Target Date Funds:

Characteristics and Performance

by

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Abstract

Research has shown that individual investors make poor asset allocation decisions in 401k plans. In response to this research, 72% of all 401k plans now offer Target Date Funds where asset allocation decisions are made for the investor and 43% of the assets of young investors are invested in them. This paper is the first comprehensive study of the characteristics and performance of these vehicles. We show that Target Date Funds are very active in their allocation decisions and this does not help the investors. Furthermore, they hold many types of asset categories like commodities and sector funds not normally thought of as part of their portfolio. We find many of their asset allocation decisions satisfy fund family goals rather than investor goals. Finally, a simple strategy of passively holding their initial allocation almost always produces higher Sharpe ratios.
There is a vast literature in financial economics which finds that participants in 401K and 403b plans generally make suboptimal asset allocation decisions.\(^1\) In response to this evidence, plans have started to offer options where the asset allocation decision is made for the investor and in particular options where the allocation changes as a function of time to retirement. These latter options are referred to as target date funds (TDF).

Target Date Funds have become an important component of pension plans. The growing use of TDFs was no doubt helped by the Department of Labor expanding the set of acceptable default options to include TDFs. In 2011, 72% of the 401K plans offered target date funds, and by 2012, 41% of 401K investors held target date funds, and 20% of all 401K assets were invested in target date funds (Van Derhei, Holden, Alonso and Bass (2012, 2013) and Barons (2014)). Target date funds are rapidly growing in importance for 401K investors. From 2008 to 2012 they grew from 160 billion to 481 billion in assets, with 91% of these assets in retirement plans (On Wall Street, April 18, 2013). In addition, 43% of the assets of recently hired employees in their 20’s with 401K plans are invested in target date funds (Van Derhei, Holden, Alonso and Bass (2012, 2013).

All of the target date funds that exist have a goal of reducing the percentage invested in stocks over time; yet, the theoretical and empirical support for this asset allocation pattern is mixed. Samuelson (1963) and Merton (1969) derive results where constant proportions are optimal. A number of subsequent authors have derived conditions where a change in stock proportions is optional. These conditions often involved assumptions about labor income (see, for example, Bodie, Merton and Samuelson (1988), Campbell, Cocco, Gomes and Maenhout

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(2001), Campbell and Viceira (2002), and Cocco, Gomes and Maenhout (2005). Based on assumptions about labor income the authors derive an optimum decrease in stock allocation over time. On the other hand, Shiller (2005) has postulated conditions under which an increase in stock proportions is optimal.

There is little empirical evidence for decreasing the stock allocation and increasing the bond allocation over time. Poterba, Rahu, Venti and Wise (2005) and (2009) simulate wealth and utility of wealth at retirement and find for most investors 100% in equity or a fixed proportion strategy dominates increasing the proportion invested in fixed income as the target date nears.

This paper does not attempt to add to the important literature on the optimal pattern of allocation over time. Rather it addresses a second set of issues: given the time pattern of asset allocation selected by any TDF how well does the management do in serving the investment needs of the plan participants. In short given the intended allocation is the investor well-served by management's decisions.

This is the first study to examine what target date funds are doing and how well they are doing it. In the first section we will discuss our sample and the characteristics of target date funds. More specifically we examine the composition of the assets held by target date funds and how this has changed over time. We find that the actual composition is substantially different from how TDF’s have been characterized. Our study is unique in that we have data on the exact holding of the target date funds as well as expense data on the target date funds and on their holdings. This impacts the type of analysis we perform in later sections.

Target date funds hold a series of other funds: either publicly traded mutual funds or master trusts. Target date funds are funds of funds and investors pay fees on the underlying funds
and usually pay an added fee to the target date fund, the size of which depends on the share class that an investor purchases. In the second section we will examine the size of these fees.

We find that most target date funds invest in low-cost share classes of mutual funds which are not available to all but very wealthy investors or institutional investors. We show that the underlying share classes have sufficiently low expense ratios so that for most investors the cost of buying the target date fund with its added expense ratio is only slightly higher than if they bought the underlying funds directly.

Most target date funds start with a planned series of asset allocations over time, but then vary from the plan depending on perceived market conditions. In addition to examining timing with respect to the bond stock mix, we examine timing between domestic and international assets and timing among holdings of individual funds. In the third section we show that none of these timing decisions enhance the performance of TDFs and if anything they detract from it.

In the fourth section we examine the overall performance of target date funds. We find that TDFs have negative alphas similar to those found from mutual funds in general. Since TDFs are designed to be an investor’s total holdings we also examined Sharpe Ratios. We find that a simple strategy of investing in index funds at the initial allocation of the TDF provides higher Sharpe Ratios than those associated with the TDF in 75% of the cases.

In the fifth section we show that some target date funds select funds that accomplish fund family goals rather than investor goals. Investors are primarily concerned with performance. Fund family goals could involve purchasing funds that need cash flow because of losing assets or helping with investment in start-up funds or investing in the fund family’s high-expense funds.

Finally, in the sixth section we show that an investor could have performed better than the target date fund by using the observed allocation at the beginning of each year and using this
allocation along with comparable ETF’s and index funds to construct their own “target date” 
fund. The last section is the Conclusion.

