
Selecting a Target-Date Benchmark

Morningstar Investment Management LLC
November 2017

Thomas Idzorek, CFA
Chief Investment Officer, Retirement
Morningstar Investment Management LLC

Lucian Marinescu
Head of Target-Date Strategies
Morningstar Investment Management LLC

A previous version of this paper was authored
by Tom Idzorek, CFA, Jeremy Stempien, and
Nathan Voris in 2011.

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Introduction

When it comes to the benchmarking of target maturity funds, the cart has been in front of the horse. In the single-asset-class world, most managers are given a specific mandate and to some degree that mandate is defined by a benchmark that is assigned to them by the fund manufacturer (e.g. a firm starts a new small-cap value fund, establishes the Russell 2000 Value as the index, and hires a portfolio manager or team to manage the fund). In the target maturity world, the largest target maturity funds were started prior to the creation of target maturity benchmarks.

Due in part to the lack of target maturity benchmarks, each fund manufacturer went about creating their own proprietary methodology for developing their target maturity fund family. This resulted in a vast array of target maturity fund families with substantially different investment characteristics. Additionally, as more money has continued to pour into target maturity funds, manufacturers have devoted more resources to these funds. This has caused periodic methodology enhancements that have resulted in substantial changes to the investment characteristics of a number of firms' fund families. As practitioners and investors stuck in our old ways of thinking, there is an unfortunate tendency to view funds with the same target-date year, for example all 2030 funds, as a homogeneous peer group or category, even though the investment characteristics of all 2030 funds are substantially less homogeneous than that of traditional peer groups or categories.

Now that a wide range of target maturity benchmarks from established benchmark creators are available, the challenge is in selecting an appropriate one. The first place a target maturity stakeholder might naturally look to for help in determining the most appropriate benchmark is the fund family's prospectus. In Table 1, we have compiled the published benchmarks for the 2422 target maturity funds in the open-end retail marketplace. The table highlights two things. The first is the lack of uniformity in published benchmarks for target maturity fund families. The second is the low adoption rate of industry accepted target maturity benchmarks, though S&P Target Date Index Series is the leader with 39% of funds using the series as their primary prospectus benchmarks. Unlike with a single asset class fund, these single strategy published benchmarks that target maturity fund manufacturers have established are all but useless in helping stakeholders assess the performance of the target maturity funds.

Table 1: Primary Prospectus Benchmark

	% of TDFs Using the Benchmark	# of Funds
S&P Target Date Index Series	39	941
Blended Benchmark	19	467
S&P 500	14	330
No Listed Primary Benchmark 18.4	9	221
Morningstar® Lifetime Allocation IndexesSM	7	158
BarCap US Aggregate Bond	4	105
Russell 1000	4	99
MSCI AC World	2	45
MSCI US Broad Market	1	18
Dow Jones Target Date Indexes	1	16
S&P Global BMI	1	13
BBgBarc US Universal TR USD	0	6
Russell 3000	0	3
Total	100	2,422

Source: Morningstar DirectSM

So, how does one select a target maturity benchmark? Operating under the typical problem faced by a typical target maturity fund stakeholder, we assume a fund family has already been chosen and the stakeholder needs to select an appropriate benchmark. In the paper, we introduce key qualitative aspects to consider when selecting a target maturity benchmark family. Additionally, we introduce three quantitative measures for determining the “goodness of fit” between a fund family and a target maturity benchmark family. We do not address the difficult topics of: 1) how to select the best / most appropriate fund family; and 2) how to properly use a target maturity benchmark series to evaluate and monitor a fund family.

