0.026	0.008	0.026	-0.059	-0.065*	-0.059	-0.064*
	(0.09)	(0.44)	(0.14)	(0.441)	(-1.58)	(-1.72)	(-1.55)	(-1.69)
Log (TNA (t-1))	-0.004	0.007	-0.009	0.003	-0.040*	-0.035	-0.042*	-0.037
	(-0.30)	(0.54)	(-0.64)	(0.24)	(-1.70)	(-1.47)	(-1.78)	(-1.56)
Retail Dummy	-0.128***	-0.160***	-0.095**	-0.131***	0.066	0.070	0.079	0.082
	(-2.94)	(-3.77)	(-2.16)	(-3.07)	(0.683)	(0.718)	(0.82)	(0.86)
Equity, % of TNA	-0.935***	-1.077***	-0.908***	-1.047***	-2.280***	-2.304***	-2.273***	-2.297***
	(-3.35)	(-3.58)	(-3.27)	(-3.49)	(-5.60)	(-5.65)	(-5.59)	(-5.64)
Log (Age)	0.147***	0.162***	0.163***	0.180***	0.269***	0.273***	0.272***	0.277***
	(3.28)	(3.41)	(3.64)	(3.79)	(3.28)	(3.34)	(3.32)	(3.38)
Family Eq., % TNA	0.504		0.417		1.000***		0.993***	
	(1.09)		(0.90)		(3.48)		(3.45)	
log (Family TNA)	-0.363***		-0.360***		-0.404***		-0.404***	
	(-3.83)		(-3.77)		(-5.838)		(-5.86)	
Family Flow Volatility	-0.690		-0.661		1.398*		1.396*	
	(-0.78)		(-0.75)		(1.840)		(1.84)	
Fixed Effects	Date, Family	Date*Family	Date, Family	Date*Family	Date, Family	Date*Family	Date, Family	Date*Family
F-Test Short change after 2008	5.25	1.83	5.96	2.50	4.40	7.46	4.35	7.45
p-value	0.025	0.180	0.017	0.119	0.040	0.008	0.041	0.008
F-Test Long change after 2008	22.00	22.95	18.71	19.12	24.71	25.25	16.39	15.85
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	133,273	132,094	133,273	132,094	886,529	886,215	886,529	886,215
R-squared	0.350	0.591	0.345	0.588	0.148	0.217	0.143	0.212

Table 4: Performance of TDFs by Horizon

This table reports the results for the alpha of the six-factor model (where factors are *Excess Market Return, SMB, HML, UMD, Default,* and *Term* factors, defined in Appendix A) for the sample of TDFs. The returns are weekly returns net of all fees (columns 1–4) and gross of fees (columns 5–6). For each quarter, we calculated alphas using the previous year. Alphas are annualized and multiplied by 100. *Target Horizon* is defined as the difference between the fund's target date and the current date. In columns 3–6, we report the results for *Target Horizon*'s interaction with period dummies. Other control variables are defined in Appendix A. Specifications 1, 3, and 5 are panel estimates with *Date* and *Family* fixed effects, while specifications 2, 4, and 6 use *Date*Family* fixed effects. We report *t*-statistics, adjusted for clustering over fund and date, in parentheses.

	Returns, Net of Fees, Six Factor Alpha				*Gross Returns, 6-F Alpha*	
	(1)	(2)	(3)	(4)	*(5)*	*(6)*
Target Horizon	-0.029***	-0.022***				
	(-6.28)	(-5.42)				
<= 2007			0.009	0.020*	0.010	0.021**
			(0.82)	(1.92)	(0.99)	(2.11)
2008-2012			-0.045***	-0.040***	-0.042***	-0.0361***
			(-6.05)	(-5.48)	(-5.61)	(-4.99)
>=2013			-0.026***	-0.021***	-0.026***	-0.019***
			(-3.63)	(-2.93)	(-3.43)	(-2.65)
Expense Ratio	-114.004***	-104.035***	-113.296***	-103.547***	-12.892**	-0.436
	(-19.55)	(-25.60)	(-20.47)	(-27.27)	(-2.38)	(-0.12)
Turnover Ratio	0.516***	0.135	0.500***	0.0922	0.506***	0.111
	(4.61)	(1.55)	(4.55)	(1.15)	(4.61)	(1.36)
Log (TNA (t-1))	-0.056***	-0.032***	-0.056***	-0.033***	-0.055***	-0.028***
	(-4.56)	(-3.40)	(-4.89)	(-3.93)	(-4.66)	(-3.39)
Retail Dummy	-0.006	0.006	-0.008	0.00616	0.029	0.028
	(-0.23)	(0.31)	(-0.31)	(0.30)	(1.19)	(1.44)
Equity, % of TNA	-1.076***	-1.624***	-1.011***	-1.519***	-0.935***	-1.457***
	(-4.04)	(-5.71)	(-3.98)	(-5.64)	(-3.82)	(-5.60)
Log (Age)	-0.043	-0.054	-0.043	-0.061*	0.014	0.007
	(-1.11)	(-1.58)	(-1.12)	(-1.76)	(0.37)	(0.22)
Family Equity, % of TNA	0.931		0.823		0.345	
	(1.04)		(0.92)		(0.37)	
log (Family TNA)	-0.370***		-0.342**		-0.338**	
	(-2.76)		(-2.61)		(-2.60)	
Family Flow Volatility	-0.314		-0.338		-0.468	
	(-0.28)		(-0.30)		(-0.42)	
Fixed Effects	Date, Family	Date*Family	Date, Family	Date*Family	Date, Family	Date*Family
Observations	42,531	42,445	42,531	42,445	42,531	42,445
R-squared	0.701	0.889	0.705	0.894	0.699	0.893

Table 5: Determinants of TDF Performance

This table reports the results for the alpha of the six-factor model (where factors are *Excess Market Return, SMB, HML, UMD, Default*, and *Term* factors, defined in Appendix A) for the sample of TDFs. The returns are weekly returns net of all fees (columns 1–3, 5–7) and gross of fees (columns 4 and 8). For each quarter, we calculated alphas using the previous year. Alphas are annualized and multiplied by 100. *Target Horizon* is defined as the difference between the fund's target date and the current date. Other control variables are defined in Appendix A. We used the same control variables as in Table 4. We do not report them for brevity. In Panel A, specifications 1–2 (5–6) report the double interactions of *Target Horizon* and *Retail Dummy* (*Family Flow Volatility*). Further, in specifications 3–4 (7–8), we triple-interacted *Target Horizon* and *Retail Dummy* (*Family Flow Volatility*) and period dummies. Specifications 1 and 5 are panel estimates with *Date* and *Family* fixed effects, while specifications 2–4 and 5–8 use *Date*Family* fixed effects. We report *t*-statistics, adjusted for clustering over fund and date, in parentheses. In Panel B, specifications 1–2 (5–6), we report Target Horizon and Family Equity's double interactions *as % of Family TNA* (*log of Family TNA*). Further, in specifications 3–4 (7–8), we triple-interacted *Target Horizon*, *Family Equity as a % of Family TNA* (*log of Family TNA*), and period dummies. Specifications 1 and 5 are panel estimates with *Date* and *Family* fixed effects, while specifications 2–4 and 6–8 use *Date*Family* fixed effects. We report *t*-statistics, adjusted for clustering over fund and date, in parentheses.

Panel A: Interaction with Retail and Family Flow Volatility

Interaction Variable	***Retail***				***Family Flow Volatility***			
6 Factor Model Alpha, using:	*Net Return*			*Gross Ret*	*Net Return*			*Gross Ret.*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Target Horizon	-0.028***	-0.021***			-0.023***	-0.016***		
	(-5.99)	(-5.02)			(-4.75)	(-3.76)		
x Interaction	-0.001	-0.003			-0.135***	-0.130***		
	(-0.74)	(-1.35)			(-3.26)	(-3.38)		
<= 2007			0.018*	0.020*			0.022*	0.025*
			(1.70)	(1.90)			(1.70)	(1.96)
x Interaction			0.003	0.002			-0.055	-0.078
			(0.88)	(0.73)			(-0.559)	(-0.82)
2008-2012			-0.038***	-0.035***			-0.025***	-0.022***
			(-5.09)	(-4.66)			(-3.21)	(-2.84)
x Interaction			-0.004**	-0.004*			-0.339***	-0.326***
			(-2.04)	(-1.73)			(-6.16)	(-5.90)
>=2013			-0.019***	-0.018**			-0.017**	-0.015**
			(-2.77)	(-2.56)			(-2.45)	(-2.11)
x Interaction			-0.005***	-0.003**			-0.081**	-0.091**
			(-2.92)	(-2.06)			(-2.00)	(-2.23)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Date, Family	Date*Family	Date*Family	Date*Family	Date, Family	Date*Family	Date*Family	Date*Family
Observations	42,531	42,445	42,445	42,445	42,531	42,445	42,445	42,445
R-squared	0.701	0.889	0.894	0.893	0.701	0.890	0.895	0.894

Panel B: Interaction with Family Equity as Percentage of Family TNA and Family Size (log of Family TNA)

Interaction	***Family Equity, % of TNA***				***Family TNA***			
6 Factor Model Alpha, using:	*Net Return*		*Gross Ret*		*Net Return*			*Gross Ret*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Target Horizon	-0.065***	-0.069***			-0.067***	-0.061***		
	(-6.85)	(-7.66)			(-4.17)	(-4.05)		
x Interaction	0.057***	0.072***			0.003**	0.003**		
	(4.22)	(5.73)			(2.42)	(2.54)		
<= 2007			0.009	0.012			0.029	0.045
			(0.29)	(0.40)			(0.61)	(1.18)
x Interaction			0.016	0.013			-0.0018	-0.002
			(0.426)	(0.363)			(-0.451)	(-0.72)
2008-2012			-0.077***	-0.073***			-0.095***	-0.102***
			(-5.572)	(-5.38)			(-4.04)	(-3.96)
x Interaction			0.062***	0.061***			0.004**	0.005***
			(3.411)	(3.45)			(2.24)	(2.78)
>=2013			-0.051***	-0.050***			-0.071***	-0.065***
			(-4.22)	(-4.18)			(-5.28)	(-4.79)
x Interaction			0.047***	0.048***			0.004***	0.004***
			(3.49)	(3.71)			(3.53)	(3.69)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Date, Family	Date * Family	Date* Family	Date* Family	Date, Family	Date* Family	Date* Family	Date* Family
Observations	42,531	42,445	42,445	42,445	42,531	42,445	42,531	42,445
R-squared	0.702	0.891	0.895	0.894	0.702	0.890	0.706	0.895

Table 6: The Selection of Underlying Funds in the TDF Portfolios

Panels A and B report the results for selecting equity funds by Target Date Funds. Panel A reports the result of Tobit regression with year, mutual funds' family, and Lipper class fixed effects (three-digits Lipper class in Specifications 1, 2, 5, 6, or four-digit Lipper class in Specifications 3, 4, 7, 8). The dependent variable is the share of fund *i* in the equity share of a Target Date Fund *k*. The set of alternative funds is defined as all funds that belong to the same family, same 3-digit (Specifications 1, 2, 5, 6) or 4-digit (Specifications 3, 4, 7, 8) Lipper class, and Activity status (i.e., active or passive funds). By passive funds, we understand both index funds and ETFs. As a measure of agency problems, we use either *Alpha-=-min(0, Alpha)* (Specifications 1-4) or *Dummy(Alpha<-1% p.a.)* (Specifications 5-8). *Alpha*, a CAPM Alpha, was calculated using 36 monthly observations and winsorized at 1% and 99%. Specifications 2, 4, 6, 8, we split the effect as pre-and-post 2008. We interact our variables of interest with *TDF Long Horizon*, where *TDF Long Horizon* is defined as one if Horizon (the difference between TDF Horizon date and today's date) is greater than 17 and zero otherwise. *Active Fund* is a dummy equal to one if the fund is active and zero otherwise. *Log (# of positions)* is a logarithm of the number of positions the Target Date Fund chooses to have. The errors are clustered for each choice (for a given Target-date fund *k* and date *t*, all funds that belong to the same three- or four-digit Lipper class and Activity Status as chosen fund *i*). We also report several F-statistics (and corresponding p-values in parentheses) to test the difference between coefficients for the variables of interest.

Panel B uses as a dependent variable the difference between the share of fund *i* in equity share of a Target Date Fund *k* and the average share of fund *i* in equity share of a Target Date Fund that belongs to the same series. This is the panel regression with year, mutual funds' family, and Lipper class fixed effects (three-digits Lipper class in Specifications 1, 2, 5, 6, or four-digit Lipper class in Specifications 3, 4, 7, 8). and errors clustered over the TDF fund and Year. As a measure of agency problems, we use either *Alpha-=-min(0, Alpha)* (Specifications 1-4) or *Dummy(Alpha<-1% p.a.)* (Specifications 5-8). *Alpha*, a CAPM Alpha, was calculated using 36 monthly observations and winsorized at 1% and 99%. We interact our variables of interest with *TDF Long Horizon*. Specifications 2, 4, 6, 8, we split the effect as pre-and-post 2008. We interact our variables of interest with *TDF Long Horizon.* Other control variables are defined previously. We also report several F-statistics (and corresponding p-values in parentheses) to test the difference between coefficients for the variables of interest. In Specifications 5-8, coefficients for *Dummy(Alpha<-1% p.a.)* and its interaction are multiplied by 100. In all specifications, *TDF Long Horizon, TDF Long Horizon*≥2008,* and *log(# of positions)* are multiplied by 100, and coefficients for *Active Fund, Log (TNA (t-1)),* and *Retail Dummy* are multiplied by 10,000.