I: SAMPLE:

There are close to 1,100 target date funds (hereafter TDF) listed in Morningstar. Many of 
these represent different proportions of the same underlying mutual funds. For example, a fund 
family might offer TDFs for 2020, 2025, 2030 … 2050 with several share classes contained in 
each of these TDFs. The different dated TDFs from one fund family will usually hold most of its 
assets in the same underlying funds, though in different proportions. The principal difference is 
that the funds with target dates close to the present hold more in debt-type funds and less in 
equity-type funds. The planned pattern of asset allocation over time for a particular fund is 
usually referred to as its glide path. Table 1 shows the glide path for the Vanguard Target Date 
Fund. If a particular TDF deviates from its glide path all TDFs with different target dates from 
the same fund family are likely to deviate in a parallel manner from their glide paths since there 
is normally one management team handling all the fund families’ TDFs. Given this high 
commonality, we selected only one dated fund from the dates that were offered. We chose 2035 
if it existed, and 2030 otherwise. Our final sample contained one target date from each fund 
family which offered target date funds. There are 50 families offering target date funds: 40 of 
the funds had a target date of 2035 and 10 a target date of 2030. There are in total 229 funds in 
our sample representing different share classes of the 50 distinct funds. We chose 2035 as our 
base year as a tradeoff between being on a part of the glide path where changes in the stock,

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2 In addition, TDFs sometimes hold more risky securities such as commodities and futures.  
3 Vanguard is unusual in that it is one of the few TDFs that give numeric data for its intended glide path. Most 
TDFs simply present a picture of their glide paths.  
4 The difference between the 1,100 target date funds (with each share class counted as a fund) and the 229 in our 
final sample is due to our selecting one target date (2035 or 2030) from each fund family.
equity allocation are fairly constant and yet some changes do occur. We have data from 2004 through 2012. However many of the funds have started after 2004.

The Vanguard Target Date Fund shown in Table 1 is unusual in that it invests in a small number of underlying mutual funds. The typical TDF in our sample invests in 17 funds on average with 68% holding 10 or more and 24% holding 25 or more funds. This understates the actual diversity in holdings because the funds with few holdings generally hold master trusts which themselves hold multiple types of securities. Most target date funds are not the simple mixture of debt and equity that is envisioned in many articles. This can be seen clearly from Table 2. In addition to the normal domestic and international debt and equity funds, a high percentage of target date funds have added emerging markets debt and equity funds, domestic and international real estate funds, and commodity funds to their holdings. While one of these new investments, domestic real estate, was first held by TDFs in 2004 others appeared later: commodities in 2006 and emerging market debt in 2007. Furthermore, a large percentage of target date funds that held these categories did not do so in their first year of existence. At the extreme, 81% of the funds that held international real estate added this category of investments one or more years after the fund started. The percentage of TDF funds holding any category increased over time. For 2011 the percentage of funds holding these new categories varied from a low of 22.2% for emerging market debt to a high of over 75% for emerging market equity. Recall that the majority of these funds have a target date of 2035 (or, in a few cases, 2030), so that these target date funds are holding and increasing their investment in investment types that are thought of as being inherently more risky as the target date approaches. In addition to the categories shown in Table 2, a number of funds made sector bets (19%) or country bets (8%) or held long-short funds (4%).
What could account for these additional asset categories? One explanation is that some TDFs were trying to differentiate themselves from other TDFs. A second explanation is that these investment categories were identified as hot investment vehicles by the financial community in general. A third explanation is that they added these investments in a belief they lowered risk through diversification.\(^5\) However, in the case of country and sector funds this has to be a bet on a particular small subset of assets.

Each target date fund family chooses a glide path for each target date fund. The glide path specifies the percentage to invest in equity and debt over time. Across target date funds with the same target date offered by different fund families the percentage invested in equity or debt has wide variation. The percent invested in debt and equity for TDFs with a target date of 2035 as of December 2011 is presented in Table 3. The lowest percent in equity held by any fund is 62% while the highest is 89%. Most target date funds hold equity in the range of 70 – 85%. The amount invested in debt also varies with the bulk of target date funds holding between 8% and 20% of their investments in the form of debt with a low 4% and a high of 27%. Thus at a point in time, target date funds vary widely in their debt and equity percentages even though they are managed to meet the needs of the same age group.\(^6\)

II. Expenses

One of the key elements determining the performance of Target Date Funds is the expenses incurred by the holders of these funds. Since the individual or institutional investor can

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\(^5\) Although TDFs may be adding additional asset categories in an attempt to lower risk it doesn’t seem to succeed. 60% of the TDFs have higher risk than vanguard which only invests in stocks and bonds. Furthermore in section 4 we match the asset allocation of each target date fund with a portfolio only containing stocks and bonds and in 75% of the cases the TDF has a higher standard deviation.
often construct (mimic) a target date fund, the question remains how much is the investor paying in total expenses by holding a target date fund rather than holding a matched set of mutual funds.

The expenses in the target date funds consist of the expense ratio on the underlying mutual funds held by the target date funds and the expenses added on by the target date fund itself. This is somewhat complicated by the fact that the target date fund offers different classes of shares to different investors. While not all target date funds offer all classes, almost all offer more than one class. The overlay of TDF expenses differ across TDF share classes, but each share class of TDF holds the same class of underlying funds in the same proportions and incurs the same expense ratio on the underlying funds. For example, the no-load class of a TDF will hold the same class of the underlying funds in the same proportions as the retirement class and incur the same expenses on the underlying funds. The mutual funds held by any one TDF will often be a combination of several share classes: for example, the no-load class for some of their holdings and the investor class for others. The funds held may be offered solely by the same family of funds as the TDF or by funds from another family or a mixture of the two. However 63% of TDFs only hold funds offered by the fund family to which the TDF belongs. Most funds held outside the family are ETFs or index funds. Only 13.7% hold any active funds outside the family, and these are almost always specialized funds such as commodity funds not offered by the family. In every case funds held out aside the family represent a very small percent of any TDF’s’ total investments.

Table 4 presents the expense ratio for different classes of target date funds as well as the breakdown of the expenses between the fees paid directly to the TDF and the fees paid to the
underlying funds.\textsuperscript{7} The highest total fees are charged by the C class TDF. The second highest expenses are those on A shares. Note that the A class shares may have loads and that the loads are not included in the expense calculations. The size of the load is a function of the size of the purchase and is often waived for large purchases.

Examining Table 4, we see some differences in the underlying fund expenses across different TDF share classes. This is due to the different sample of funds which offer each class. The major difference in total expenses is differences in the TDF fees paid across different TDF share classes. The investor class and the no-load class have the lowest TDF expenses and the lowest total expenses.