Qualitative Aspects of Selecting a Target-Date Benchmark

The CFA Institute curriculum defines a benchmark as "...a collection of securities or risk factors and associated weights that represents the persistent and prominent investment characteristics of asset category or manager's investment process."¹ As it pertains to target maturity benchmarking, we must expand our thinking beyond a single benchmark to the "investment process" associated with a given manager's overall target maturity fund family relative to a target maturity benchmark family. In other words, the philosophies inherent in the benchmark family should be reasonably consistent with the "manager's investment process" or philosophies. When it comes to target maturity benchmarks there are three major decisions that will determine the fund family risk and return characteristics:

- ▶ Overall stock-bond glide path
- ▶ Various intra-stock and intra-bond asset classes in the benchmark
- ▶ Weighting scheme of the individual asset classes

As such, we have attempted to expand upon the CFA Institute's curriculum's list identifying the six characteristics of a good benchmark by adding three additional factors in italics:

- ▶ Unambiguous
- ▶ Investable
- ▶ Measurable
- ▶ Appropriate
- ▶ Reflective of current investment opinions
- ▶ Specified in advance
- ▶ *Robust overall glide path methodology*
- ▶ *Robust opportunity set of individual asset classes*
- ▶ *Robust methodology for determining the detailed intra-stock and intra-bond asset class allocations*

From a qualitative stand point considerable work is required. The benchmark selector must understand and evaluate a) the overall glide path methodology, b) the asset classes used, and c) the methodology for determining the detailed intra-stock and intra-bond allocations for not only the fund family in question, but for all of the possible target maturity benchmarks in order

¹ Tuttle, Donald L., McLeavey, Dennis W., Maginn, John L. and Pinto, Jerald E. eds. "Evaluating Portfolio Performance," Managing Investment Portfolios: A Dynamic Process, (JohnWiley & Sons, 2007), pp. 731–732

to make an informed selection. To assist the reader in this endeavor we have identified the key qualitative elements of the three major target maturity index families (representing seven potential benchmark series) in Tables 2, 3, and 4.²

Table 2: Overall Glide Path Methodology

Index	Glide Path Methodology	Robustness of Theory
S&P Target Date Series	Modified peer group average based on survey of fund families with AUM of \$100 million or more. If an asset class is included in 25% of target maturity funds it is included in the average. Summed survey results lead to the equity glide path. Final curve fitting procedure smooths the results.	Low
S&P Target Date Style Indexes	The S&P Target Date Style Indices are created based on the standard S&P Target Date Indices, by classifying funds included in the annual target-date fund holdings survey into two styles, the <i>to</i> style and the <i>through</i> style.	Low
Dow Jones Target Indexes	Semi-variance-based glide path. Starting 35 years or more prior to the target-date, the funds target 90% of the semi-variance of equity. This decreases to 20% of the semi-variance of equity 10 years after the retirement date.	Medium
Dow Jones U.S. Target Indexes	Semi-variance-based glide path. Starting 35 years or more prior to the target-date, the funds target 90% of the semi-variance of equity. This decreases to 20% of the semi-variance of equity 10 years after the retirement date. Excludes non-US asset classes for the optimization.	Medium
Morningstar Lifetime Allocation (with risk tracks)	Modern Portfolio Theory (MPT)-based glide path evolves with the median U.S. citizen's total economic situation (including an evolving picture of their financial capital, human capital, and retirement income liability). The glide paths attempt to maximize a participant's total financial health by investing their financial capital in such a way that it brings their total wealth closest to MPT's Sharpe maximizing portfolio (adjusted for risk preferences) while considering the nature of the participants' liabilities.	High (Published)

Source: Internal Morningstar Investment Management LLC analysis based on information collected in March 2011. See References for specific sources.

From Table 2 and Table 4, we see that the S&P Target Date series is based on a modified peer-grouping process coupled with a final curve-fitting algorithm. In our opinion, while there is little in the way of theory, S&P-based documents such as Murphy and Tsui (2011) provide a clear description of their philosophy and methodology. The index series reflects the target-date market consensus for glide path construction and asset allocation for different target-date horizons.

The construction of the Dow Jones Indexes, Global and U.S. relies on the application of Modern Portfolio Theory, specifically the assumption that the primary goal of any portfolio is to maximize return for the amount of risk incurred.