Panel A: TDF Choice of Underlying Funds

	X=-MIN(0, Alpha)				*X*=Dummy(Alpha<-1% p.a.)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X	3.859***		2.569***		0.012***		0.008***	
	(11.65)		(7.70)		(7.60)		(4.95)	
x TDF Long Horizon	0.690*		0.893**		0.010***		0.010***	
	(1.76)		(2.31)		(4.64)		(4.90)	
x Year<=2007		0.361		1.057		0.014		0.016
		(0.13)		(0.38)		(1.28)		(1.45)
x Year<=2007 x TDF Long Horizon		-0.895		-0.111		0.011		0.014
		(-0.22)		(-0.03)		(0.74)		(0.92)
x Year>=2008		3.967***		2.658***		0.013***		0.008***
		(11.88)		(7.91)		(7.67)		(4.96)
x Year>=2008 x TDF Long Horizon		0.666*		0.893**		0.010***		0.010***
		(1.69)		(2.30)		(4.53)		(4.79)
Expense Ratio	-27.32***		-29.53***		-27.22***		-29.45***	
	(-61.51)		(-61.79)		(-61.63)		(-61.92)	
x TDF Long Horizon	1.811***		1.719***		1.708***		1.635***	
	(5.89)		(5.55)		(5.62)		(5.332)	
x Year<=2007		-18.55***		-23.41***		-18.56***		-23.39***
		(-16.08)		(-17.52)		(-16.11)		(-17.55)
x Year<=2007 x TDF Long Horizon		-1.880		1.894		-2.078		1.648
		(-1.23)		(1.14)		(-1.35)		(0.98)
x Year>=2008		-27.66***		-29.75***		-27.56***		-29.66***
		(-61.24)		(-61.51)		(-61.37)		(-61.65)
x Year>=2008 x TDF Long Horizon		1.930***		1.707***		1.826***		1.626***
		(6.17)		(5.43)		(5.91)		(5.23)
TDF Long Horizon	-0.020***	0.012	-0.023***	-0.021	-0.020***	0.011	-0.024***	-0.023
	(-3.34)	(0.91)	(-3.64)	(-1.47)	(-3.43)	(0.84)	(-3.81)	(-1.56)
x Year>=2008	0.009*	-0.023*	0.012**	0.011	0.007	-0.025*	0.011*	0.009
	(1.66)	(-1.72)	(2.05)	(0.72)	(1.24)	(-1.86)	(1.78)	(0.63)
Log (TNA (t-1))	0.059***	0.059***	0.057***	0.057***	0.059***	0.059***	0.057***	0.057***
	(91.93)	(92.05)	(88.52)	(88.65)	(92.21)	(92.33)	(88.80)	(88.93)
Retail Dummy	-0.119***	-0.119***	-0.109***	-0.109***	-0.119***	-0.119***	-0.109***	-0.109***
	(-57.98)	(-57.91)	(-52.14)	(-52.08)	(-58.00)	(-57.93)	(-52.22)	(-52.16)
Active Fund	0.019***	0.019***	0.025***	0.025***	0.018***	0.018***	0.024***	0.024***
	(7.61)	(7.59)	(9.22)	(9.10)	(7.43)	(7.41)	(9.03)	(8.91)
Log (# of positions)	-0.014***	-0.013***	-0.009***	-0.008***	-0.015***	-0.014***	-0.009***	-0.009***
	(-8.23)	(-7.77)	(-5.20)	(-4.79)	(-8.66)	(-8.21)	(-5.54)	(-5.13)
SIGMA	0.029***	0.029***	0.028***	0.027***	0.029***	0.029***	0.028***	0.028***
	(49.70)	(49.71)	(48.73)	(48.74)	(49.73)	(49.74)	(48.75)	(48.75)
Matching Sample Lipper Code Digits	3	3	4	4	3	3	4	4
Fixed Effects	Year, Family, Lipper3	Year, Family, Lipper3	Year, Family, Lipper4	Year, Family, Lipper4	Year, Family, Lipper3	Year, Family, Lipper3	Year, Family, Lipper4	Year, Family, Lipper4
Observations	594,041	594,041	515,389	515,389	594,041	594,041	515,389	515,389
Pseudo R2	0.660	0.660	0.682	0.682	0.660	0.660	0.682	0.682
Log pseudolikelihood	-29071	-29046	-25331	-25315	-29077	-29053	-25323	-25306
F-Tests: X+X*TDF Long Horizon=0								
Full Sample	177.1		102.2		168.9		116.3	
p-value	(0.000)		(0.000)		0.000		0.000	
Before 2008		0.03		0.10		5.42		7.50
p-value		(0.864)		(0.757)		(0.020)		(0.006)
After 2008		181.2		105.9		166.4		113.3
p-value		(0.000)		(0.000)		(0.000)		(0.000)
F-Tests:ExpRatio+ExpRatio*TDF Long Horizon=0								
Full Sample	3805		3851		3804		3850	
p-value	(0.000)		(0.000)		(0.000)		(0.000)	
Before 2008		329.2		339.5		327.6		334.4
p-value		(0.000)		(0.000)		(0.000)		(0.000)
After 2008		3768		3824		3766		3823
p-value		(0.000)		(0.000)		(0.000)		(0.000)

Panel B: Determinants of Fund Overweighting across TDFs in the Same Series

	X=-MIN(0, Alpha)				*X*=Dummy(Alpha<-1% p.a.)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X	-0.249**		-0.252**		-0.305***		-0.307***	
	(-2.81)		(-2.83)		(-5.30)		(-5.28)	
x TDF Long Horizon	0.493***		0.495***		0.614***		0.615***	
	(3.44)		(3.47)		(5.52)		(5.52)	
x Year<=2007		0.577		0.575		0.295		0.293
		(0.65)		(0.65)		(1.04)		(1.03)
x Year<=2007 x TDF Long Horizon		-1.605		-1.605		-0.681		-0.680
		(-0.71)		(-0.711)		(-0.92)		(-0.92)
x Year>=2008		-0.260**		-0.263***		-0.319***		-0.322***
		(-2.94)		(-2.96)		(-5.62)		(-5.60)
x Year>=2008 x TDF Long Horizon		0.513***		0.515***		0.643***		0.643***
		(3.58)		(3.61)		(5.84)		(5.84)
Expense Ratio	-0.569***		-0.569***		-0.543***		-0.543***	
	(-3.77)		(-3.853)		(-3.719)		(-3.81)	
x TDF Long Horizon	1.173***		1.173***		1.118***		1.119***	
	(4.79)		(4.80)		(4.78)		(4.79)	
x Year<=2007		-1.382		-1.382		-1.341		-1.343
		(-1.34)		(-1.35)		(-1.34)		(-1.35)
x Year<=2007 x TDF Long Horizon		2.714**		2.714**		2.668**		2.669**
		(2.29)		(2.29)		(2.30)		(2.30)
x Year>=2008		-0.552***		-0.552***		-0.524***		-0.523***
		(-3.86)		(-3.95)		(-3.81)		(-3.90)
x Year>=2008 x TDF Long Horizon		1.139***		1.139***		1.080***		1.080***
		(4.72)		(4.73)		(4.72)		(4.73)
TDF Long Horizon	-1.131***	-2.189**	-1.130***	-2.193**	-1.203***	-2.078*	-1.202***	-2.084*
	(-4.19)	(-2.23)	(-4.20)	(-2.24)	(-4.42)	(-2.12)	(-4.43)	(-2.13)
x Year>=2008	0.145	1.217	0.145	0.012	0.050	0.937	0.050	0.937
	(0.87)	(1.29)	(0.87)	(1.29)	(0.30)	(0.99)	(0.30)	(0.99)
Log (TNA (t-1))	0.069	0.028	0.050	0.010	0.139	0.111	0.124	0.095
	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.03)	(0.02)
Retail Dummy	-0.103	-0.002	-0.067	0.038	-0.368	-0.273	-0.333	-0.222
	(-0.01)	(-0.00)	(-0.00)	(0.00)	(-0.02)	(-0.02)	(-0.02)	(-0.01)
Active Fund	-0.025	0.134	-0.080	0.067	-0.072	0.075	-0.175	-0.050
	(-0.00)	(0.02)	(-0.01)	(0.01)	(-0.01)	(0.01)	(-0.02)	(-0.01)
Log (# of positions)	0.011	0.011	0.010	0.010	0.011	0.011	0.010	0.011
	(0.21)	(0.23)	(0.18)	(0.19)	(0.21)	(0.23)	(0.19)	(0.20)
Fixed Effects:	Year, Family, Lipper3	Year, Family, Lipper3	Year, Family, Lipper4	Year, Family, Lipper4	Year, Family, Lipper3	Year, Family, Lipper3	Year, Family, Lipper4	Year, Family, Lipper4
Observations	33,759	33,759	33,759	33,759	33,759	33,759	33,759	33,759
R-squared	0.007	0.007	0.007	0.007	0.009	0.009	0.009	0.009
F-Tests: X+X*TDF Long Horizon=0								
Full Sample	20.33		20.87		20.01		20.69	
p-value	(0.000)		(0.000)		(0.000)		(0.000)	
Before 2008		0.48		0.48		0.51		0.51
p-value		(0.500)		(0.499)		(0.487)		(0.485)
After 2008		10.82		10.33		30.27		30.01
p-value		(0.005)		(0.006)		(0.000)		(0.000)
F-Tests: ExpRatio+ExpRatio*TDF Long Horizon=0								
Full Sample	9.31		8.88		24.95		24.67	
p-value	(0.008)		(0.009)		(0.000)		(0.000)	
Before 2008		3.89		3.88		4.10		4.10
p-value		(0.068)		(0.068)		(0.061)		(0.061)
After 2008		19.43		19.91		19.19		19.83
p-value		(0.001)		(0.000)		(0.001)		(0.000)

Table 7: Determinants of TDF Underperformance

This table reports the results for the alpha of the six-factor model (where factors are *Excess Market Return, SMB, HML, UMD, Default,* and *Term* factors, defined in Appendix A) for the sample of TDFs. The returns are weekly returns net of all fees (columns 1–4) and gross of fees (columns 5 and 6). For each quarter, we calculated alphas using the previous year. Alphas are annualized and multiplied by 100. *Target Horizon* is defined as the difference between the fund's target date and the current date. Other control variables are defined in Appendix A. We used the same control variables as in Table 4. We do not report them for brevity. *Underlying Same Family Fund Outflows* represents the sum of monthly outflows over the last year for all underlying funds managed by the same family, scaled by assets at the beginning of the year. *Family Tilt* is constructed as the difference between the same family-style weight (e.g., the sum of all positions for US equity underlying funds managed by the same family) in the TDF portfolio minus the allocation benchmark, which is defined as the average ratio of family assets in the same style relative to total style assets. In Panel A, we report the interaction of *Target Horizon* with *Underlying Same Family Fund Outflows*. In Panel B, specifications 1 and 2 report the triple interactions of *Target Horizon, Family Tilt,* and *Underlying Same Family Fund Outflows.* Further, in specifications 3–6, we interacted *Target Horizon* with period dummies. Odd specifications are panel estimates with *Date* and *Family* fixed effects, while even specifications use *Date**Family* fixed effects. We report *t*-statistics, adjusted for clustering over fund and date, in parentheses.

Panel A: Alpha and Outflows from Underlying Funds

	Returns, Net of Fees, Six Factor Alpha				*Gross Returns, 6-F Alpha*	
	(1)	(2)	(3)	(4)	*(5)*	*(6)*
Target Horizon	-0.016***	-0.013***				
	(-3.07)	(-3.09)				
x Underlying Same Family Outflows	-0.107***	-0.0972***				
	(-5.55)	(-4.99)				
<= 2007			0.006	0.013	0.011	0.018
			(0.34)	(0.71)	(0.69)	(1.05)
x Underlying Same Family Outflows			-0.163**	-0.131*	-0.168***	-0.140**
			(-2.56)	(-1.95)	(-2.81)	(-2.10)
2008-2012			-0.028***	-0.025***	-0.024***	-0.020***
			(-3.72)	(-3.66)	(-3.24)	(-3.06)
x Underlying Same Family Outflows			-0.082***	-0.096***	-0.082***	-0.101***
			(-2.75)	(-3.03)	(-2.73)	(-3.21)
>=2013			-0.013*	-0.012*	-0.011	-0.010
			(-1.71)	(-1.71)	(-1.49)	(-1.46)
x Underlying Same Family Outflows			-0.106***	-0.087***	-0.104***	-0.084***
			(-5.08)	(-4.32)	(-5.13)	(-4.24)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Date, Family	Date*Family	Date, Family	Date*Family	Date, Family	Date*Family
Observations	33,903	33,866	33,903	33,866	33,903	33,866
R-squared	0.724	0.899	0.726	0.901	0.720	0.900

Panel B: Alpha, Family Tilt, and Underlying Same Family Fund Outflows

	Returns, Net of Fees, Six Factor Alpha				*Gross Returns, 6-F Alpha*	
	(1)	(2)	(3)	(4)	*(5)*	*(6)*
Target Horizon	-0.031***	-0.027***				
	(-5.26)	(-5.05)				
x Family Tilt	0.019***	0.018***				
	(4.45)	(4.45)				
x Underlying Same Family Fund Outflows	0.582***	0.439***				
	(4.78)	(4.07)				
x Family Tilt x Underlying Same Family Fund Outflows	-0.744***	-0.588***				
	(-5.33)	(-4.62)				
<= 2007			0.024	0.004	0.021	0.005
			(0.62)	(0.17)	(0.54)	(0.22)
x Family Tilt			-0.029	0.017	-0.018	0.023*
			(-0.78)	(1.33)	(-0.48)	(1.73)
x Underlying Same Family Fund Outflows			0.902	-0.798	0.883	-0.682
			(0.91)	(-0.93)	(0.86)	(-0.78)
x Family Tilt x Underlying Same Family Fund Outflows			-1.072	0.642	-1.064	0.506
			(-1.07)	(0.79)	(-1.02)	(0.61)
2008-2012			-0.053***	-0.039***	-0.051***	-0.035***
			(-4.61)	(-3.88)	(-4.34)	(-3.61)
x Family Tilt			0.036***	0.021***	0.037***	0.022***
			(2.96)	(2.74)	(3.08)	(2.93)
x Underlying Same Family Fund Outflows			0.176	0.305	0.180	0.420
			(0.52)	(1.17)	(0.50)	(1.64)
x Family Tilt x Underlying Same Family Fund Outflows			-0.331	-0.452	-0.334	-0.576**
			(-0.93)	(-1.65)	(-0.89)	(-2.15)
>=2013			-0.029***	-0.026***	-0.028***	-0.0246***
			(-3.81)	(-3.66)	(-3.71)	(-3.56)
x Family Tilt			0.018***	0.019***	0.019***	0.021***
			(3.07)	(4.32)	(3.39)	(4.66)
x Underlying Same Family Fund Outflows			0.560***	0.425***	0.567***	0.415***
			(4.12)	(3.90)	(4.00)	(3.69)
x Family Tilt x Underlying Same Family Fund Outflows			-0.714***	-0.566***	-0.722***	-0.556***
			(-4.57)	(-4.29)	(-4.47)	(-4.10)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Date, Family	Date * Family	Date, Family	Date * Family	Date, Family	Date * Family
Observations	32,759	32,721	32,759	32,721	32,759	32,721
R-squared	0.723	0.901	0.726	0.903	0.719	0.901

Table 8: Determinants of Family Tilt and Actively Managed Funds in the Same Family

Panel A reports the results for the *Family Tilt* for the sample of TDFs. *Family Tilt* is constructed as the difference between the same family-style weight (e.g., the sum of all positions for US equity underlying funds managed by the same family) in the TDF portfolio minus the allocation benchmark, which is defined as the average ratio of family assets in the same style relative to total style assets. Panel B reports the investments in actively managed funds results by the same family (defined as a fraction of AUM invested in actively managed funds by the same family). *Target Horizon* is defined as the difference between the fund's target date and the current date. All coefficients for *Target Horizon* are multiplied by 100. Other control variables are defined in Appendix A. We used the same control variables as in Table 4. *Underlying Same (Different) Family Fund Outflows* represents the sum of monthly outflows over the last year for all underlying funds managed by the same family (different families), scaled by assets at the beginning of the year. In specifications 5 and 6, we interacted *Target Horizon* with period dummies. Specifications 1, 3, and 5 are panel estimates with *Date* and *Family* fixed effects, while specifications 2, 4, and 6 use *Date*Family* fixed effects. We report *t*-statistics, adjusted for clustering over family and date, in parentheses.