For A shares the total expense ratio is 114 bp, made up of 61 bp of fees on the underlying funds overlaid by 53bp of fees for the target date fund. While the breakdown of fees is interesting, it does not represent the opportunity cost to investors of not putting together the target date fund themselves.

The target date fund often holds mutual fund classes not available to any investor or only available to some investors. For example, 56% of the funds held by TDFs are institutional class funds, 6.5% are retirement class funds, and 15.93% are master trusts. Table 5 shows a detailed breakdown of TDF holdings by share class.

Table 6 shows for investors who qualified for A class shares (or alternatively no load class shares) how much the investor would pay to hold the underlying funds directly if he or she

\textsuperscript{7} We report two entries for retirement funds, the average and the maximum. Many funds offer a number of classes of retirement funds. They differ in whether the fund or the retirement plan handles some of the administration of the plan. Since we cannot determine how these costs are split, we report the maximum which for most funds means the administrative costs are borne by the mutual fund family and the average.
duplicated the TDF with A class shares or no load class shares. 8 For example, from Table 6 an investor who only qualifies for A shares would have to duplicate the target date fund with A shares and would incur an expense ratio of 102bp In doing so. 9 Thus an investor who could only hold A shares is only paying an additional fee of 9.6bp for the services provided by the TDF management. 10 Likewise, we see that for an investor who could buy no-load shares, the additional charge is only 4 bp. When we make this comparison the additional charges from holding a target date fund are small. Target date funds provide access to low cost classes of mutual funds and charge a higher fee at the TDF level to capture the advantage to investors who would have to buy a more expensive class of the underlying fund. Since TDFs predominantly or exclusively hold funds within the same fund family, the split of expenses depicted in Table 6 between the TDF and the underlying funds is a matter of little consequence to the target date fund sponsors.

One other aspect of expenses is worth examining. We generally expect the holding of TDFs to shift over time from holding funds that invest in more risky assets which have higher expense ratios to funds holding less risky assets which have lower expense ratios. In Table 7 we show what happens to expenses when a retirement is planned for 2025 and 2045 versus 2035. The change in overall expenses is quite small, going from 1.119 for retirement in 2025 to 1.139 for retirement 10 years later to 1.174 for retirement 20 years later. The change in total expenses

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8 We limit this to A class and no-load class since these are the classes where we can find underlying funds of the same class for a meaningful number of TDFs.
9 Recall a TDF holds the same funds with the same expense ratios across the different share classes of the target date funds.
10 The expenses reported in Table 6 differ from those in Table 4 because not all target date funds belong to families that offer A share that matched the funds the TDF held. A shares have load fees. In this calculation we are assuming that the load on the underlying funds is the same as the TDF, or that the investor purchases enough so the load fee is waived.
and the change in underlying expenses are consistent with the holdings of funds become less risky as retirement comes closer and bond funds having lower expense ratios than stock funds.

We now turn to the question of whether investors gain by the timing decisions made by target date funds.

III. TIMING

Target date funds have a glide path that specifies the stock-bond split over time. However, target date funds often deviate from the stated glide path because of beliefs about future returns on stocks and bonds. In addition, funds have a choice for both stocks and bonds of how much to invest domestically and how much to invest internationally. Finally a TDF can change the proportions invested in any individual fund as their beliefs about the relative performance of that fund changes over time. We now discuss how well management does in each of these timing decisions. For most target date funds we have fund holdings monthly. In addition, we have a quarterly breakdown of how much is invested in cash, domestic stock, international stock, domestic bonds and international bonds as estimated by Morningstar.

A. Stock Bond Timing

All target dates funds have a stated glide path. The glide path involves increasing the amount invested in bonds and decreasing the amount invested in stocks over time. Therefore, the manager’s bond-stock timing decision becomes how much to deviate from the glide path. For most funds the glide path is presented pictorially in the prospectus. Examining the picture, it is impossible to accurately estimate the glide path numerically. Thus we estimate the glide path from the data. What the pictures do show is that the glide path is linear or close to linear over the relevant range of years included in our analysis. Thus we assumed a linear glide path. For each
target date fund we calculated both the average proportion invested in stocks over all time periods and the average change in this proportion over each period in our sample history. To estimate the glide path for each fund we use the average proportion it invested in stocks as the mid-point of its history and the average change in stock investment to calculate the glide path on other dates. To measure bond stock timing we take the deviations from the glide path for stocks and bonds at the beginning of each quarter and multiply each by the return on that investment class over the quarter.

In order to measure timing rather than the return on the particular funds held, we used returns on indexes to calculate returns from deviating from the glide path. For domestic stock we used the Fama-French Market Index plus the riskless rate (since the Fama-French market index is return above the riskless rate). For international stock we used the MSCI World Index ex-US. For domestic bonds we used the Barclay’s U.S. Aggregate Bond Index. Finally, for foreign bonds we used the Bank of America Global Bond Index ex US. Since a glide path is the bond-stock split and not how much is in domestic or international, we need a single stock and a single bond index. In constructing a single index for any fund, for computing stock returns we used the weights for that fund at the beginning of each quarter in domestic stocks as well as in international stocks with the sum scaled to 100%. We then multiply each by its return over the quarter. The bond return is calculated in a similar manner with cash which is assumed to earn the Treasury bill rate as one of the bond components. Quarterly timing returns for each TDF are then accumulated to compute overall timing returns for the fund.\textsuperscript{11} The average return due to timing across all funds is -11.52 bp per year with a $t$ value of -1.8. If we pool all

\textsuperscript{11} Timing represents the difference between what the TDF would have earned by duplicating the bond stock mix of the TDF while investing in indexes, and what the TDF would have earned if it followed its glide path and invested in indexes.
observations which weight funds with a longer history more heavily, the result is -14.1 with a \( t \) of -2.76. Thus target date funds do not improve and may hurt their performance by having their stock-bond mix deviate from the glide path.