² As one of our authors is also the author of "Lifetime Asset Allocations: Methodologies for Target Maturity Funds", which serves as the basis for the Morningstar Lifetime Allocation Indexes, and is thus potentially biased, we encourage readers to review the various methodologies and form their own conclusions.

Table 3: Asset Classes

Index	Asset Classes	# of Asset Classes
S&P Target Date Series	Equity: U.S. Large Cap, U.S. Mid Cap, U.S. Small Cap, International Equities, Emerging Markets, U.S. REITs, International REITs Fixed Income: Core Fixed Income, Short Term Treasuries, TIPS, High Yield Corporate Bonds, Commodities	12
Dow Jones Target Indexes	Equity: U.S. Large Cap Growth, U.S. Large Cap Value, U.S. Mid Cap Growth, U.S. Mid Cap Value, U.S. Small Cap Growth, U.S. Small Cap Value, Europe/Canada/Middle East Developed, Asia/Pacific Developed, Emerging Markets Fixed Income: U.S. Government Bonds, U.S. Corporate Bonds, U.S. Mortgage Bonds, Majors (ex U.S.), 1-3 month T-bill	14
Dow Jones U.S. Target	Equity: U.S. Large Cap Growth, U.S. Large Cap Value, U.S. Mid Cap Growth, U.S. Mid Cap Value, U.S. Small Cap Growth, U.S. Small Cap Value Fixed Income: U.S. Government Bonds, U.S. Corporate Bonds, U.S. Mortgage Bonds, 1-3 month T-bill	10
Morningstar Lifetime Allocation (with risk tracks)	Equity: U.S. Large Cap Growth, U.S. Large Cap Value, U.S. Large Cap Core, U.S. Mid Cap Growth, U.S. Mid Cap Value, U.S. Mid Cap Core, U.S. Small Cap Growth, U.S. Small Cap Value, U.S. Small Cap Core, Non-US Developed, Emerging Markets, REITs Fixed Income: U.S. Long-Term Core Bonds, U.S. Intermediate-Term Bonds, U.S. Short-Term Bonds, Global Government Bonds, Long-Term TIPS, Short-Term TIPS, Cash Other: Commodities	20

Source: Internal Morningstar Investment Management LLC analysis based on information collected in August 2017. See References for specific sources.

Looking at the Dow Jones Target Date Indexes (the Global Series), we see that within the U.S. portion of equity they equally weight U.S. Large Cap, U.S. Mid Cap, and U.S. Small Cap, which results in a small cap bias that far exceeds that of actual target maturity funds. Likewise, within non-U.S. equities, the Global series equally weights the three non-U.S. asset classes of Europe/Canada/Middle East, Asia/Pacific, and Emerging markets.

Table 4: Intra-Stock/Intra-Bond Detailed Asset Allocation Methodology

Index	Intra-Stock/Intra-Bond Methodology	# of Asset Classes
S&P Target Date Series	Modified peer group average based on survey of fund families with AUM of \$100 million or more. If asset class is included in 25% of target maturity funds it is included in the average. Summed survey results lead to the equity glide path. Final curve fitting procedure smoothes the results.	Low
Dow Jones Target Indexes	Optimization based on historical 36-month inputs determines the optimal stock, bond, and cash split at target semi-variance levels	Low
Dow Jones U.S. Target Indexes	Optimization based on historical 36-month inputs determines the optimal stock, bond, and cash split at target semi-variance levels	None
Morningstar Lifetime Allocation (with risk tracks)	Gradual movement from asset-only asset class allocations to liability-relative optimization-based asset allocations. In addition, there is a gradual movement from mean-variance asset allocation to mean-conditional value-at-risk optimizations.	High (Published)

Source: Internal Morningstar Investment Management LLC analysis based on information collected in March 2011. See References for specific sources.

While some fund families are forthcoming with critical methodological underpinnings such as the overall glide path methodology, the asset classes used, and the methodology for determining the detailed intra-stock and intra-bond asset class allocations, others hide behind a wall of impenetrable marketing materials making it necessary to also use quantitative measures based on available data.