Panel A: Family Tilt

	(1)	(2)	(3)	(4)	(5)	(6)
Target Horizon			0.064	0.110**		
			(1.19)	(2.06)		
<= 2007					0.047	0.036
					(1.166)	(1.16)
2008-2012					0.087	0.121**
					(1.62)	(2.28)
>=2013					0.055	0.115*
					(0.89)	(1.86)
Underlying Same Family Fund Outflows	0.919***	1.244***	0.913***	1.230***	0.914***	1.230***
	(9.17)	(7.68)	(9.29)	(7.70)	(9.29)	(7.69)
Underlying Different Family Fund Outflows	-0.947***	-1.559***	-0.951***	-1.600***	-0.952***	-1.602***
	(-5.87)	(-5.48)	(-5.89)	(-5.58)	(-5.90)	(-5.58)
Expense Ratio	-0.285	0.107	-0.271	0.210	-0.253	0.216
	(-0.22)	(0.10)	(-0.21)	(0.20)	(-0.20)	(0.20)
Turnover Ratio	-0.015	-0.062***	-0.016	-0.061***	-0.015	-0.061***
	(-1.09)	(-2.76)	(-1.10)	(-2.79)	(-1.08)	(-2.73)
Log (TNA (t-1))	0.007**	0.005*	0.007**	0.006**	0.007**	0.006**
	(2.12)	(1.95)	(2.15)	(2.14)	(2.16)	(2.14)
Retail Dummy	0.019**	0.018**	0.019**	0.018**	0.019**	0.018**
	(2.36)	(2.53)	(2.35)	(2.49)	(2.35)	(2.49)
Equity, % of TNA	0.034	0.026	0.001	-0.039	0.001	-0.0421
	(1.57)	(1.25)	(0.02)	(-0.94)	(0.03)	(-0.98)
Log (Age)	0.044***	0.049***	0.045***	0.051***	0.044***	0.051***
	(3.46)	(3.39)	(3.55)	(3.52)	(3.52)	(3.51)
Family Equity, % of TNA	-0.212***		-0.206***		-0.207***	
	(-2.92)		(-2.83)		(-2.83)	
log (Family TNA)	0.039***		0.037***		0.037***	
	(2.91)		(2.754)		(2.75)	
Family Flow Volatility	0.055		0.060		0.060	
	(0.39)		(0.42)		(0.42)	
Fixed Effects	Date, Family	Date*Family	Date, Family	Date*Family	Date, Family	Date*Family
Observations	34,748	34,701	34,748	34,701	34,748	34,701
R-squared	0.808	0.873	0.808	0.873	0.808	0.873

Panel B: Actively Managed Funds in the Same Family

	(1)	(2)	(3)	(4)	(5)	(6)
Target Horizon			0.106**	0.106**		
			(2.33)	(2.48)		
<= 2007					0.103	0.103
					(1.29)	(1.65)
2008-2012					0.108**	0.105**
					(2.12)	(2.471)
>=2013					0.106**	0.107**
					(2.06)	(2.17)
Underlying Same Family Fund Outflows	0.524***	1.183***	0.515***	1.169***	0.515***	1.169***
	(5.08)	(7.63)	(4.97)	(7.50)	(4.96)	(7.49)
Underlying Different Family Fund Outflows	-0.430***	-0.438***	-0.439***	-0.477***	-0.439***	-0.477***
	(-5.60)	(-4.07)	(-5.66)	(-4.45)	(-5.66)	(-4.44)
Expense Ratio	1.233	3.727***	1.226	3.792***	1.227	3.791***
	(1.05)	(3.71)	(1.04)	(3.78)	(1.04)	(3.79)
Turnover Ratio	0.037***	0.007	0.036***	0.008	0.036***	0.008
	(5.24)	(0.82)	(5.22)	(0.85)	(5.19)	(0.84)
Log (TNA (t-1))	0.005	0.006**	0.006*	0.007**	0.006*	0.007**
	(1.52)	(2.09)	(1.75)	(2.37)	(1.75)	(2.37)
Retail Dummy	0.048***	0.037***	0.048***	0.036***	0.049***	0.036***
	(5.47)	(4.64)	(5.48)	(4.62)	(5.47)	(4.62)
Equity, % of TNA	0.106***	0.112***	0.051	0.052*	0.051	0.0515*
	(5.20)	(5.73)	(1.60)	(1.75)	(1.57)	(1.68)
Log (Age)	0.031***	0.036***	0.033***	0.038***	0.033***	0.038***
	(3.39)	(3.76)	(3.56)	(3.96)	(3.55)	(3.94)
Family Equity, % of TNA	-0.287**		-0.280**		-0.276**	
	(-2.53)		(-2.43)		(-2.43)	
log (Family TNA)	0.049**		0.048**		0.048**	
	(2.44)		(2.32)		(2.31)	
Family Flow Volatility	-0.416***		-0.411***		-0.411***	
	(-2.80)		(-2.77)		(-2.77)	
Fixed Effects	Date, Family	Date*Family	Date, Family	Date*Family	Date, Family	Date*Family
Observations	37,931	37,889	37,931	37,889	37,931	37,889
R-squared	0.737	0.860	0.737	0.860	0.737	0.860

Table 9: Underlying Fund Average Expense Ratio and its Equity Components

Panel A reports the *Underlying Fund Average Expense Ratio*. We report the regression for the average expense ratio of the TDF's underlying funds (e.g., the VFORX underlying expense ratio was calculated as 0.1442% in 2018, which matched the Vanguard website). The observations are yearly. In columns 5–6, we report Target Horizon's interaction with period dummies results. All coefficients are multiplied by 100. Control variables are defined in Appendix A. Specification 1 is panel estimate with *Date* and *Family* fixed effects, while specifications 2-6 use *Date***Family* fixed effects In Panel B, we report the components of fees associated with underlying US and Foreign Equity funds. Specifications (1) and (4) [(2) and (5), (3) and (6)] are similar to Specification (3) [(5), (6), correspondingly] of Panel A. We report *t*-statistics, adjusted for clustering over fund and date, in parentheses. All coefficients are multiplied by 100.

Panel A: Underlying Fund Average Expense Ratio

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Target Horizon	0.374***	0.383***	0.335***	0.242***		
	(6.02)	(5.78)	(5.25)	(3.17)		
x Same Family Actively Managed Funds				0.185***		
				(4.18)		
<= 2007					0.308***	0.0868
					(7.98)	(1.13)
x Same Family Actively Managed Funds						0.395***
						(4.72)
2008-2012					0.428***	0.361***
					(5.24)	(4.34)
x Same Family Actively Managed Funds						0.0895*
						(1.978)
>=2013					0.304***	0.228**
					(3.93)	(2.59)
x Same Family Actively Managed Funds						0.171***
						(3.35)
Turnover Ratio	2.286	3.506	1.632	1.738	1.877	1.908
	(1.46)	(1.67)	(1.19)	(1.25)	(1.33)	(1.34)
Log (TNA (t-1))	-0.026	-0.072	-0.042	-0.047	-0.032	-0.041
	(-0.12)	(-0.38)	(-0.19)	(-0.23)	(-0.15)	(-0.19)
Retail Dummy	4.167***	2.389***	0.741*	0.794*	0.740*	0.776*
	(8.04)	(3.51)	(1.95)	(2.06)	(1.94)	(2.02)
Log (Age)	8.610***	11.091***	8.758***	8.785***	8.707***	8.745***
	(7.51)	(10.45)	(12.63)	(12.49)	(12.25)	(12.27)
Equity, % of TNA	-5.238	-4.285	-5.392	-4.807	-5.090	-4.557
	(-0.87)	(-0.68)	(-0.93)	(-0.83)	(-0.86)	(-0.74)
Same Family Funds, % of TNA	11.73***	19.95***	2.976	3.746	3.093	3.654
	(3.33)	(7.20)	(0.86)	(1.04)	(0.87)	(0.95)
Family Equity, % of TNA	-59.001***					
	(-4.26)					
log (Family TNA)	3.650					
	(1.55)					
Family Flow Volatility	-41.76**					
	(-2.87)					
Same Family Actively Managed Funds			38.51***	34.98***	38.46***	
			(6.51)	(5.65)	(6.51)	
x <= 2007						4.52**
						(2.92)
x 2008-2012						38.329
						(5.12)
x >=2013						35.16***
						(5.01)
Fixed Effects	Date,	Date*Family	Date*Family	Date*Family	Date*Family	Date*Family
Observations	10,152	10,143	9,788	9,788	9,788	9,788
R-squared	0.688	0.843	0.892	0.894	0.893	0.894

Panel B: Equity Subcomponents of Underlying Fund Average Expense Ratio

	US Equity			Foreign Equity		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Target Horizon	0.208***			0.253**		
	(3.33)			(2.40)		
<= 2007		0.056*	0.043		0.005	-0.066
		(1.90)	(0.65)		(0.11)	(-1.02)
x Same Family Actively Managed Funds			0.099			0.167**
			(1.35)			(2.27)
2008-2012		0.182***	0.227***		0.268**	0.270**
		(2.97)	(3.05)		(2.50)	(2.51)
x Same Family Actively Managed Funds			-0.0678			-0.009
			(-1.438)			(-0.13)
>=2013		0.231***	0.213***		0.275**	0.280**
		(3.81)	(3.34)		(2.49)	(2.61)
x Same Family Actively Managed Funds			0.028			-0.016
			(0.32)			(-0.21)
Turnover Ratio	1.896	1.807	1.809	0.515	0.498	0.515
	(1.13)	(1.09)	(1.09)	(0.32)	(0.31)	(0.33)
Log (TNA (t-1))	-0.263	-0.262	-0.268	0.101	0.111	0.110
	(-1.10)	(-1.10)	(-1.13)	(0.32)	(0.35)	(0.34)
Retail Dummy	1.382***	1.379***	1.362***	1.848***	1.844***	1.836***
	(3.05)	(3.04)	(2.98)	(4.24)	(4.26)	(4.29)
Log (Age)	9.962***	9.991***	9.986***	8.524***	8.532***	8.521***
	(11.04)	(11.08)	(10.95)	(10.66)	(10.57)	(10.40)
Equity, % of TNA	-10.72**	-11.41**	-10.92**	-19.16**	-20.35**	-20.22**
	(-2.42)	(-2.57)	(-2.41)	(-2.31)	(-2.38)	(-2.34)
Same Family Funds, % of TNA	17.78***	17.78***	17.44***	-5.611	-5.459	-5.470
	(3.309)	(3.301)	(3.170)	(-1.041)	(-1.01)	(-0.92)
Same Family Actively Managed Funds	43.75***	43.78***		44.12***	44.14***	
	(9.85)	(9.87)		(4.10)	(4.09)	
x <= 2007			9.521***			13.221*
			(2.34)			(1.85)
x 2008-2012			40.963***			46.397***
			(6.29)			(3.95)
x >=2013			44.34***			44.25***
			(7.86)			(3.35)
Fixed Effects	Date*Family	Date*Family	Date*Family	Date*Family	Date*Family	Date*Family
Observations	9,667	9,667	9,667	9,519	9,519	9,519
R-squared	0.886	0.886	0.887	0.898	0.898	0.898