**B. Domestic-International Timing**

Almost all of the target date funds hold part of their stock and bond portfolios in international mutual funds. There is no stated glide path for the investment allocation between domestic and international funds.\(^{12}\) Thus to measure management’s active domestic international choice we use deviations from the average level for each fund over all periods in our data. Once again we want to compute the effect of their domestic international choice and not the return on the particular funds they hold. Thus we use returns on the domestic and international indexes described earlier to measure their timing decision. Our measure of domestic-international timing is the deviation from average proportions invested domestically and internationally at the beginning of the quarter times the return over the quarter. This is then cumulated for each fund for both stocks and bond separately and then averaged across all target date funds. Domestic international timing adds an average +.36bp per year to the stock return and -.32bp per year to the bond return. Neither is close to significant. If we measure across observations rather than across funds, the return due to the international domestic timing is +.08bp for stocks and -.16bp for bonds per year. Neither is close to significant. Thus our results do not support that target date funds add value by switching their allocations between domestic and foreign stocks or bonds.

**C. Fund Selection Timing**

TDFs change the individual funds they hold over time and the proportion they invest in each fund. Does this changing allocation improve performance? To answer this question, we

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\(^{12}\) The one exception is Vanguard. Results are unchanged whether Vanguard is included or not.
will examine the future alpha on the funds they buy or in which they increase their investment relative to the alpha on the funds they sell or decrease their investment.

We start by computing the monthly alpha on each fund held by the target date fund. We then calculate the change in the monthly alpha on the TDF due to the change in fund allocation. This is computed by calculating the change in proportions times each fund’s monthly alpha. These monthly alphas were then cumulated over the life of the fund. For each fund held by a TDF, alpha was computed using the standard multi-index model and the set of indexes described below.

\[ R_{it} - R_{Ft} = \alpha_i + \sum \beta_{it} R_{it} + e_i \]

where:

1. \( R_{it} \) is the return on the fund in period \( t \)
2. \( R_{Ft} \) is the riskless rate in period \( t \)
3. \( R_{It} \) is the return on the index in period \( t \)
4. \( \beta_{it} \) is the sensitivity of fund \( i \) to index \( I \)
5. \( \alpha_i \) is the average return unexplained by the index
6. \( e_i \) is the residual.

Since we had many different types of funds with different characteristics, we need to use many different index models. For stocks we used the Fama-French three-index model plus momentum. For bonds we used, following Blake, Elton & Gruber (1993) a three-index model consisting of a general bond index, a mortgage-backed index, and a high yield index. For foreign bonds, foreign stocks, domestic real estate, foreign real estate, sector funds, country funds,
commodity funds, emerging market stocks and emerging market bonds, we used market indexes of the appropriate market. In cases of low $R^2$ with the indexes employed we examine the holdings and classify the fund consistent with its holdings. In a number of cases the funds’ holdings were not consistent with the Morningstar category. The alpha for any fund month was computed as the three-year alpha plus the residual for the month in question.\(^\text{13}\)

The average change in alpha from changing their allocation was -.036 bp per year. This is not close to significant ($t = .4$). Thus there is no evidence that TDFs, by changing their allocation across funds, improve their alpha.

In summary we find that most TDFs do not follow their declared glide path. In fact, they make active allocation decisions across stock versus bond funds. In addition they make active decisions concerning international versus domestic funds, and the individual funds they hold. We find that these allocation decisions add no value.

IV Overall Performance

To measure overall performance of mutual funds, one normally estimates alpha using the returns of the fund being evaluated. This approach is inappropriate for TDFs since by design their betas are meant to and do change over time due to allocation decisions across existing asset categories and the addition of new asset categories. Furthermore, we know of no model that has been shown to be appropriate for the planned changing asset allocation and the wide range of asset types held by TDFs. Thus we use the bottom-up approach of Elton, Gruber and Blake (2011). Since a portfolio’s alphas and betas are weighted averages of the assets that comprise it,

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\(^{13}\) The three years used in estimating alpha were the three years starting in the month in question. If three years of data didn’t exist, we used the longest time frame we had providing it was at least 12 months. If adequate data didn’t exist, the fund held by the TDF was excluded.
we compute the monthly alpha on each fund the TDF holds and then use the proportions invested in each fund at the beginning of the month to compute the TDF’s monthly alpha.

More specifically we start with the three-year alphas computed every month using data ending with the month for which we are computing alpha. Then we calculate the one month alpha for each month by taking three year alphas and adding back the residual for the month in question. These are then cumulated and averaged over the history of the TDF. The average alpha over the history across all target date funds is a negative 20bp per year, which is significantly different from zero at the 1% level. This is the alpha across all the TDFs holdings and is after the fees on the underlying funds but before the TDF fees.

Most studies looking at alphas on the average mutual fund find that the average fund underperforms by about 70 bp. Does this suggest that TDFs display superior selection ability with respect to the funds they hold? The answer is no. Examining the average fees on the funds they hold (Table 2) shows fees of about 60 b.p. Most mutual fund studies are studying share classes of funds with average fees of 110 to 120 b.p. TDFs have better alphas on the funds they hold, primarily because they are able to hold share classes with low fees. If one takes into account the difference in fees, the average alpha on the funds they hold is similar to what is normally found in mutual fund studies.

As stated above the average alpha on the underlying funds does not take into consideration the fees added by the target date fund itself. Investors purchasing a target date fund pay fees on the TDF as well as fees on the funds that the TDF holds. Table 8 shows the average alpha including all fees for each target date share class as well as the percentage of funds in each share class which have negative alphas. We see that each class has on average a negative alpha. The A class are the most commonly examined share classes. The target date funds Class A
shares have alphas consistent with the alphas of A shares of mutual funds in general; about minus 77 b.p. per year. The C class has more negative alphas of about 1.37% per year. No load funds have negative alphas closer to zero (minus 27 basis points per year), approximately the alphas for the lower cost index funds found in the market. The investor class is close to that of the no load (33 basis points per year). However, investor class shares are usually sold through investment advisors, who add their own fees to those charged by the target date fund.