Quantitative Aspects of Selecting a Target-Date Benchmark

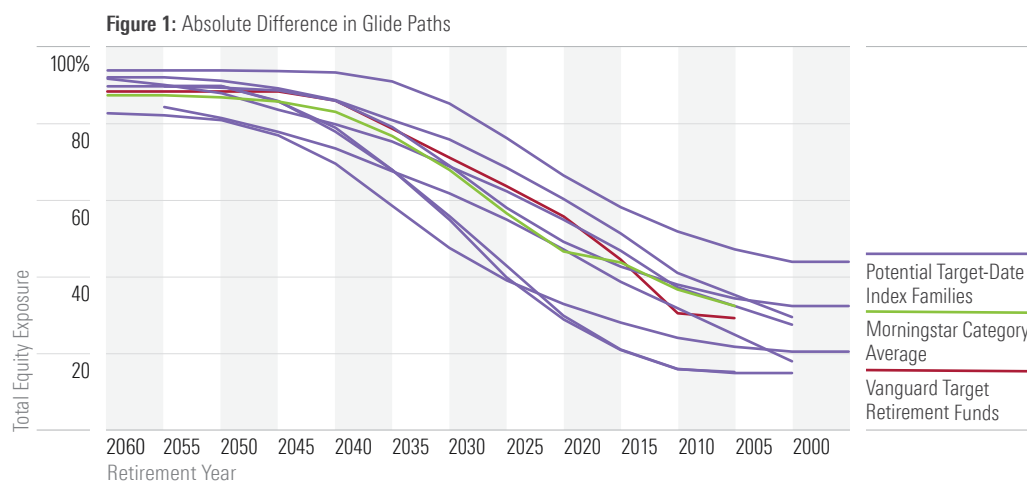
In addition to the qualitative methods recommended in the first section, we propose three quantitative measures to help select a “best-fit” target maturity benchmark series for a given fund family:

- ▶ Average Absolute Difference in Glide Paths
- ▶ Average Historical Tracking Error
- ▶ Average Forward Looking (or Current) Tracking Error

To help introduce these three quantitative measures, we apply each of them to the largest target maturity fund family in terms of assets, Vanguard.

Average Absolute Difference in Glide Paths

The first measure, Average Absolute Difference in Glide Paths, is the most simplistic. It is a quantitative measurement of what many attempt to do by eyeballing a glide path graph. It measures which of the index glide paths is the closest (across the entire glide path) to that of the target maturity fund family. Figure 1 displays the glide path for Vanguard Target Retirement Funds (red) and the eight target-date benchmarks representing the 3 benchmark families from table 1 above (purple lines). The green glide path illustrates the equity allocations for the Morningstar Category Average.



In some cases eyeballing the graph to make a “best-fit” assessment is quite easy; other times it is difficult to find the best-fit benchmark series. Table 5 displays the absolute difference in glide paths (i.e. differences in overall equity exposure) of the Vanguard Target Retirement Funds relative to each of the target maturity benchmark series.

Table 5: Absolute Differences in Glide Paths (Percentage Points)

Name	Morningstar Lifetime Agg	Morningstar Lifetime Mod	Morningstar Lifetime Con	DJ Target Indexes	DJ US Target Indexes	S&P Target Date Indexes	S&P Target Date Through Indexes	S&P Target Date To Indexes
Income	16.21	4.55	8.47	14.33	14.33	1.76	0.27	11.36
2015	15.55	0.41	14.93	21.56	21.56	4.26	8.79	3.76
2020	11.62	5.29	21.79	25.19	24.19	0.87	6.25	6.89
2025	12.60	5.41	24.39	22.60	19.60	0.16	5.96	7.58
2030	14.52	2.17	23.76	14.94	13.94	0.96	6.04	7.98
2035	13.71	0.97	20.43	9.24	9.24	1.81	3.86	9.57
2040	9.21	1.05	16.54	6.56	5.56	4.62	1.78	10.82
2045	6.45	1.23	11.17	1.85	1.85	4.16	1.46	9.83
2050	6.44	2.01	7.17	2.13	2.13	0.17	3.41	6.28
2055	6.37	2.32	5.34	2.15	2.15	2.43	4.42	3.39
2060	6.26	2.28	4.81	2.13	2.13	3.97	4.43	3.40
Average	10.81	2.52*	14.44	11.15	10.61	2.29*	4.24	7.35