Table 10: Determinants of TDFs' Risk-Taking

We report the results for the quarterly volatility. *Target Horizon* is defined as the difference between the fund's target date and the current date. All coefficients are multiplied by 100. Other control variables are defined in Appendix A. We used the same control variables as in Table 4. In specifications 1–4, we interacted *Target Horizon* with *Underlying Same Family Fund Outflows* and *Family Tilt*. In specifications 5–8, we interacted with *Target Horizon*, *Underlying Same Family Fund Outflows,* and actively managed funds by the same family (defined as a fraction of AUM invested in actively managed funds, same family, *AMF Same Family*). In specifications 2, 3, 6, and 7, we interacted *Target Horizon* with period dummies. Specifications 1, 3, 5, and 7 are panel estimates with *Date* and *Family* fixed effects, while specifications 2, 4, 6, and 8 use *Date*Family* fixed effects. We report *t*-statistics, adjusted for clustering over family and date, in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Family Tilt				*Same Family Active Fund Assets*		
Target Horizon	0.136***	0.127***			0.198***	0.197***		
	(9.17)	(8.68)			(13.27)	(13.34)		
x Interaction Var	-0.022**	-0.025**			-0.020**	-0.026***		
	(-2.27)	(-2.56)			(-2.11)	(-2.76)		
x Underlying Same Family Fund Outflows	-0.833***	-0.785***			-0.204**	-0.160*		
	(-4.53)	(-3.59)			(-2.635)	(-1.97)		
x Int.Var x Underlying Same Family Fund Outflows	1.003***	0.975***			0.443***	0.435***		
	(5.03)	(4.19)			(3.77)	(3.55)		
<= 2007			0.259***	0.179***			0.255***	0.266***
			(5.42)	(3.57)			(6.41)	(5.67)
x Interaction Var			-0.553	2.278*			-0.046	-0.175**
			(-0.96)	(1.85)			(-0.50)	(-2.23)
x Underlying Same Family Fund Outflows			-0.042**	0.059*			-0.006	-0.002
			(-2.22)	(1.90)			(-0.37)	(-0.07)
x Int. Var x Underlying Same Family Fund Outflows			0.708	-2.461**			0.260	0.037
			(1.27)	(-2.04)			(1.61)	(0.20)
2008-2012			0.210***	0.201***			0.281***	0.270***
			(6.95)	(6.15)			(8.46)	(8.56)
x Interaction Var			-0.029	-0.060			-0.161	0.040
			(-0.08)	(-0.08)			(-1.40)	(0.23)
x Underlying Same Family Fund Outflows			-0.032**	-0.0455*			-0.036***	-0.045**
			(-2.43)	(-1.85)			(-2.73)	(-2.67)
x Int. Var x Underlying Same Family Fund Outflows			0.098	0.196			0.314**	0.234
			(0.22)	(0.27)			(2.20)	(1.14)
>=2013			0.094***	0.084***			0.172***	0.171***
			(5.91)	(5.404)			(11.00)	(11.03)
x Interaction Var			-0.551***	-0.548***			-0.144**	-0.098
			(-3.82)	(-3.25)			(-2.14)	(-1.45)
x Underlying Same Family Fund Outflows			-0.025***	-0.029***			-0.031***	-0.029***
			(-2.76)	(-3.20)			(-3.11)	(-3.00)
x Int Var x Underlying Same Family Fund Outflows			0.711***	0.726***			0.333***	0.268**
			(4.49)	(3.94)			(3.22)	(2.38)
Interaction Var	48.569***	42.387**	50.917***	40.387**	45.485**	73.521**	52.394***	73.212**
	(3.23)	(2.37)	(3.44)	(2.42)	(2.53)	(2.53)	(2.80)	(2.51)
Underlying Same Family Fund Outflows	282.176*	211.586	124.092	74.017	180.694	83.192	127.128	0.8
	(1.93)	(1.51)	(0.95)	(0.59)	(1.62)	(0.52)	(1.36)	(0.57)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Date, Family	Date * Family	Date, Family	Date * Family	Date, Family	Date * Family	Date, Family	Date * Family
Observations	32,759	32,721	32,759	32,721	35,039	34,999	35,039	34,999
R-squared	0.920	0.935	0.930	0.945	0.905	0.922	0.914	0.930

Figure 1: Growth of TDFs in Total Assets, Cumulative Flows, and Number of Fund Share Classes

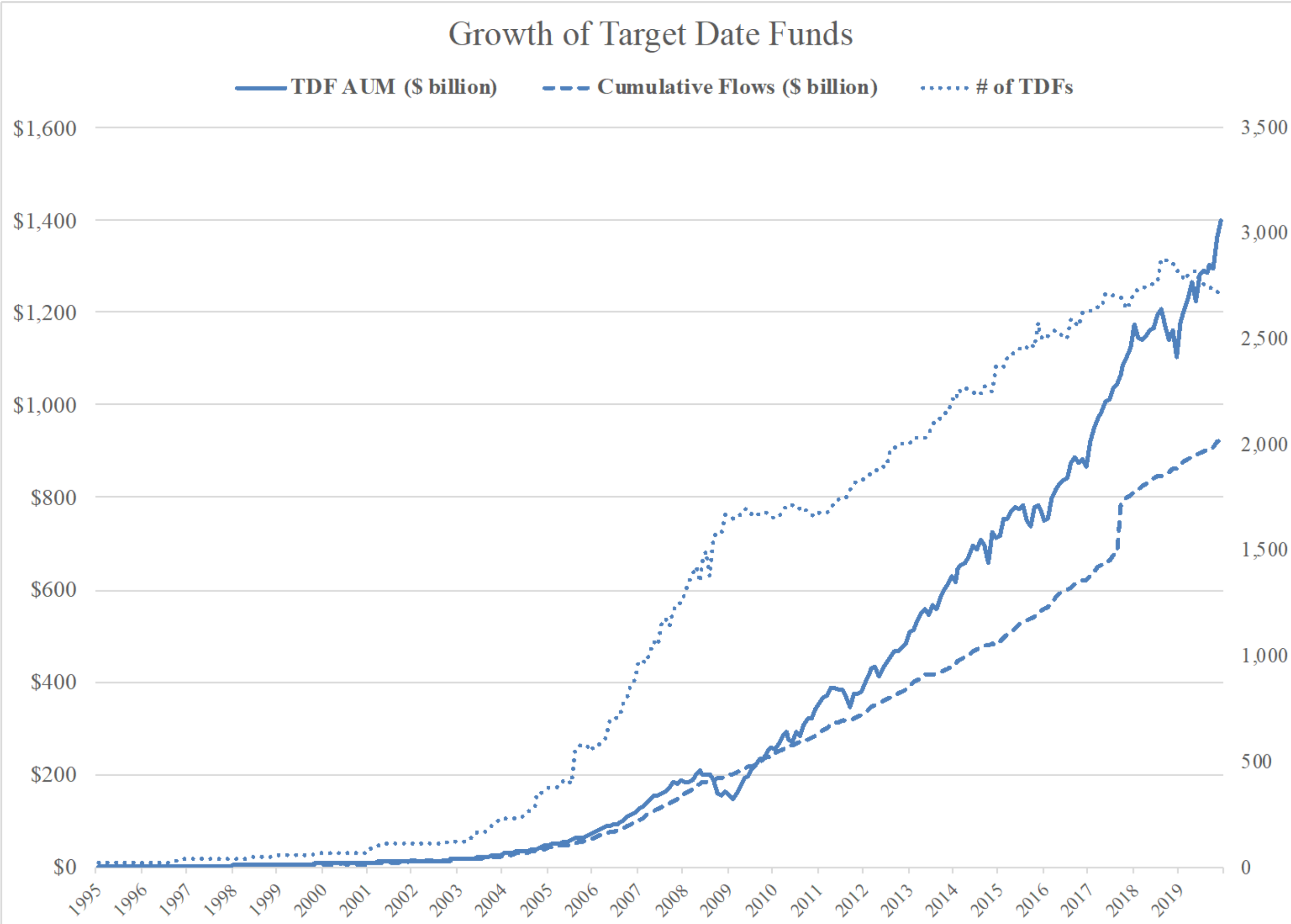
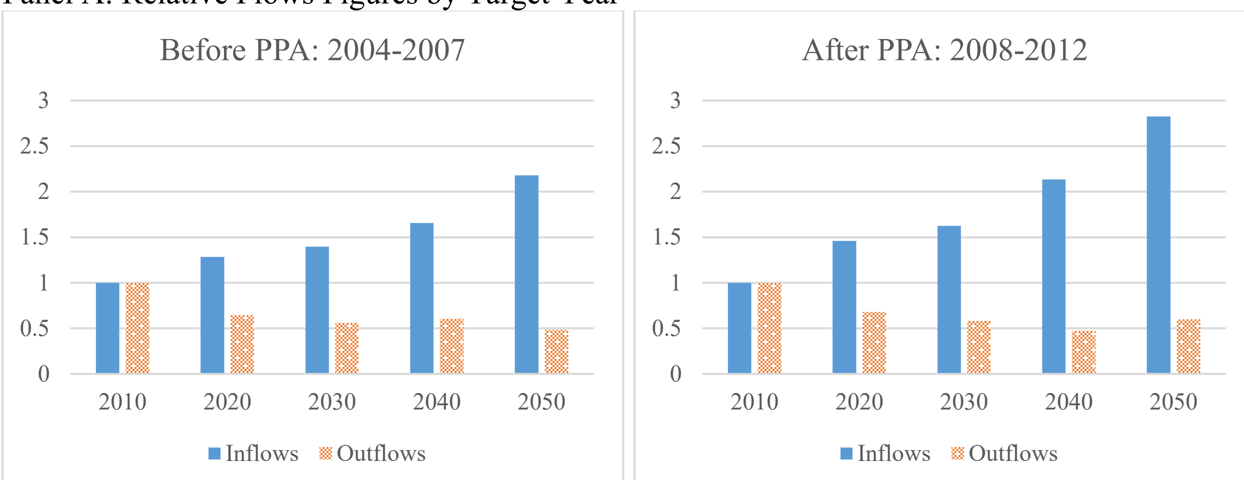


Figure 2: Target Date Funds and the Pension Protection Act Introduction

The figures present the distribution of annual flows of target date funds, by target horizon, before and after the introduction of the Pension Protection Act in 2008. The *y*-axis represents the relative annual flows (N-SAR's New Subscriptions or Inflows in blue, and Redemptions or Outflows in orange), scaled by total assets at the beginning of the period. At the beginning of the period, we use the total assets to scale the dollar annual Inflows (Outflows) and as weights in computing the average Inflows (Outflows) figures. We use the first reported assets for the funds that are incepted after the start of the event period. For illustration purposes and to reflect the relative magnitude of flows in longer-horizon TDFs relative to short-horizon funds, the vertical bars represent the average Inflows (Outflows) figures for each bucket standardized by the Inflows (Outflows) level of the first bucket, which corresponds to short-horizon funds. In the first panel, we use discrete target year cutoffs in constructing the five buckets by collapsing the mid-decade (2015, 2025, 2035, 2045) with the end-of-decade funds (2010, 2020, 2030, 2040, and 2050). The 2050 bucket also includes 2055+ target-date funds. In the second panel, we use annual sorts on *Target Horizon* to classify target date funds into five buckets. The *Target Horizon* is the difference between the fund's target and current dates, and quintiles are computed every year.

Panel A: Relative Flows Figures by Target Year



Panel B: Relative Flows Figures Using Annual Sorts on Target Horizon

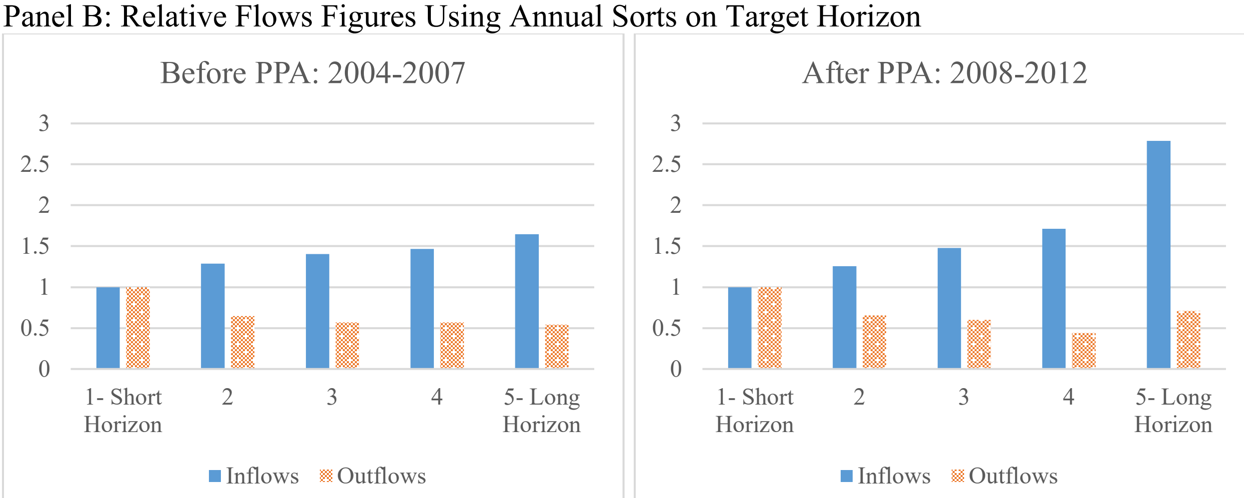
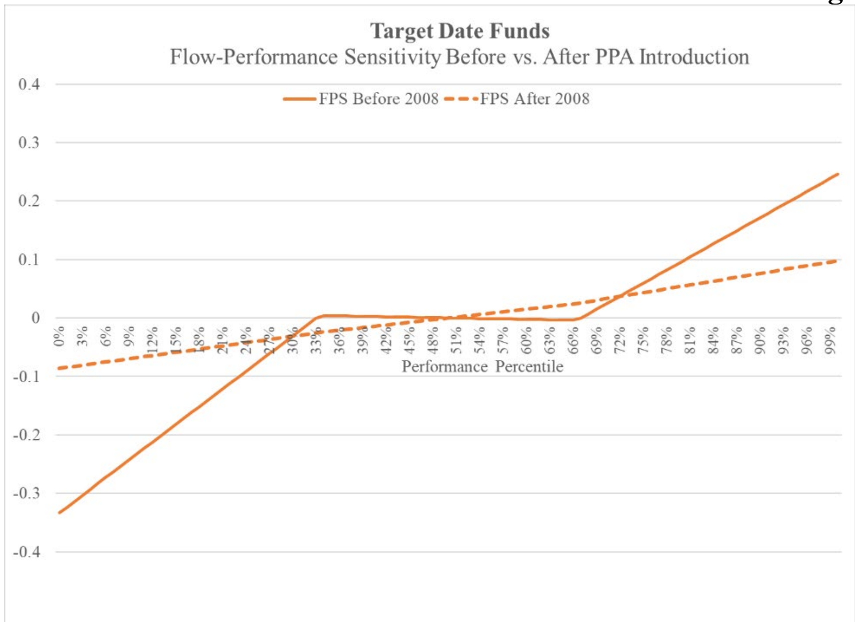


Figure 3: Flow-Performance Sensitivities for TDFs and Balanced Funds

The figure represents the comparison of flow-performance sensitivity for TDFs and balanced funds (Figure 3A) and flow-performance sensitivity for TDFs with different horizons (Figure 3B) using the piecewise linear specification of Sirri and Tufano (1998). We regress the annual fund flows on three performance rank variables of the fund's prior year annual return within its Lipper style. *Low*, *Mid*, and *High-Performance Rank* variables represent the fund's ranked annual return performance constructed using the percentile rank of the prior year's annual return for the fund within its Lipper Style. We split the performance percentile ranks into three equal groups to capture the non-linearity in the flow performance sensitivity. *Low Performance Rank* is defined as the min(*Annual Return Percentile Rank*, 0.33), *Mid* = min(*Annual Return Percentile Rank* – *Low*, 0.33), and *High* = (*Annual Return Percentile Rank* – *Low* – *Mid*). We include *Family*Date* and style fixed effects and cluster the errors at *Fund* and *Date* level. We include various controls such as the aggregate flows by all funds in the same style or category, the fund's expense ratio, turnover ratio, return volatility, and a retail share class dummy. In Figure 3A, solid lines represent FPS prior to PPA went into effect at the end of 2007, and dashed line represents FPS past 2008.