The alpha on retirement accounts is slightly higher than the alpha on A shares. There is a range of alphas on retirement accounts which we believe is a function of whether the fund company, financial advisors or the retirement account itself handles some of the administrative costs. Many fund families offer several sub-classes of retirement shares. For example, John Hancock has R1, R2, R3, R4, R5 and R6 shares with slightly different expense ratios. When we compare the expense ratio of the highest expense retirement share for each family (where the fund bears the administrative costs) with the average retirement share class, the returns go down but only by 7 b.p. per year.

Since the TDF can be an investor’s total portfolio it is appropriate to examine Sharpe ratios as a test of overall performance. We examine the Sharpe ratio for each fund over its history versus the Sharpe ratio of a very simplistic decision rule.

We assume that an investor observes the first reported asset allocation that occurred at least three months after the start of each TDF and holds the same proportions over the life of the fund in five categories of indexes: domestic stock, international stock, domestic bonds,
international bonds and cash. For cash we use the one-month Treasury bill rate, and for the other four categories we use the indexes discussed in section III.

We then compute the Sharpe ratio for the returns on each TDF and the associated simple investment strategy over the life of each fund. The number of funds in each share class, along with the number of times the simple investment strategy had a higher Sharpe ratio than the TDF shown in Table 9. We also report results subtracting fifteen basis points from the returns on the simple strategy to represent the fees on low cost exchange traded funds.

In each share class the Sharpe ratio is greater for the naïve strategy in the preponderance of cases, and the difference is statistically significant at the .01 level for most classes. Thus an investor would be better off using a buy and hold strategy investing only in passive portfolios and only using domestic and international stocks and bonds and cash.

Examining the components of the Sharpe ratio for all share classes and all funds we find that in 75% of the cases the standard deviation of the returns from the naïve strategy is less than that of the TDF. Thus the additional types of investment used by the TDF (e.g. real estate commodities) do not seem to reduce risk. On average the variance of the naive strategy was 12% less than the variance of the TDF. The mean return on the naïve strategy was also higher in 75% of the cases averaging 62 b.p. per year. Since TDF do not appear to be maximizing investor performance perhaps they are pursuing fund family objectives.

14 We took our starting point three months after the TDF was started, because the first observation often contains an allocation before the fund is fully invested, e.g. a very large cash position. In addition we assumed that investment in the “other” category was allocated proportionally over the five categories named above. The “other” category was generally well below 5% of assets except in three cases not included in our sample.

15 Results are reported for the retirement class in two ways: first, where each retirement class is treated separately and second, where the Sharpe ratio for each retirement class offered by each target date fund are averaged.
V. SHAREHOLDERS OBJECTIVES OR FAMILY OBJECTIVES

TDFs primarily hold mutual funds of the fund family that sponsors the TDF. When a TDF invests in a fund outside the family it is almost always because a similar fund does not exist within the family. Across our sample 69.9% of the funds that were added by the TDF had at least one alternative fund in the family with the same Morningstar classification. We refer to these funds as the alternatives. The average number of alternatives was 3.8 and the percentage of times there was more than one was 68.1%.

The question we examine in this section is do they add funds which have better performance in the past than the alternatives and do these funds have better performance after they are added? A second question is can we identify other characteristics that separate the funds added from alternative choices, and do these characteristics satisfy family objectives rather than investor objectives?

We compare the performance of the funds that the TDF added with the performance of alternatives in the same fund family with the same Morningstar objective. We examine the difference in alpha on the funds added compared to the alternatives for the three years before they were added and for the three years after they were added. On average, the target date funds added funds that had a higher alpha than the alternatives in the period before they were added. The funds that the TDF added had an alpha that was higher by 18 basis points per year in the three years before they were added. However, the difference is not statistically significant (t=.96). In the three years after the funds that were added the alpha on the fund that was added was 5 basis points per year lower than the alternative funds although the difference does not approach statistical significance. Target date funds select funds from the fund family in a particular Morningstar category with higher historical alpha but do not select funds with superior future
alpha. One reason that some TDFs may not select funds with superior future performance is that they may be using a criterion that satisfies family objectives at the expense of shareholder’s returns.

We examine four variables that might satisfy fund family objectives but not necessarily objectives of the target date fund shareholders:\(^{16}\):

1. Start date – the family might want to help startup funds.
2. Management fee. Higher-fee funds bring in more money to the family.\(^ {17}\)
3. Total net assets – management might select funds to include which are smaller than the alternatives to help these funds reach a scale where they are profitable.
4. Cash Flow – the T.D.F. might select funds which were losing assets or growing at a rate slower than alternatives to help a fund reach a size that is profitable.

It would be in the interest of fund families to have TDFs invest in recently started funds to help startup funds boost their asset size and to deal with economies of scale. We find that many target date funds do add an abnormal number of funds which have been in existence for a short period of time. Out of 720 funds added where alternatives existed, 79 were in existence for less than 3 months and 116 for less than one year.\(^ {18}\) For each of these cases alternatives existed which had an average life of more than ten years. How well have the startup funds done relative to the alternative funds available in the same family? The funds added that were in existence for 3 months or less had alphas over the next three years that were lower by 86 bp per year than the

\(^{16}\) In all analysis in this section we only examine funds that were added by management that are in the T.D.F’s fund family.

\(^{17}\) We do not look at total expenses since the alternatives may not be available in the same share class, but the fund can always offer a new share class for the T.D.F. Management fees are constant across share classes.

\(^{18}\) Four funds which were in existence for less than one year when they were added are not included in our sample because they disappeared within three years of their addition. We measure time in existence; not by the share class held by the target date fund but by the start date of the oldest share class.
three year alphas on alternative funds. This is statistically significantly different from zero ($t = 2.14$). Differences are much larger than those found for the overall sample of added funds compared to alternatives. Management is clearly adding a disproportionate percentage of new funds which have three-year performance after addition which is inferior to the alternatives they could have added.