*Target-date indexes did not exist for these target-dates; thus, the stock-bond split was inferred from corresponding near-dated indexes from the same index family. Source: Glide paths are estimated by Morningstar Investment Management LLC using information collected in August 2017 from Dow Jones website, S&P website, and Morningstar databases.

From Table 5 we see that on average the S&P Target Date Indexes and the Morningstar Moderate Index series are the best-fit index series with an average absolute difference in glide paths of 2.29 percentage points of equity exposure, and 2.52% respectively. While these two Index series had the lowest average differential, there were substantial differences for the 2025, the 2020 and Income funds, with differences greater than 4.5 percentage points.

Average Historical Tracking Error

The next measure is Average Historical Tracking Error. Historical tracking error measures how closely a portfolio tracked a given index in the past. All seven benchmark families have historical backfilled return data going back at least five years. This enables one to calculate the historical tracking error of a given fund, such as the Vanguard Target Retirement 2030 fund, relative to each of the eight 2030 target maturity indexes. Table 6 contains the historical annualized tracking error for all of the Vanguard Target Retirement funds relative to the corresponding target maturity benchmarks during the last five years ending August 2017.

The target maturity index family with the best-fit was the S&P Target Date series with annualized historical tracking error of 0.77%, followed relatively closely by the Morningstar Moderate Index series with a tracking error of 1.01%.

Table 6: Historical Tracking Error (%)

Name	Morningstar Lifetime Agg	Morningstar Lifetime Mod	Morningstar Lifetime Con	DJ Target Indexes	DJ US Target Indexes	S&P Target Date Indexes	S&P Target Date Through Indexes	S&P Target Date To Indexes
Income	1.91	1.03	1.16	1.57	1.51	0.44	0.49	0.84
2015	1.54	0.88	2.12	2.56	2.38	0.51	0.80	0.92
2020	1.51	1.04	2.57	2.49	2.44	0.56	0.78	1.03
2025	1.69	0.93	2.66	2.03	2.27	0.64	0.85	1.08
2030	1.79	0.88	2.46	1.54	2.30	0.71	0.84	1.12
2035	1.56	0.93	2.13	1.31	2.53	0.85	0.78	1.25
2040	1.21	0.94	1.81	1.28	2.84	1.05	0.87	1.39
2045	1.23	1.02	1.39	1.28	3.02	0.93	0.88	1.14
2050	1.29	1.09	1.26	1.36	3.11	0.89	0.91	0.97
2055	1.33	1.15	1.25	1.35	3.11	0.95	0.95	0.98
2060	1.38	1.20	1.30	1.35	0.97	0.96	8.71	8.71
Average	1.49	1.01	1.83	1.65	2.41	0.77	1.53	1.77

Source: Glide paths are estimated by Morningstar Investment Management LLC using information collected in August 2017 from Dow Jones website, S&P website, and Morningstar databases.

A potential strength of the historical analysis is that it reflects any historical changes and differences in the detailed asset allocations that may have occurred in the past. This strength is also a potential weakness, as the current implied glide paths of the fund family and index families may be a better indication of the “best-fit” benchmark series moving forward; hence, our final quantitative measure.