Figure 3A



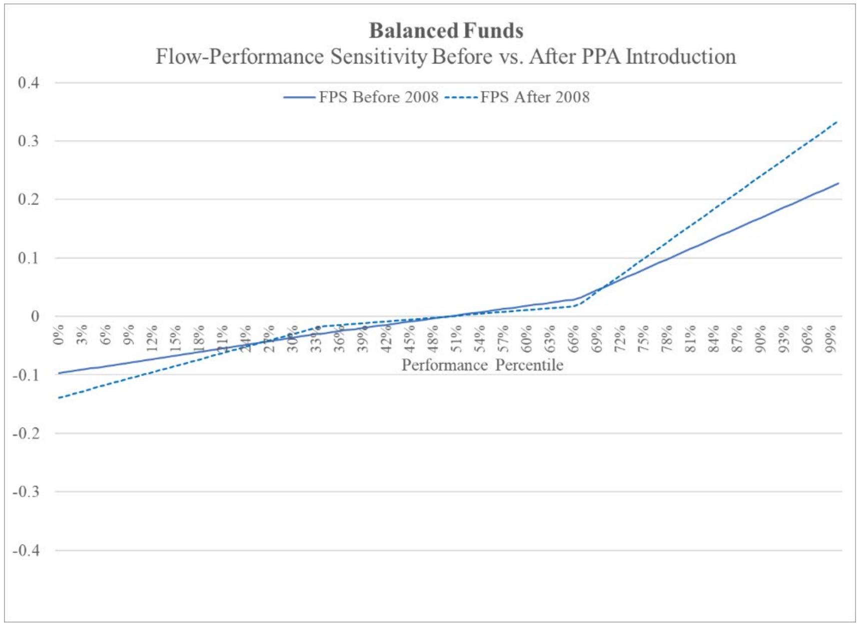


Figure 3B

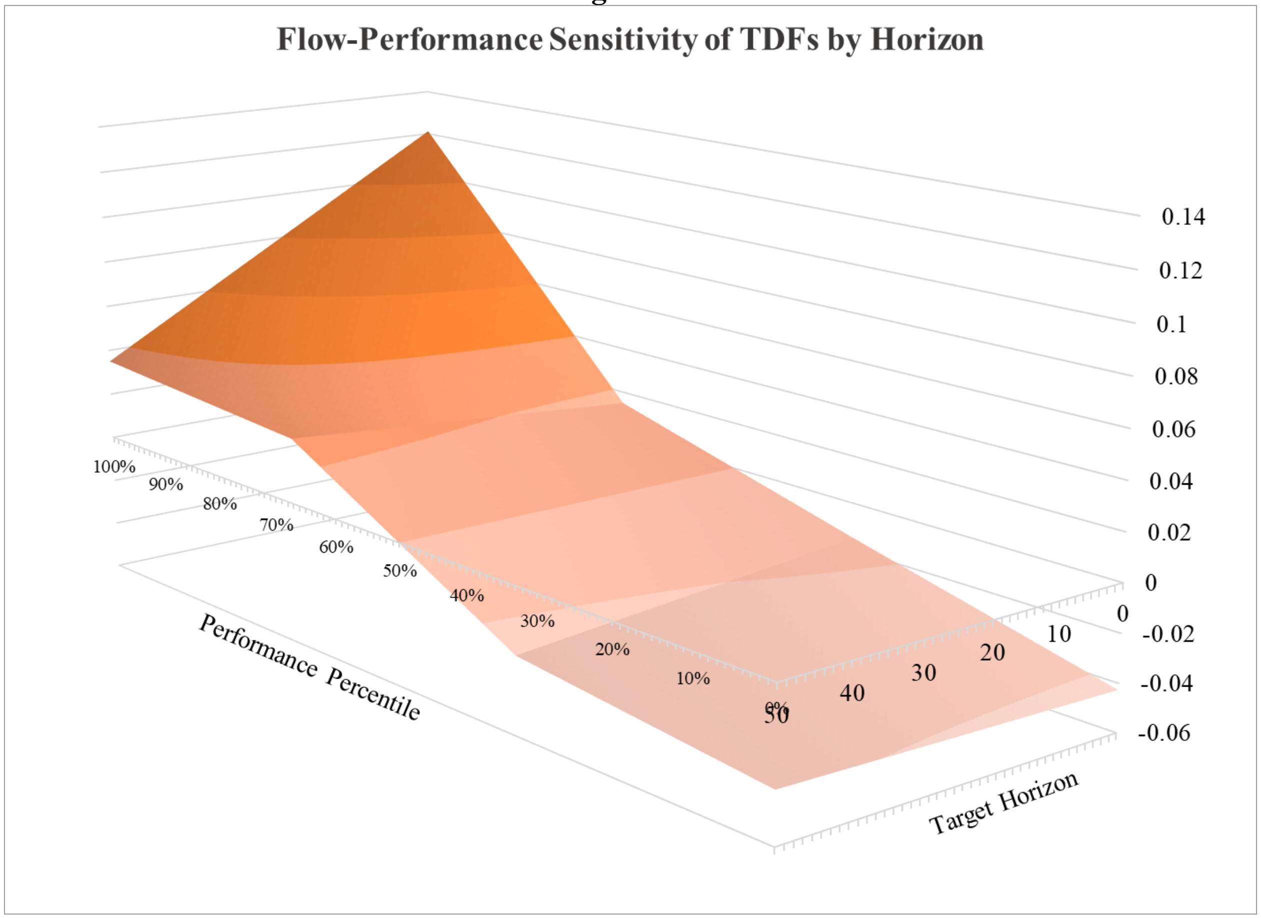

Flow-Performance Sensitivity of TDFs by Horizon
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Performance Percentile
0
10
20
30
40
50
Target Horizon

Figure 4: Underperformance of TDFs by Target Date

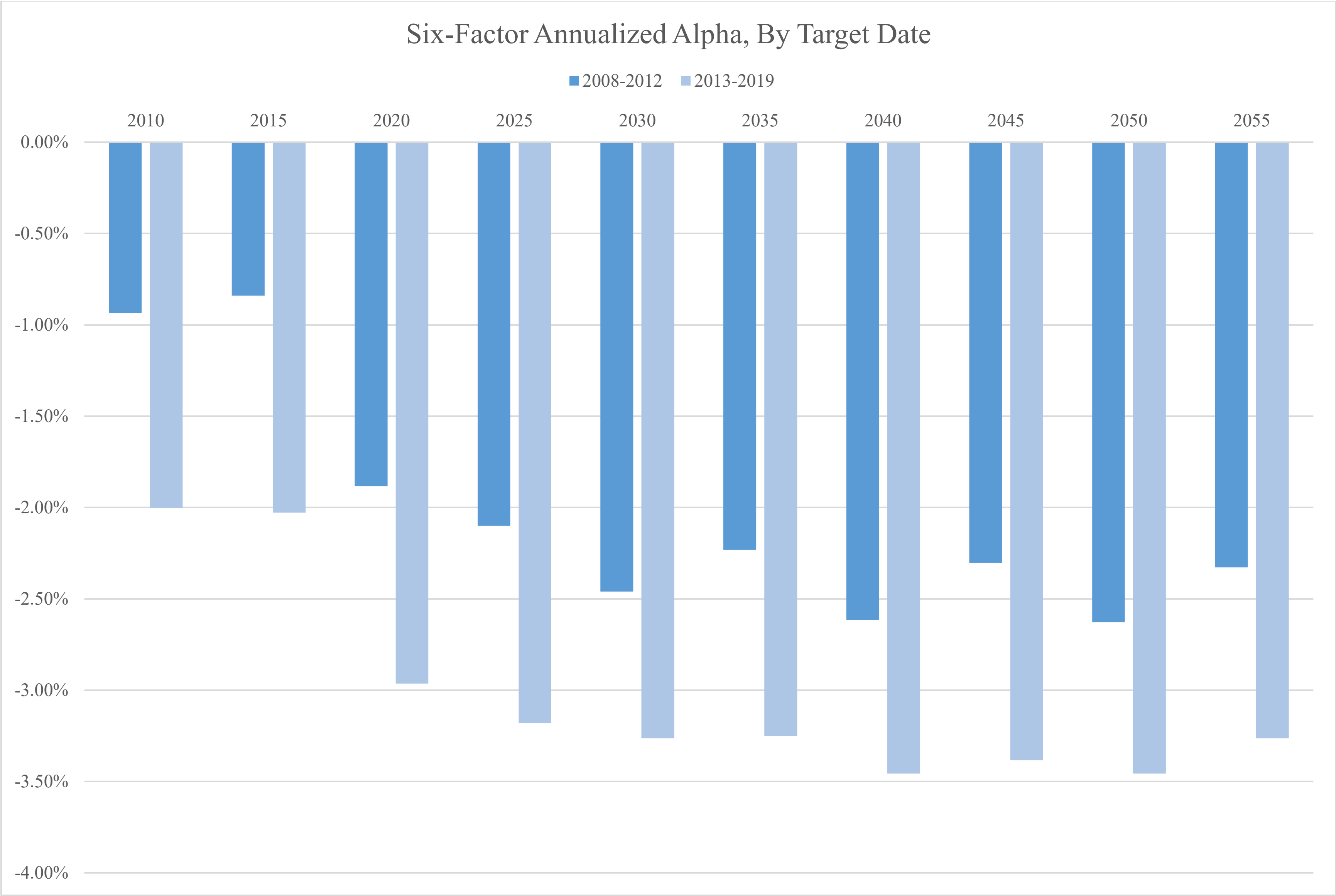


Figure 5: Hypothetical Underperformance of TDFs.

We assume that the investor starts investing at the age of 18 and invests $1 each year for 50 years. We assume the standard glide path of the portfolio of 90% equity and 10% bonds for horizons for ages 18-48, 10% equity and 90% bonds for retirement (age 68+), and linear for ages between 49 and 68 with a 4% per year equity reduction. We assume that the real return for equity and bonds is 7% and 2% per year, respectively.

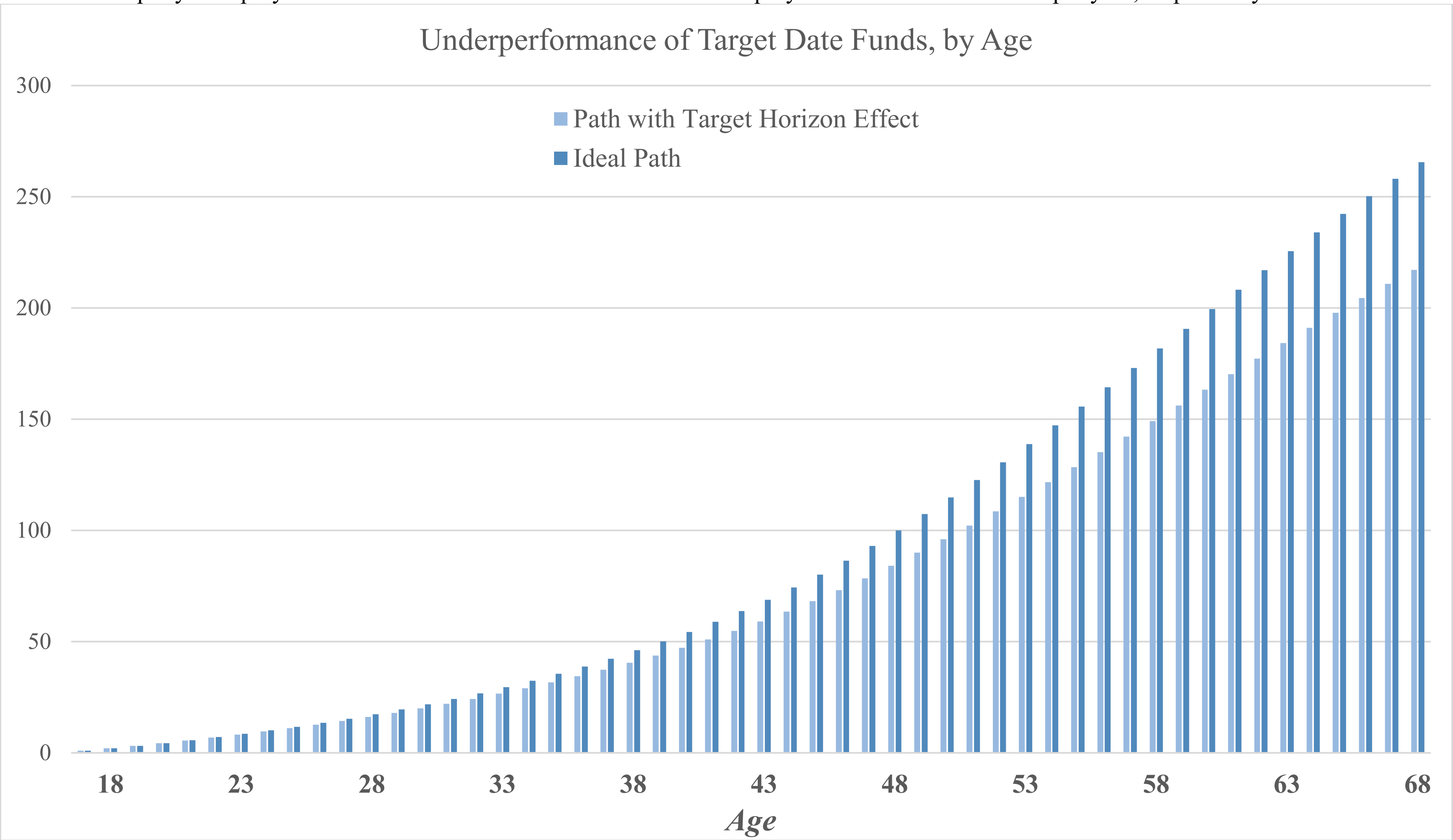
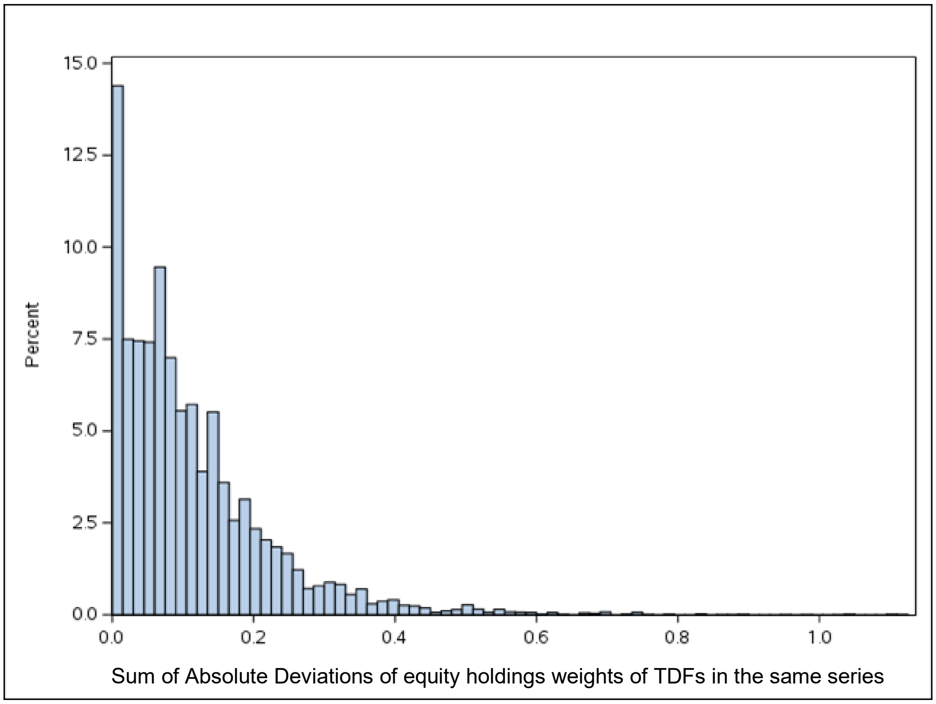