The next variable we examined was management fees. If a specific manager is concerned with family objectives rather than investor objectives she would add funds with higher management fees than the alternative funds of the same type offered by the fund family. In fact the average manager does not do so. However specific managers do. When a TDF manager chooses funds that had a much higher management fee than the alternatives we find that the funds selected had much lower future alphas than the alternatives. For example there were 13 funds where the difference in fees was 40 basis points or greater and the yearly difference in alpha for the following three years was 256 bp per year with a $t$ of 2.4. Examining the 33 additions that had a difference in management fees of 30bp or higher per year the funds that were added underperformed the alternatives by 115bp per year with a $t$ of 1.43. TDF managers on average do not seem to be adding funds that have higher management fees than alternative funds but when a manager adds fund with much higher fees than fees on alternatives in the same fund family, the funds that are added have much lower performance than the alternatives. Some managers seem to be maximizing family objectives rather than shareholder objectives.

If some fund managers were selecting funds in part because of family concerns rather than shareholder concerns, we would expect them to select more small funds than could be justified by future alpha. Since startup funds are generally of small size, and since we have
analyzed startup funds earlier in this section we eliminated all startup funds in the first 6 months of their existence.\textsuperscript{19} We then ranked all funds by size.

When TDF management selected funds with less than 60 million under management (26 funds) they earned, over the next three years, a monthly alpha 240 bp per year less than the alternatives (t = 2.09). We chose 60 million since the belief in the investment community is this is minimum size to be profitable. We chose three other breakpoints 100 million or less resulted in underperformance of 209 bp per year (t = 2.73), 150 million or less 144 bp underperformance (t = 2.04) and 200 million or less 116 bp underperformance (t = 2.07). Selecting funds of small size is desirable from a family point of view but it has hurt TDF performance.

The last variable we examined was growth. If a fund had a large outflow, it would help the family if the TDF invested in these funds. We find no evidence of TDFs selecting funds with large outflows.

We find that in pursuing a number of characteristics that serve fund family objectives, TDFs add funds with poor subsequent alpha relative to alternatives in the same family. These characteristics are new funds, funds with high management fees and small funds.

\textbf{VI. REPLICATING TDFs}

TDFs are used in 401K plans. However, they are also offered directly to investors. These are offered as A, C, or no load shares. Earlier we showed that an investor would almost always have a higher Sharpe ratio and be better off by investing in low cost exchange traded funds or index funds using the initial allocation of the TDF than by investing in the TDF. The investor can observe the holdings of the TDF on a monthly or quarterly basis. Thus an investor can implement a more complicated investment strategy than the naïve strategy discussed earlier.

\textsuperscript{19} Including these funds only strengthens the results reported below.
In this section we examine whether an individual investor using the observed holdings, and exchange traded funds (ETFs) would earn a higher return than investing in the T.D.F directly or the naïve strategy discussed earlier. We assume the investor only changes his or her allocation once a year at the beginning of January. He or she observes the holdings and the Morningstar classification of each holding. For each holding the investor selects the lowest cost ETF with the same Morningstar classification. These ETFs are then weighted in the same proportion as that holding represents in the TDF.²⁰ We then computed returns on the TDF and the replicating portfolio of ETFs over the subsequent year. We repeated this over all years for A class shares, C class shares, and the no load class shares.

The target date C class shares have the highest expense ratio. Thus the investor who buys C class shares in a target date fund is likely to get the most benefit from replicating the fund with exchange traded funds. For C Class shares, the portfolio of exchange-traded funds outperformed the TDF by 124 bp per year with a t value of 4.39. A portfolio of exchange-traded funds outperformed TDFs in 91% of the cases which is significant at the 1% level. We have overstated the benefit of replication slightly for the investor replicating the fund would have to pay transaction costs on buying or selling the ETFs. However these costs are likely to be very small for several reasons. First, which ETF is lowest cost changes infrequently. Once an ETF is selected by an investor it remains the best ETF in 45 out of 62 cases. In only one case over the life of any TDF is more than 2 ETFs employed to match a Morningstar objective. Second, while

²⁰In a couple of cases no E.T.F. existed. In this case we added index funds. In the rare cases where an index fund didn’t exist, we assumed the investor selected the same fund as held by the T.D.F. Currently there are E.T.F.s for all Morningstar objectives held by T.D.F.s.
TDFs have added new categories of mutual funds, as pointed out in section one, these new funds are added in small amounts. Third, changes in the major types of investments by exchange-traded funds take place slowly over time. For these three reasons and because transaction costs of buying exchange-traded funds are small, the numbers reported above are good representations of the saving from replication.

We next examined A class shares. Shares designated as class A carry a load that differs by the size of purchase. Thus we have overestimated the performance of A class share because we ignore all front end loads. For the A Class shares the portfolio of ETFs outperformed the TDF by 44 b.p. per year, which is significant with a t of 2.13. Examining individual TDFs shows 75% of the TDFs had returns lower than the portfolio of ETFs. This is significant at the 5% level. For most TDFs the investor in A class shares is better off replicating the holdings of the target date funds even if the investor gets the target date fund to waive all front end loads. Given the presence of front end loads, the performance of A class TDFs relative to the replicating portfolio is probably a lot closer to the results for C class than the results given above for A class shares.21

Finally, results are different for no-load TDFs. On average no-load funds outperform a portfolio of E.T.Fs by 27 bp per year which is not statistically significant. They outperform in 57% of the cases. The principal reason for the difference is the lower expense ratios of the no-load funds. A second reason is that many of the TDF no load funds were among the funds with the higher returns. However if we compare Sharpe ratios The Trading rule has a higher Sharpe ratio in all but one case. If we compare Sharpe ratios for the more complicated trading rule with

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21 For both A and C class shares the underperformance relative to replication is less than the fees. This is consistent with the mutual fund literature that finds that mutual funds have selection ability but not enough to cover their fees.
the naïve rule examined earlier, we find that the more complicated rule has a higher Sharpe ratio than 84% of the A class TDF, 63% of the C Class, and 86% of the no load class.