Average Forward-Looking (or Current) Expected Tracking Error

The most-sophisticated quantitative measure presented here is the Average Forward-Looking (or Current) Expected Tracking Error measure based on the current detailed asset allocations of the fund family versus the detailed asset allocations of the respective target maturity index. To calculate this measure, one must obtain the current detailed asset allocations of all of the funds in a fund family as well as the current detailed asset allocations for all of the target maturity indexes. For a given fund (e.g. Vanguard Target Retirement 2030), assuming that one orders the detailed asset allocations in a consistent fashion (including a placeholder with a 0% for any non-common asset classes) one can estimate the “active” asset allocation weights by subtracting each detailed asset allocation weight of the index from the corresponding detailed asset allocation index. For example, if a family’s 2040 fund allocates 20% to U.S. large cap value, whereas the index for that fund allocates 17% to U.S. large cap value, this implies an active decision (knowingly or unknowingly) by the fund to allocate 3% more to the asset class than the index. The list of active asset allocation positions relative to the index will sum to zero and can then be coupled with a forward-looking covariance matrix of returns to calculate the forward-looking tracking error.³ Table 7 lists the forward-looking tracking error estimates of the Vanguard Target Retirement Funds relative to the various indexes.

³ Assuming that $\mathbf{h}_f$ is an $n \times 1$ column vector of asset class weights for the fund, $\mathbf{h}_b$ is an $n \times 1$ column vector of asset class weights for the benchmark, and Σ is an $n \times n$ covariance matrix of asset class returns, the forward-looking tracking error (TE) equals $\sqrt{[(\mathbf{h}_f - \mathbf{h}_b)^T \Sigma (\mathbf{h}_f - \mathbf{h}_b)]}$

Table 7: Forward-Looking Tracking Error (%)

Name	Morningstar Lifetime Agg	Morningstar Lifetime Mod	Morningstar Lifetime Con	DJ Target Indexes	DJ US Target Indexes	S&P Target Date Indexes	S&P Target Date Through Indexes	S&P Target Date To Indexes
Income	2.6	1.1	1.7	2.8	3.0	1.3	1.3	2.4
2015	2.6	0.7	2.5	3.3	3.5	1.2	1.8	1.3
2020	1.9	1.2	3.7	3.6	3.8	1.1	1.4	1.6
2025	2.0	1.2	4.1	2.9	3.3	1.1	1.4	1.7
2030	2.3	0.7	3.9	2.0	2.9	1.1	1.3	1.7
2035	2.2	0.5	3.4	1.3	2.9	1.1	1.1	1.7
2040	1.5	0.4	2.7	1.2	3.2	1.4	1.1	2.0
2045	1.1	0.3	1.9	0.9	3.3	1.4	1.1	1.8
2050	1.1	0.4	1.3	0.9	3.3	1.1	1.1	1.2
2055	1.1	0.4	0.9	0.9	3.3	0.9	1.0	0.8
2060	1.1	0.5	0.8	0.9	N/A	0.9	1.0	N/A*
Average	1.8	0.7	2.4	1.9	3.3	1.2	1.2	1.6

*Target-date indexes did not exist for these target-dates; thus, the stock-bond split was inferred from corresponding near-dated indexes from the same index family. Source: Glide paths are estimated by Morningstar Investment Management LLC using information collected in August 2017 from Dow Jones website, S&P website, and Morningstar databases.

Once again, the lowest average forward-looking tracking error was for the Morningstar Moderate Index series. In addition, based on this measure both the Morningstar Lifetime Moderate Index series ("Morningstar Moderate Index series") and the S&P Target Date Index series fit quite nicely as well.

Summary of Quantitative Measures

Table 8 provides a summary of our three quantitative measures applied to the Vanguard Target Retirement funds.