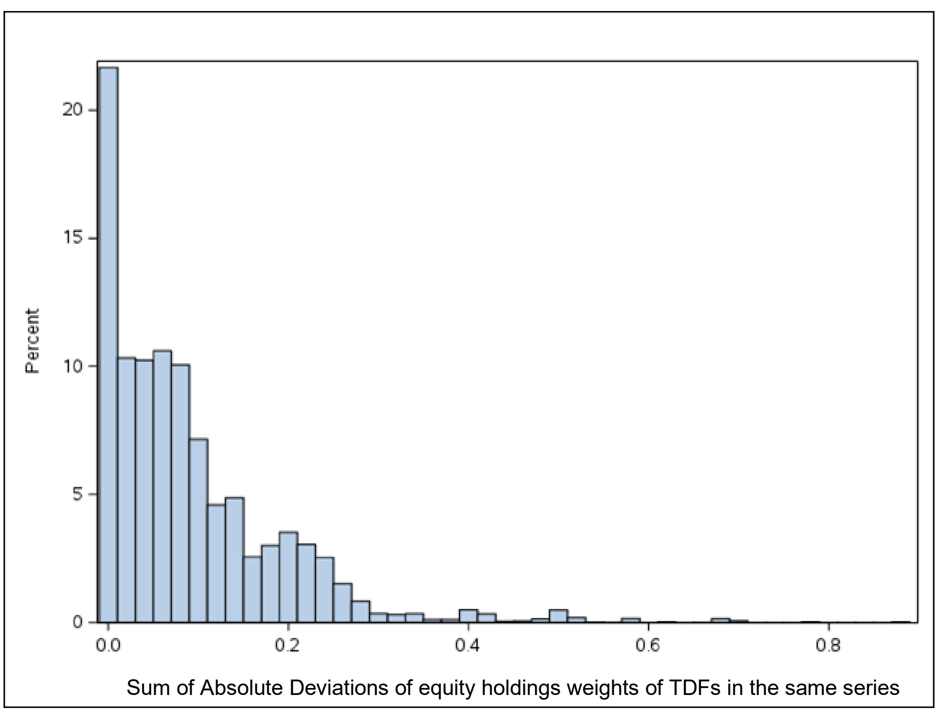
Figure 6: Variations of Underlying Equity Fund Allocations, within TDF Series

We report the distribution of the sum of absolute deviations of equity weights within different Target-Date Funds that belongs to the same series using yearly observations. In Panel A, we report the overall sample of funds, while in Panel B, we limit the sample only to the series that uses the same underlying holdings for different TDFs and report on the same date.

Panel A: All Funds



Panel B: Funds in the TDF series with the same holdings observed on the same report dates



<u>Internet Appendix:</u> Additional Results and Robustness Checks

Table A1: Descriptive Statistics

This table reports the descriptive statistics for our sample extracted from the CRSP mutual fund database between Q1 2000 and Q1 2019. We use Lipper Class (MATA – MATM) to identify TDFs with target dates of 2010 to 2065 respectively. Panel A represents the descriptive statistics for the entire sample of TDFs. Panel B reports the descriptive statistics for the TDF subsample. Panels A and B present the number of TDFs and AUM during the sample period.

Panel A: Target Date Fund Sample, by Year

			# of Funds											
			Target Date											
	Lipper Class		*MATA*	*MATF*	*MATB*	*MATG*	*MATC*	*MATD*	*MATH*	*MATI*	*MATE*	*MATK*	*MATL*	*MATM*
Year	*# of Shares*	*AUM*	*2010*	*2015*	*2020*	*2025*	*2030*	*2035*	*2040*	*2045*	*2050*	*2055*	*2060*	*2065*
2000	63	$9,980	11	21	14		9		8					
2001	109	$12,026	18	28	22		17		17		7			
2002	109	$14,565	18	28	22		17		17		7			
2003	163	$20,185	29	37	33		30		27		7			
2004	238	$35,092	47	54	42	8	37	8	34	1	7			
2005	413	$56,590	71	88	63	26	61	23	51	15	15			
2006	693	$91,304	131	125	107	45	106	43	82	31	23			
2007	1,047	$156,648	169	163	149	75	147	97	112	68	64	3		
2008	1,441	$201,198	208	225	197	109	191	134	157	94	117	9		
2009	1,697	$195,643	226	276	209	140	210	161	188	127	145	15		
2010	1,713	$271,289	210	284	202	144	203	156	191	135	149	39		
2011	1,741	$385,095	175	286	197	148	202	157	191	135	172	78		
2012	1,893	$430,628	181	296	214	162	216	171	208	156	196	93		
2013	2,047	$547,142	175	320	221	189	228	193	210	178	210	123		
2014	2,254	$695,472	173	343	243	207	251	211	233	196	228	169		
2015	2,454	$774,371	165	357	255	222	262	231	245	211	240	266		
2016	2,505	$835,248	132	344	261	223	268	232	249	212	241	343		
2017	2,718	$1,013,349	141	346	278	241	283	251	267	232	266	413		
2018	2,756	$1,165,968	140	338	270	246	282	255	270	237	268	450		
2019	2,778	$1,284,464	146	336	261	250	273	260	260	241	263	448	34	6

Panel B: Target Date Fund Total Assets under Management, by Year

	AUM ($ million)											
Year	*2010*	*2015*	*2020*	*2025*	*2030*	*2035*	*2040*	*2045*	*2050*	*2055*	*2060*	*2065*
2000	$3,516	$1,439	$2,784		$1,690		$551					
2001	$4,478	$1,728	$3,370		$1,908		$541		$1			
2002	$5,616	$1,943	$4,137		$2,255		$608		$6			
2003	$7,406	$2,391	$5,938		$3,411		$1,021		$20			
2004	$11,092	$4,245	$10,443	$471	$6,189	$222	$2,319	$53	$58			
2005	$15,097	$8,344	$15,135	$2,947	$9,123	$1,550	$3,947	$331	$116			
2006	$19,671	$14,237	$22,341	$7,815	$14,159	$4,472	$7,111	$1,214	$286			
2007	$28,763	$24,348	$35,906	$16,045	$24,482	$9,779	$13,091	$3,205	$1,012	$18		
2008	$33,571	$32,466	$44,004	$22,642	$30,546	$13,882	$16,764	$4,997	$2,267	$58		
2009	$27,609	$31,938	$40,432	$23,475	$29,440	$15,212	$17,636	$6,400	$3,408	$94		
2010	$31,914	$44,782	$54,491	$34,670	$41,067	$22,451	$25,553	$10,098	$6,077	$187		
2011	$37,087	$60,354	$75,400	$51,163	$59,841	$34,629	$38,673	$16,778	$10,615	$556		
2012	$34,099	$69,196	$82,518	$58,109	$67,221	$40,068	$44,073	$20,561	$13,700	$1,084		
2013	$35,175	$81,411	$100,098	$77,869	$85,689	$55,622	$57,662	$30,279	$20,342	$2,998		
2014	$35,585	$92,590	$123,346	$101,224	$111,564	$75,072	$77,546	$42,621	$29,727	$6,197		
2015	$32,921	$93,762	$133,416	$115,713	$125,627	$86,827	$88,077	$50,911	$36,778	$10,341		
2016	$30,950	$90,396	$138,671	$128,157	$136,131	$96,446	$95,691	$58,830	$44,149	$15,828		
2017	$30,148	$92,843	$155,933	$156,320	$167,226	$123,340	$121,054	$78,973	$60,473	$27,039		
2018	$22,319	$99,711	$164,033	$181,405	$192,828	$147,984	$141,860	$97,999	$76,436	$41,394		
2019	$21,469	$97,575	$165,344	$199,387	$213,250	$166,838	$158,179	$113,796	$91,181	$57,410	$25	$12

Table A2: Performance of TDFs Relative to Non-TDF Funds, Alternative Specifications

This table reports the results for the alpha of the six-factor model (where factors are *Excess Market Return, SMB, HML, UMD, Default*, and *Term* factors, defined in Appendix A). The returns are weekly returns net of all fees (columns 1–4) and gross of fees (columns 5–8). For each quarter, we calculated alphas using the previous year. Alphas are annualized and multiplied by 100. We report the sample of all CRSP funds (similar to Table 4, Panel B). Panel C reports the results for both samples with double interaction between *TDF Dummy* (short — less than 7 years, medium — between 7 and 17 years, and long — above 17 years), and Period Dummies. *TDF Dummy* is a dummy equal to one if the fund is defined as a TDF and zero otherwise. In columns 3 and 7, we report the results for short-, medium-, and long-horizon dummies. Columns 4 and 8 report the TDF dummy interaction results with period dummies. Other control variables are defined in Appendix A. Specifications 1 and 5 are panels with *Date, Lipper Class,* and *Family* fixed effects, while specifications 2-4 and 6-8 use *Date*Family* and *Date*Lipper Class* fixed effects. The *t*-statistics, adjusted for clustering over fund and date, are in parentheses. We report the *F*-statistics of the equality test between short and long horizons (specifications 3 and 7) and the difference between the periods before PPA and post-PPA (specifications 4 and 8).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TDF Dummy	-0.589***	-0.703***			-0.541***	-0.660***		
	(-3.88)	(-6.76)			(-3.54)	(-6.28)		
TDF Short Horizon			-0.618***				-0.560***	
			(-4.91)				(-4.70)	
TDF Medium Horizon			-0.500***				-0.494***	
			(-3.40)				(-3.34)	
TDF Long Horizon			-1.111***				-1.041***	
			(-4.95)				(-4.44)	
<= 2007				-0.377**				-0.340**
				(-2.62)				(-2.25)
2008-2012				-0.889***				-0.862***
				(-7.09)				(-6.89)
>=2013				-0.702***				-0.541**
				(-2.85)				(-2.10)
Control variables	Y	Y	Y	Y	Y	Y	Y	Y
Fixed Effects	Date, Family, Lipper4	Date*Family, Lipper4*date	Date*Family, Lipper4*date	Date*Family, Lipper4*date	Date, Family, Lipper4	Date*Family, Lipper4*date	Date*Family, Lipper4*date	Date*Family, Lipper4*date
Observations	852,408	851,896	851,896	851,896	852,408	851,896	851,896	851,896
R-squared	0.219	0.691	0.691	0.691	0.214	0.689	0.689	0.689
F-Stat			4.15	8.30			3.78	8.12
Prob>F			0.045	0.005			0.056	0.006

Table A3: Performance of TDFs Relative to Equity-dominated US Equity Funds

This table reports the results for the alpha of the six-factor model (where factors are *Excess Market Return, SMB, HML, UMD, Default*, and *Term* factors, defined in Appendix A). Panel A (B) reports the results for TDFs and US equity funds with at least 90% (94%) of equity. The returns are weekly returns net of all fees (columns 1–3) and gross of fees (columns 4–6). For each quarter, we calculated alphas using the previous year. Alphas are annualized and multiplied by 100. *TDF Dummy* is a dummy equal to one if the fund is defined as a TDF and zero otherwise. In columns 3 and 6, we report the results for subperiods. Other control variables are defined in Appendix A. Specifications 1 and 4 are panel estimates with *Date* and *Family* fixed effects, while specifications 2, 3, 5, and 6 use *Date*Family* fixed effects. We report *t*-statistics, adjusted for clustering over fund and date, in parentheses.