In general, for most T.D.F. share classes available to individual investors, the investor would have higher returns by observing the allocation in the month of December and using low-cost ETFs with the same Morningstar classification to replicate the TDF.

VII. CONCLUSIONS

Target date funds (TDF) have become an important vehicle for retirement plans: 72% of 401(k) plans offer TDFs and over 43% of new 401(k) money of young employees is invested in them. Despite their importance for the financial health of future retirees, very little is known about their characteristics and performance. In this paper we rectify this lack of knowledge.

Target date funds are usually thought of as holding a mix of debt and equity while following a predetermined glide path, with the equity proportion declining over time. The reality is more complex. Currently many target date funds hold commodity funds, domestic and international real estate funds and funds holding the debt or equity of emerging markets. TDFs take active bets, deviating from their stock-bond glide path, managing their mix of domestic and international assets and changing the funds they hold over time. We show that this active timing, whether it’s with respect to the bond stock mix, domestic versus international assets, or changing individual fund holdings, does not add value.

Target date funds are funds of funds. As such they add an additional fee to the fee charged by the mutual funds they hold. This additional fee can be quite high averaging 53bp for A class shares. We show that this added fee is mostly offset by TDFs investing in low expense classes of mutual funds not available to most investors. We find that the total fee an investor
pays is not that much higher than the investor would pay for the TDF portfolio by purchasing the share class available to that investor.

On average the performance of the funds selected by target date funds is better than those normally found in mutual fund studies. This difference is due to the lower fees on the classes of shares TDFs hold. When the added fee of target date fund is taken into account, the performance of target date funds is similar to what is normally found in mutual fund studies. We show that a simple strategy of buying index funds using the initial allocation of each TDF almost always produces higher Sharpe Ratios.

Target date funds almost always hold funds of the fund family to which they belong. Normally a TDF only selects a fund outside the fund family when the family doesn’t offer a similar fund (e.g. commodity, international real estate). In the majority of cases when the TDF adds a fund, the target date fund has alternatives with the same objective in the fund family. We show that on average the management of target date funds adds funds that had higher alpha than alternatives in the past but slightly lower alphas in the future. The lower future performance can be explained in part by some of the managers of target date funds investing in funds that satisfy family goals rather than investor goals. This is manifested by TDF’s selecting new startups, funds with much higher management fees than alternatives, and small funds even when the effect of startups is removed. All of these additions have lower alphas than alternatives in the fund family.

Examining share classes open to individual investors we show that investors who would purchase A or C class shares are better off constructing a copycat fund by observing asset allocation once a year and investing in ETFs in the same Morningstar classification.
Table 1

Allocation in Future

<table>
<thead>
<tr>
<th>Asset Category</th>
<th>Current</th>
<th>5 Years</th>
<th>10 Years</th>
<th>15 Years</th>
<th>20 Years</th>
<th>At Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Stock Market Index</td>
<td>60</td>
<td>55</td>
<td>50</td>
<td>44</td>
<td>38</td>
<td>29</td>
</tr>
<tr>
<td>Total International Stock Index</td>
<td>26</td>
<td>24</td>
<td>21</td>
<td>19</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Total Bond Market Index</td>
<td>14</td>
<td>22</td>
<td>29</td>
<td>37</td>
<td>40</td>
<td>42</td>
</tr>
<tr>
<td>Inflation-Protected Securities</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Prime Money Market</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

This table shows the planned asset allocation for Vanguard in various asset categories over time. It is inferred from Vanguard’s 2011 prospectus using holdings of target date funds with different maturities.
Table 2

TDF Holdings of 5 Types of Underlying Funds (in percent)

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>Add with Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging Market Equity</td>
<td>0</td>
<td>0.0%</td>
<td>0.0%</td>
<td>33.3%</td>
<td>45.8%</td>
<td>62.5%</td>
<td>52.5%</td>
<td>62.8%</td>
<td>75.6%</td>
<td>44.1%</td>
</tr>
<tr>
<td>Emerging Market Debt</td>
<td>0</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>4.2%</td>
<td>15.6%</td>
<td>17.5%</td>
<td>16.3%</td>
<td>22.2%</td>
<td>70.0%</td>
</tr>
<tr>
<td>Domestic Real Estate</td>
<td>0</td>
<td>20.0%</td>
<td>14.3%</td>
<td>33.3%</td>
<td>25.0%</td>
<td>40.6%</td>
<td>35.0%</td>
<td>39.5%</td>
<td>53.3%</td>
<td>58.3%</td>
</tr>
<tr>
<td>International Real Estate</td>
<td>0</td>
<td>0.0%</td>
<td>14.3%</td>
<td>6.7%</td>
<td>29.2%</td>
<td>37.5%</td>
<td>32.5%</td>
<td>34.9%</td>
<td>35.6%</td>
<td>81.3%</td>
</tr>
<tr>
<td>Commodities</td>
<td>0</td>
<td>0.0%</td>
<td>0.0%</td>
<td>6.7%</td>
<td>12.5%</td>
<td>18.8%</td>
<td>30.0%</td>
<td>39.5%</td>
<td>40.0%</td>
<td>55.6%</td>
</tr>
</tbody>
</table>

This table shows the percentage of TDFs in our sample for each calendar year that hold each of 5 types of mutual funds. The last column shows the percent of TDFs that while holding each type of fund did not hold that type in the initial year for which the T.D.F. first reports portfolio data.
This table shows holdings of equity and debt as of December 2011 for target date funds with a target date of 2035.
### Table 4

**Expense Ratios Across Target Share Classes**

<table>
<thead>
<tr>
<th>Share Class</th>
<th>Average Total Expenses</th>
<th>Average Target Fund Expenses</th>
<th>Average Fund Underlying Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.135</td>
<td>0.527</td>
<td>0.609</td>
</tr>
<tr>
<td>C</td>
<td>1.822</td>
<td>1.202</td>
<td>0.62</td>
</tr>
<tr>
<td>Investor</td>
<td>0.731</td>
<td>0.249</td>
<td>0.483</td>
</tr>
<tr>
<td>No Load</td>
<td>0.81</td>
<td>0.132</td>
<td>0.678</td>
</tr>
<tr>
<td>Average Retirement</td>
<td>1.028</td>
<td>0.417</td>
<td>0.612</td>
</tr>
<tr>
<td>Maximum Retirement</td>
<td>1.244</td>
<td>0.63</td>
<td>0.616</td>
</tr>
</tbody>
</table>

Average Total Expenses represents the annual expenses as a percent of assets that an investor who holds the class of shares indicated in the first column would pay. Average target fund expenses are the fees as a percent of assets paid to the target date fund. Average fund underlying expenses represent the fees (as a percent of assets) that are paid to the underlying funds held by the TDF.
Table 5

<table>
<thead>
<tr>
<th>Share Class</th>
<th>Number Held</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>46</td>
</tr>
<tr>
<td>Advisor</td>
<td>20</td>
</tr>
<tr>
<td>Cash</td>
<td>82</td>
</tr>
<tr>
<td>ETF</td>
<td>46</td>
</tr>
<tr>
<td>Institutional</td>
<td>440</td>
</tr>
<tr>
<td>Master Trusts</td>
<td>93</td>
</tr>
<tr>
<td>No Load</td>
<td>79</td>
</tr>
<tr>
<td>Retirement</td>
<td>45</td>
</tr>
<tr>
<td>Total</td>
<td>851</td>
</tr>
</tbody>
</table>

Table 5 shows for each share class the number of underlying funds of that share class held by all T.D.F’s.
Table 6
A Class Fees and No-Load Class Fees for T.D.F.’s and Fees to Match the Holdings of the T.D.F.

<table>
<thead>
<tr>
<th></th>
<th>Total Fees</th>
<th>Underlying Fees</th>
<th>Investor Matching Portfolio Fees</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Shares (22 Funds)</td>
<td>1.117</td>
<td>0.587</td>
<td>1.021</td>
</tr>
<tr>
<td>No-Load Shares</td>
<td>0.767</td>
<td>0.71</td>
<td>0.725</td>
</tr>
</tbody>
</table>

This table shows the total fees and fees of the underlying funds for the A shares and for the no load shares of TDF’s. It also shows the fees an investor would pay if the investor replicated the holdings of the fund by buying A shares when comparing to the A class TDF’s or no load shares when comparing to the no load class.
### Table 7

**Fiscal Year 2011 Net Expenses (In Percent) For Target Year 2025, 2035 and 2045 Target Date Funds**

<table>
<thead>
<tr>
<th></th>
<th>Total Expenses</th>
<th>T.D.F. Expenses</th>
<th>Underlying Funds Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Year 2035 Funds</td>
<td>1.139</td>
<td>0.524</td>
<td>0.618</td>
</tr>
<tr>
<td>Target Year 2025 Minus Target Year 2035</td>
<td>-0.02</td>
<td>-0.009</td>
<td>-0.01</td>
</tr>
<tr>
<td>Target Year 2045 Minus Target Year 2035</td>
<td>0.035</td>
<td>0.003</td>
<td>0.033</td>
</tr>
</tbody>
</table>

This table shows the average fees on the underlying funds, the T.D.F.’s, fees and total expenses for 2035, and the change in these expenses for 2025 and 2045 target date funds.
Table 8
Overall Performance of T.D.F’s

<table>
<thead>
<tr>
<th>Share Class</th>
<th>Average Alpha</th>
<th>Percent Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-0.0638</td>
<td>85%</td>
</tr>
<tr>
<td>C</td>
<td>-0.1141</td>
<td>92%</td>
</tr>
<tr>
<td>Investor</td>
<td>-0.0275</td>
<td>73%</td>
</tr>
<tr>
<td>No Load</td>
<td>-0.0226</td>
<td>71%</td>
</tr>
<tr>
<td>Average Retirement</td>
<td>-0.0548</td>
<td>83%</td>
</tr>
<tr>
<td>Maximum Retirement</td>
<td>-0.0607</td>
<td>90%</td>
</tr>
</tbody>
</table>

This table shows the monthly alpha of the TDF by share class and the percentage negative within each class.
Table 9
Sharpe Ratios On Target Date Funds Compared To Index Funds

<table>
<thead>
<tr>
<th>class</th>
<th>Number of funds</th>
<th>before fees</th>
<th>after fees</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>27</td>
<td>24***</td>
<td>24***</td>
</tr>
<tr>
<td>B</td>
<td>9</td>
<td>9***</td>
<td>9***</td>
</tr>
<tr>
<td>C</td>
<td>16</td>
<td>16***</td>
<td>16***</td>
</tr>
<tr>
<td>INST</td>
<td>21</td>
<td>19***</td>
<td>18***</td>
</tr>
<tr>
<td>NO LOAD</td>
<td>6</td>
<td>6**</td>
<td>6**</td>
</tr>
<tr>
<td>RETIRE</td>
<td>94</td>
<td>88***</td>
<td>85***</td>
</tr>
<tr>
<td>RETIRE BY COMPANY</td>
<td>37</td>
<td>34***</td>
<td>34***</td>
</tr>
</tbody>
</table>

*** indicates significance at the 1% level using a binomial test
** indicates significance at the 5% level using a binomial test

This table shows the number of times a portfolio index fund had a higher Sharpe ratio than the associated target date fund. The index funds were constructed with the same split between domestic and international stock and bonds and cash as the target date fund had 3 months after it started to report composition. We have excluded 3 funds that reported more than 25 % in the category other. We assumed an average of 15 b.p. fees on the index funds. This is consistent with what is available on exchange traded funds. Assuming 30 b.p. would not change significance. The entry retire counts each retirement fund as an observation. The entry retire by company averages across all retirement funds offered by a company and treats each company as an observation.
REFERENCES


Barrons Target – Date funds take over July 5, 2014


On Wall Street, April 18, 2013.