	Returns, Net of Fees, Six Factor Alpha			Returns, Gross of Fees, Six Factor Alpha		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A			
TDF	-2.877***	-2.708***		-2.614***	-2.444***	
	(-5.89)	(-6.07)		(-5.24)	(-5.35)	
<= 2007			-1.991***			-1.701***
			(-4.92)			(-4.15)
2008-2012			-5.446***			-5.257***
			(-9.77)			(-9.53)
>=2013			-2.141***			-1.902***
			(-5.28)			(-4.70)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Date,	Date*Family	Date*Family	Date,	Date*Family	Date*Family
F-test TDF PER1=TDF PER2 (p-value)			25.68(0.000)			27.38 (0.000)
Observations	338,719	338,128	338,128	338,719	338,128	338,128
R-squared	0.087	0.210	0.210	0.084	0.207	0.208
			Panel B			
TDF	-2.941***	-2.641***		-2.672***	-2.368***	
	(-5.28)	(-5.20)		(-4.70)	(-4.58)	
<= 2007			-2.026***			-1.738***
			(-4.81)			(-4.08)
2008-2012			-6.274***			-6.059***
			(-18.19)			(-17.81)
>=2013			-2.205***			-2.071**
			(-2.69)			(-2.58)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Date,	Date*Family	Date*Family	Date,	Date*Family	Date*Family
F-test TDF PER1=TDF PER2 (p-value)			60.83(0.000)			63.35 (0.000)
Observations	266,200	265,506	265,506	266,200	265,506	265,506
R-squared	0.086	0.229	0.231	0.071	0.217	0.218

Table A4: Determinants of TDF Performance by Horizon, Alternative Specifications

This table reports the specifications similar to Table 4 (Specification 1 and 2) and Table 5 (Specifications 2 and 6 in Panels A and B), and Table 8 (Specification 2 of Panels A and B). Specification 1 is estimated using Family, Lipper Class, and Date fixed effects, whereas other specifications use Family*Date and Lipper Class*Date fixed effects. For Target Date Funds, 4-digit Lipper class coinsides with target date (for example, "2035 TDFs")

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Target Horizon	-0.025**	-0.033**	-0.032**	-0.029**	-0.066***	-0.051**	-0.016	-0.025**
	(-2.21)	(-2.18)	(-2.10)	(-1.97)	(-4.19)	(-2.46)	(-1.46)	(-2.09)
x Retail			-0.003**					
			(-2.08)					
x Family Flow Volatility				-0.084**				
				(-2.63)				
x Family Equity, % of TNA					0.047***			
					(4.67)			
x Family TNA						0.002**		
						(1.99)		
x Family Tilt								0.015***
								(4.36)
x Underlying Same Family Fund Outflows							-0.078***	0.134
							(-6.40)	(1.41)
x Family Tilt x Underlying Same Family Fund Outflows								-0.253**
								(-2.41)
Control variables	Y	Y	Y	Y	Y	Y	Y	Y
Fixed Effects	Date, Family, Lipper4	Date*Family, Lipper4*date	Date*Family, Lipper4*date	Date*Family, Lipper4*date	Date*Family, Lipper4*date	Date*Family, Lipper4*date	Date*Family, Lipper4*date	Date*Family, Lipper4*date
Observations	41,681	41,568	41,568	41,568	41,568	41,568	33,812	31,252
R-squared	0.703	0.930	0.930	0.930	0.930	0.930	0.940	0.943

Table A5: TDF Portfolio Analysis

We report factor regression results based on portfolios of TDFs. The portfolios were formed based on *Target Horizon* quartiles. The portfolios are constructed every month, and the returns and alphas are monthly and expressed in percentages. We report the resulting alphas from the six-factor model, including four equity (market, size, value, and momentum) and two fixed-income (term and default) risk factors. Columns 1–5 report the 2001–2019 sample results, while columns 6–10 report the 2008–2019 subsample results. Columns 5 and 10 report long-short strategies, where the long side corresponds to the long-horizon quartile of target date funds and the short side represents a short quartile. We report *t*-statistics in parentheses.

	Sample Period: 2001-2019					Sample Period: 2008-2019				
Horizon Portfolio	(1- Short)	(2)	(3)	(4-Long)	(4) - (1)	(1-Short)	(2)	(3)	(4-Long)	(4) - (1)
Alpha(%): <=2007	0.253***	0.190*	0.233***	0.260***	0.007					
	(4.42)	(1.95)	(2.99)	(3.30)	(0.17)					
Alpha(%): 2008-2012	-0.069	-0.133	-0.167*	-0.173*	-0.104**	-0.095	-0.164**	-0.193**	-0.200**	-0.105**
	(-1.03)	(-1.17)	(-1.83)	(-1.88)	(-2.15)	(-1.35)	(-1.99)	(-2.26)	(-2.13)	(-2.21)
Alpha(%): >=2013	-0.161***	-0.140	-0.212**	-0.252***	-0.089**	-0.174***	-0.229***	-0.252***	-0.275***	-0.101**
	(-2.62)	(-1.36)	(-2.55)	(-2.97)	(-2.02)	(-2.72)	(-3.04)	(-3.24)	(-3.23)	(-2.36)
Market - r_f	0.432***	0.557***	0.756***	0.843***	0.411***	0.442***	0.647***	0.797***	0.866***	0.424***
	(37.64)	(28.63)	(48.36)	(53.33)	(49.43)	(30.57)	(37.98)	(44.98)	(44.74)	(43.08)
SMB Factor	-0.025*	-0.033	-0.019	-0.006	0.019*	-0.034	-0.038	-0.035	-0.033	0.001
	(-1.70)	(-1.32)	(-0.96)	(-0.32)	(1.74)	(-1.60)	(-1.54)	(-1.38)	(-1.17)	(0.05)
HML Factor	0.015	0.066***	0.018	0.009	-0.006	-0.015	-0.025	-0.044*	-0.042	-0.028**
	(1.05)	(2.80)	(0.96)	(0.47)	(-0.56)	(-0.77)	(-1.08)	(-1.85)	(-1.63)	(-2.07)
UMD Factor	-0.007	0.034**	0.019*	0.010	0.017***	-0.037***	-0.034**	-0.033**	-0.036**	0.001
	(-0.78)	(2.40)	(1.66)	(0.88)	(2.75)	(-3.21)	(-2.56)	(-2.37)	(-2.34)	(0.12)
Default Factor	0.198***	0.280***	0.229***	0.210***	0.012	0.203***	0.217***	0.204**	0.201***	-0.002
	(10.24)	(8.53)	(8.69)	(7.88)	(0.86)	(8.68)	(7.88)	(7.12)	(6.43)	(-0.10)
Term Factor	0.208***	0.230***	0.164***	0.134***	-0.074***	0.217***	0.195***	0.154***	0.137***	-0.079***
	(15.16)	(9.86)	(8.74)	(7.09)	(-7.44)	(12.16)	(9.28)	(7.03)	(5.75)	(-6.54)
Observations	215	215	215	215	215	133	133	133	133	133
R-squared	0.946	0.910	0.963	0.969	0.963	0.955	0.967	0.975	0.975	0.970

Table A6: Portfolio Analysis of the Determinants of TDF Performance

In Panels A, B, C, and D, we report alphas for factor regression results based on portfolios of TDFs double-sorted on several determinant factors: first, we sort on the focus variable into two buckets, then we sort within each bucket into Target Distance quartiles. Horizon portfolio (1) contains the shortest horizon (near- or post-maturity) TDFs, and (4) contains the TDFs with the longest horizon period. The portfolios are constructed every month, and the returns and alphas are monthly and expressed in percentages. We report the resulting alphas from the six-factor model, including four equity (market, size, value, and momentum) and two fixed-income (term and default) risk factors. For brevity, we do not report the factor loadings. In Panel A, we report the results similar to Table 5, columns 6–10, but split them into retail and institutional funds. The last two columns report the long-short portfolio results between short-horizon and long-horizon quartile portfolios for retail (long) and institutional (short) funds. In Panel B, we report the results separately for high (top quartile) and low family flow volatility. In Panel C, we use funds' equity as a percentage of TNA. In Panel D, we use splitting over family size. We report *t*-statistics in parentheses.

Panel A: Double Sorts: Target Horizon and Institutional/Retail Funds

Alpha(%)	Institutional					Retail					Retail - Institutional	
Horizon	(1)	(2)	(3)	(4)	(4) - (1)	(1)	(2)	(3)	(4)	(4) - (1)	(1) - (1)	(4) - (4)
2008-2012	-0.089	-0.157*	-0.186**	-0.194**	-0.104**	-0.104	-0.175**	-0.214**	-0.219**	-0.114**	-0.015	-0.025*
	(-1.26)	(-1.92)	(-2.15)	(-2.06)	(-2.17)	(-1.50)	(-2.04)	(-2.47)	(-2.31)	(-2.39)	(-1.16)	(-1.76)
>=2013	-0.176***	-0.224***	-0.247***	-0.269***	-0.093**	-0.183***	-0.265***	-0.271***	-0.290***	-0.107**	-0.007	-0.021
	(-2.72)	(-3.02)	(-3.16)	(-3.16)	(-2.14)	(-2.91)	(-3.41)	(-3.45)	(-3.39)	(-2.47)	(-0.64)	(-1.64)
Obs.	133	133	133	133	133	133	133	133	133	133	133	133
R-squared	0.956	0.969	0.976	0.975	0.968	0.951	0.962	0.973	0.974	0.972	0.822	0.428

Panel B: Double Sorts: Target Horizon and Family Flow Volatility

Alpha(%)	Low Family Flow Vol					High Family Flow Vol					High – Low	
Horizon	(1)	(2)	(3)	(4)	(4) - (1)	(1)	(2)	(3)	(4)	(4) - (1)	(1) - (1)	(4) - (4)
2008-2012	-0.079	-0.161*	-0.190**	-0.202**	-0.124***	-0.103	-0.151*	-0.184**	-0.201**	-0.099	-0.024	0.001
	(-1.12)	(-1.90)	(-2.24)	(-2.19)	(-2.62)	(-1.33)	(-1.84)	(-1.99)	(-1.98)	(-1.54)	(-0.63)	(0.04)
>=2013	-0.162**	-0.224***	-0.239***	-0.262***	-0.100**	-0.194***	-0.243***	-0.279***	-0.316***	-0.122**	-0.032	-0.054**
	(-2.55)	(-2.92)	(-3.10)	(-3.14)	(-2.34)	(-2.78)	(-3.27)	(-3.33)	(-3.43)	(-2.10)	(-0.91)	(-2.05)
Obs.	133	133	133	133	133	133	133	133	133	133	133	133
R-squared	0.954	0.966	0.976	0.976	0.971	0.944	0.965	0.971	0.970	0.950	0.198	0.119

Panel C: Double Sorts: Target Horizon and Family Equity as Percentage of TNA

	Family with Low % of Equity TNA					Family with High % of Equity TNA					High – Low	
Alpha(%)	(1)	(2)	(3)	(4)	(4) - (1)	(1)	(2)	(3)	(4)	(4) - (1)	(1) - (1)	(4) - (4)
2008-2012	-0.098	-0.098	-0.098	-0.200**	-0.103**	-0.043	-0.164*	-0.197**	-0.198**	-0.156***	0.055**	0.002
	(-1.36)	(-1.36)	(-1.36)	(-2.12)	(-2.07)	(-0.65)	(-1.90)	(-2.21)	(-2.07)	(-2.81)	(2.13)	(0.06)
>=2013	-0.183***	-0.183***	-0.183***	-0.295***	-0.112**	-0.127**	-0.187**	-0.208**	-0.209**	-0.082	0.056**	0.086***
	(-2.83)	(-2.83)	(-2.83)	(-3.45)	(-2.50)	(-2.13)	(-2.39)	(-2.58)	(-2.41)	(-1.64)	(2.39)	(2.91)
Obs.	133	133	133	133	133	133	133	133	133	133	133	133
R-squared	0.954	0.954	0.954	0.975	0.968	0.956	0.960	0.972	0.973	0.962	0.405	0.350

Panel D: Double Sorts: Target Horizon and Family Size

	Small Family by Total $ TNA					Large Family by Total $TNA					Large - Small	
Alpha(%)	(1)	(2)	(3)	(4)	(4) - (1)	(1)	(2)	(3)	(4)	(4) - (1)	(1) - (1)	(4) - (4)
2008-2012	-0.077	-0.166**	-0.206**	-0.215**	-0.138***	-0.096	-0.155	-0.169*	-0.161	-0.066	-0.019	0.054**
	(-1.12)	(-2.10)	(-2.41)	(-2.29)	(-2.73)	(-1.20)	(-1.64)	(-1.91)	(-1.66)	(-1.26)	(-0.57)	(2.05)
>=2013	-0.171***	-0.234***	-0.264***	-0.286***	-0.115**	-0.161**	-0.224**	-0.217***	-0.234***	-0.073	0.011	0.053**
	(-2.78)	(-3.28)	(-3.41)	(-3.38)	(-2.51)	(-2.23)	(-2.60)	(-2.72)	(-2.65)	(-1.54)	(0.35)	(2.22)
Obs.	133	133	133	133	133	133	133	133	133	133	133	133
R-squared	0.955	0.970	0.976	0.975	0.969	0.946	0.957	0.973	0.972	0.959	0.298	0.410

Table A7: Determinants of TDF Underperformance, Portfolio Analysis

We report factor regression results based on portfolios of long-horizon TDFs sorted on *Underlying Same Family Fund Outflows* within *Family Tilt* buckets. The portfolios are constructed every month during the period 2008–2019, and the returns and alphas are monthly and expressed in percentages. We report *t*-statistics in parentheses. We report the resulting alphas from the six-factor model, including four equity (market, size, value, and momentum) and two fixed-income (term and default) risk factors. We focus on long-horizon TDFs, defined every period as the funds in the top quartile by distance to the target horizon. Then funds are sorted into two equal *high* and *low Family Tilt* groups. *Family Tilt* is constructed as the difference between the same family-style weight (e.g., the sum of all positions for US equity underlying funds managed by the same family) in the TDF portfolio minus the allocation benchmark, which is defined as the average ratio of family assets in the same style relative to total style assets. As in Table 6, we construct portfolio returns by sorting TDFs within each *Family Tilt* group on *Underlying Same Family Fund Outflows*. The top quartile group is compared to the rest. *Underlying Same Family Fund Outflows* represents the sum of monthly outflows over the last year for all underlying funds managed by the same family, scaled by assets at the beginning of the year.

Long-Horizon TDFs: Family Tilt x Underlying Same Family Fund Outflows					
	Low Family Tilt		High Family Tilt		Difference
Outflows	*Low*	*High*	*Low*	*High*	
	(1)	(2)	(3)	(4)	(4) – (3)
Alpha(%): 2008-2012	-0.218**	-0.251**	-0.199**	-0.239**	-0.040
	(-2.20)	(-2.26)	(-2.18)	(-2.25)	(-0.90)
Alpha(%): >=2013	-0.289***	-0.302***	-0.243***	-0.327***	-0.084**
	(-3.22)	(-3.00)	(-2.93)	(-3.39)	(-2.08)
Risk Factors			*Six Factor Model*		
Observations	133	133	133	133	133
R-squared	0.973	0.964	0.977	0.967	0.154

Table A8: Expense Ratio Analysis

This table reports the results for the *Expense Ratio* and its components. The *Expense Ratio* is winsorized at a 1% level. All coefficients are multiplied by 100. The observations are yearly. All control variables are defined in Appendix A. In Panel A, we report the *Expense Ratio* regression for the overall sample of mutual funds. *TDF Dummy* is a dummy equal to one if the fund is defined as a TDF and zero otherwise. In columns 2 and 4, we report the results for *TDF Dummy* interaction with period dummies. Specifications 1 and 3 are panel estimates with *Date* and *Family* fixed effects, while specifications 2 and 4 use *Date***Family* fixed effects. We report *t*-statistics, adjusted for clustering over fund and date, in parentheses. In Panel B, we report the regression for the *CRSP Expense Ratio* for the TDF, expressed by the *exp_ratio* variable in CRSP (e.g., VFORX *exp_ratio* is zero). The observations are yearly. *Target Horizon* is defined as the difference between the fund's target date and the current date. In columns 5–8, we report the results for *Target Horizon*'s interaction with period dummies. All coefficients for *Target Horizon* are multiplied by 10,000, and all other coefficients are multiplied by 100. Control variables are defined in Appendix A. Specification 1 is panel estimate with *Date* and *Family* fixed effects, while specifications 2-6 use *Date***Family* fixed effects. We report *t*-statistics, adjusted for clustering over fund and date, in parentheses.

Panel A: All Funds, CRSP Expense Ratio

	(1)	(2)	(3)	(4)
TDF Dummy	-0.422***		-0.426***	
	(-25.46)		(-26.16)	
<= 2007		-0.509***		-0.498***
		(-13.96)		(-14.09)
2008-2012		-0.436***		-0.445***
		(-26.33)		(-26.72)
>=2013		-0.403***		-0.405***
		(-22.40)		(-23.42)
Turnover Ratio	0.060***	0.060***	0.061***	0.061***
	(14.99)	(15.00)	(14.76)	(14.75)
Log (TNA (t-1))	-0.0892***	-0.0892***	-0.0891***	-0.0891***
	(-25.59)	(-25.61)	(-25.44)	(-25.45)
Retail Dummy	0.537***	0.537***	0.534***	0.534***
	(31.44)	(31.42)	(30.63)	(30.61)
Equity, % of TNA	0.330***	0.330***	0.332***	0.332***
	(23.18)	(23.06)	(23.11)	(23.04)
Log (Age)	0.0356***	0.0353***	0.0357***	0.0354***
	(6.841)	(6.825)	(6.783)	(6.786)
Family Equity, % of TNA	0.0377	0.0375		
	(1.583)	(1.575)		
log (Family TNA)	0.0161*	0.0155*		
	(2.037)	(1.965)		
Family Flow Volatility	-0.292***	-0.288***		
	(-5.74)	(-5.737)		
Fixed Effects	Date, Family	Date, Family	Date*Family	Date*Family
Observations	237,153	237,153	237,073	237,073
R-squared	0.577	0.577	0.593	0.593

Panel B: TDFs: CRSP Expense Ratio and Target Horizon

	(1)	(2)	(3)	(4)	(5)	(6)
Target Horizon	0.053	-0.042	-0.066	-0.013		
	(0.68)	(-0.55)	(-0.85)	(-0.15)		
x Same Family Actively Managed Funds				-0.106		
				(-0.84)		
<= 2007					-0.040	0.033
					(-0.39)	(0.17)
x Same Family Actively Managed Funds						-0.079
						(-0.29)
2008-2012					-0.147	-0.008
					(-1.58)	(-0.06)
x Same Family Actively Managed Funds						-0.200
						(-1.23)
>=2013					-0.035	-0.030
					(-0.52)	(-0.35)
x Same Family Actively Managed Funds						-0.035
						(-0.26)
Turnover Ratio	-1.832	-2.701	-2.823	-2.889	-3.041	-3.036
	(-1.43)	(-1.28)	(-1.36)	(-1.39)	(-1.40)	(-1.38)
Log (TNA (t-1))	-8.335***	-8.529***	-8.551***	-8.548***	-8.560***	-8.566***
	(-10.82)	(-12.35)	(-13.28)	(-13.25)	(-13.28)	(-13.26)
Retail Dummy	18.80***	20.40***	17.33***	17.30***	17.33***	17.29***
	(10.91)	(9.74)	(9.95)	(9.89)	(9.95)	(9.87)
Log (Age)	19.09***	16.71***	16.97***	16.96***	17.01***	17.00***
	(14.19)	(12.82)	(12.19)	(12.15)	(12.17)	(12.10)
Equity, % of TNA	-1.853	4.933	4.616	4.280	4.364	4.685
	(-0.44)	(1.09)	(0.86)	(0.79)	(0.79)	(0.83)
Same Family Funds, % of	-2.972	-10.39*	-15.01**	-15.44***	-15.12**	-15.82***
TNA	(-0.73)	(-1.96)	(-2.91)	(-2.95)	(-2.93)	(-3.00)
Family Equity, % of TNA	29.11**					
	(2.14)					
log (Family TNA)	3.119*					
	(1.75)					
Family Flow Volatility	2.700					
	(0.16)					
Same Family Actively Managed Funds			14.98***	16.99***	15.04***	
			(4.21)	(4.58)	(4.23)	
x <= 2007						3.031
						(1.22)
x 2008-2012						10.568**
						(2.49)
x >=2013						17.23***
						(4.41)
Fixed Effects	Date, Family	Date*Family	Date*Family	Date*Family	Date*Family	Date*Family
Observations	11,874	11,862	9,921	9,921	9,921	9,921
R-squared	0.540	0.620	0.595	0.595	0.595	0.596

Table A9: Determinants of TDFs' Risk-Taking

We report the results for the quarterly drawdowns (maximal loss in the past three months, Panel A and market beta (Panel B). *Target Horizon* is defined as the difference between the fund's target date and the current date. All coefficients are multiplied by 100. Other control variables are defined in Appendix A. We used the same control variables as in Table 4. In specifications 1–4, we interacted *Target Horizon* with *Underlying Same Family Fund Outflows* and *Family Tilt*. In specifications 5–8, we interacted with *Target Horizon*, *Underlying Same Family Fund Outflows,* and actively managed funds by the same family (defined as a fraction of AUM invested in actively managed funds, same family, *AMF Same Family*). In specifications 2, 3, 6, and 7, we interacted *Target Horizon* with period dummies. Specifications 1, 3, 5, and 7 are panel estimates with *Date* and *Family* fixed effects, while specifications 2, 4, 6, and 8 use *Date*Family* fixed effects. We report *t*-statistics, adjusted for clustering over family and date, in parentheses.

Panel A: Quarterly Drawdowns

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Interaction Variable	*Family Tilt*				*Same Family Active Fund Assets*			
Target Horizon	0.058***	0.055***			0.087***	0.086***		
	(6.94)	(6.57)			(8.00)	(8.01)		
x Interaction Variable	-0.007	-0.008			-0.005	-0.008		
	(-1.26)	(-1.54)			(-0.89)	(-1.41)		
x Underlying Same Family Fund Outflows	-0.335**	-0.299*			-0.074	-0.061		
	(-2.40)	(-1.94)			(-1.62)	(-1.25)		
x Int.Var x Same Family Fund Outflows	0.413***	0.384**			0.179**	0.182**		
	(2.74)	(2.33)			(2.397)	(2.29)		
<= 2007			0.122***	0.091***			0.124***	0.131***
			(4.69)	(3.07)			(5.37)	(4.14)
x Interaction Variable			-0.009	0.027			0.007	0.002
			(-0.70)	(1.61)			(0.65)	(0.13)
x Underlying Same Family Fund Outflows			-0.203	1.189*			2.112	-0.059
			(-0.74)	(1.82)			(0.35)	(-1.42)
x Int. Var x Same Family Fund Outflows			0.272	-1.256*			0.060	-0.001
			(0.96)	(-1.98)			(0.49)	(-0.01)
2008-2012			0.093***	0.089***			0.126***	0.121***
			(5.47)	(4.47)			(6.21)	(6.11)
x Interaction Variable			-0.013*	-0.018			-0.015*	-0.0173
			(-1.86)	(-1.45)			(-1.69)	(-1.65)
x Underlying Same Family Fund Outflows			0.192	0.339			-0.089	0.008
			(0.78)	(0.85)			(-1.21)	(0.09)
x Int. Var x Same Family Fund Outflows			-0.173	-0.305			0.159	0.097
			(-0.68)	(-0.76)			(1.65)	(0.89)
>=2013			0.037***	0.033***			0.074***	0.074***
			(3.65)	(3.29)			(5.88)	(5.96)
x Interaction Variable			-0.008	-0.010			-0.010	-0.011
			(-1.54)	(-1.56)			(-1.54)	(-1.48)
x Underlying Same Family Fund Outflows			-0.223**	-0.218*			-0.040	-0.031
			(-2.02)	(-1.73)			(-0.98)	(-0.74)
x Interaction Var x Same Family Fund Outflows			0.303**	0.308**			0.127*	0.116
			(2.56)	(2.24)			(1.97)	(1.64)
Interaction Variable	0.486***	0.424**	0.509***	0.404**	0.455**	0.735**	0.524***	0.732**
	(3.23)	(2.396)	(3.44)	(2.417)	(2.53)	(2.53)	(2.80)	(2.51)
Underlying Same Family Fund Outflows	2.821*	2.116	1.241	0.740	1.807	0.832	1.278	0.008
	(1.93)	(1.51)	(0.95)	(0.59)	(1.62)	(0.52)	(1.36)	(0.57)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Date, Family	Date*Family	Date, Family	Date * Family	Date, Family	Date * Family	Date, Family	Date *Family
Observations	32,759	32,721	32,759	32,721	35,039	34,999	35,039	34,999
R-squared	0.928	0.942	0.933	0.947	0.920	0.935	0.924	0.939

Panel B: Market Beta

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Family Tilt				*Same Family Active Fund Assets*		
Target Horizon	0.899***	0.844***			1.278***	1.278***		
	(13.71)	(12.30)			(41.01)	(40.54)		
x Interaction Var	-0.228***	-0.266***			-0.260***	-0.292***		
	(-5.41)	(-5.91)			(-5.95)	(-6.37)		
x Underlying Same Family Fund Outflows	-2.991***	-3.629***			-1.127***	-0.875**		
	(-4.52)	(-4.58)			(-3.02)	(-2.31)		
x Int.Var x Underlying Same Family Fund Outflows	3.823***	4.635***			2.578***	2.502***		
	(5.55)	(5.51)			(5.36)	(4.86)		
<= 2007			1.642***	1.010***			1.538***	1.556***
			(13.76)	(6.19)			(24.04)	(27.29)
x Interaction Var			-0.413***	0.192			-0.197***	-0.289**
			(-4.56)	(1.15)			(-2.90)	(-2.51)
x Underlying Same Family Fund Outflows			-5.882**	17.495***			-1.445**	-1.212***
			(-2.38)	(3.45)			(-2.42)	(-3.04)
x Int. Var x Underlying Same Family Fund Outflows			6.567**	-17.021***			3.409***	3.267***
			(2.63)	(-3.36)			(3.90)	(3.63)
2008-2012			1.021***	1.115***			1.404***	1.408***
			(14.74)	(9.94)			(34.69)	(28.62)
x Interaction Var			-0.280***	-0.515***			-0.268***	-0.383***
			(-4.06)	(-4.60)			(-4.78)	(-5.80)
x Underlying Same Family Fund Outflows			1.856	-0.512			-1.219	-0.209
			(1.37)	(-0.26)			(-1.52)	(-0.23)
x Int. Var x Underlying Same Family Fund Outflows			-1.321	1.418			2.512***	2.071*
			(-0.92)	(0.69)			(2.68)	(1.94)
>=2013			0.750***	0.652***			1.229***	1.213***
			(13.66)	(10.36)			(45.52)	(49.39)
x Interaction Var			-0.216***	-0.218***			-0.302***	-0.273***
			(-4.86)	(-5.03)			(-6.70)	(-6.11)
x Underlying Same Family Fund Outflows			-2.681***	-3.417***			-0.938***	-0.837***
			(-4.78)	(-5.05)			(-2.97)	(-3.02)
x Int Var x Underlying Same Family Fund Outflows			3.570***	4.355***			2.316***	2.017***
			(6.01)	(5.92)			(5.39)	(4.36)
Interaction Var	4.618***	3.403*	4.412***	2.445	5.193***	5.93**	5.641***	6.381**
	(3.04)	(1.76)	(2.98)	(1.32)	(3.14)	(2.48)	(3.38)	(2.67)
Underlying Same Family Fund Outflows	27.293**	10.283	16.788	-4.991	31.488***	14.192	31.091***	11.485
	(2.29)	(0.61)	(1.59)	(-0.30)	(3.77)	(1.18)	(3.95)	(1.04)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Date, Family	Date * Family	Date, Family	Date * Family	Date, Family	Date * Family	Date, Family	Date * Family
Observations	29,107	29,072	29,107	29,072	31,269	31,232	31,269	31,232
R-squared	0.872	0.905	0.883	0.917	0.828	0.856	0.833	0.860