Table 8: Historical Tracking Error (%)

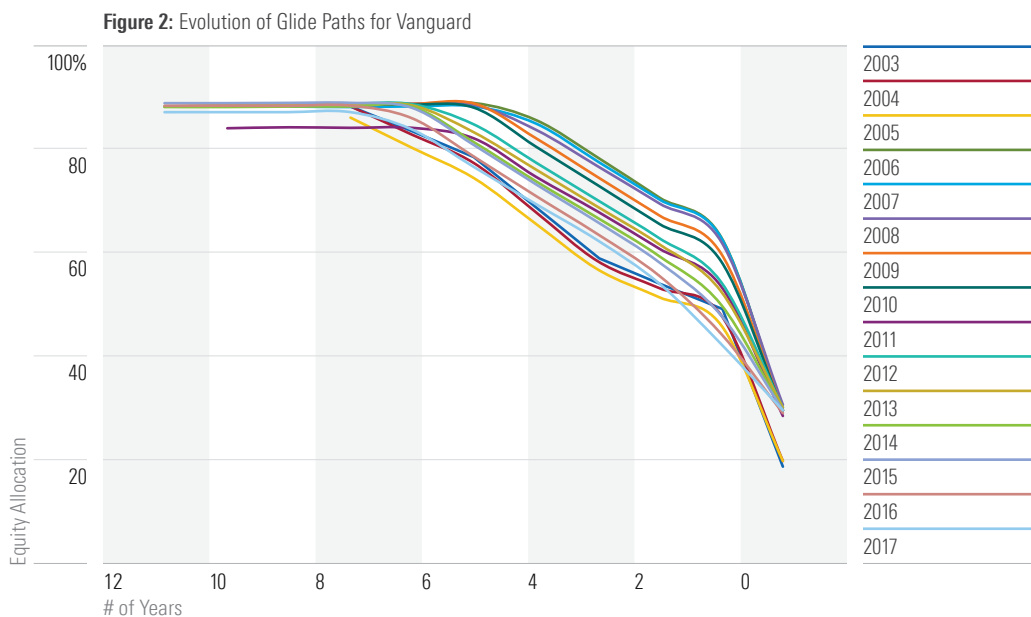
Name	Average Absolute Glide Path Equity Differential	Average Annual Tracking Error (%)	Average Forward-Looking Tracking Error (%)
Morningstar Lifetime Aggressive	10.81	1.49	1.78
Morningstar Lifetime Moderate	2.52	1.01	0.67
Morningstar Lifetime Conservative	14.44	1.83	2.45
DJ Target Indexes	11.15	1.65	1.88
DJ US Target Indexes	10.61	2.41	3.26
S&P Target Date Indexes	2.29	0.77	1.16
S&P Target Date Through Indexes	4.24	1.53	1.25
S&P Target Date To Indexes	7.35	1.77	1.61

[†]Target-date indexes did not exist for these target-dates; thus, the stock-bond split was inferred from corresponding near-dated indexes from the same index family. Source: Morningstar Direct

We've highlighted in blue the index with the lowest and second lowest value, indicating the best-fit, for each of the three metrics discussed. We believe that all three measures in Table 8 provide valuable information for choosing a best-fit benchmark based on non-subjective measures. Furthermore, we believe that reasonable practitioners may prefer one measure over another or to weight them differently. While we believe the takeaway from our example is that both the Morningstar Moderate Index series and the S&P Target Date Index series are the best-fit benchmarks for Vanguard Target Retirement Funds (being the best-fit or the second best-fit for each metric), clearly different benchmarks series will provide a best-fit for other fund families. We should also point out that although we indicate the best-fit index for each quantitative measure is based on the lowest average value across all of the individual fund family target maturity funds, for any individual fund the best-fit may vary among the different index series. We do not think it is practical to choose multiple index funds for different target maturity funds along a single fund family's glide path, but rather a single index series should be chosen.

Additional Considerations

In the case of Vanguard Target Retirement funds, since 2003 the implied glide path has changed marginally. (see Figure 2).



If one thinks the current implied glide path is the best predictor of the glide path moving forward, then more emphasis should be placed on our first and third quantitative measures — Average Absolute Difference in Glide Paths and Average Forward-Looking (or Current) Expected Tracking Error — as these measures are based on current allocations. If one thinks the Vanguard Target Retirement glide path is likely to bounce around, it could make sense to put more weight on our second quantitative measure — historical tracking error.

Conclusion

Perhaps in the future the cart will once again be behind the horse. Appropriately benchmarking target maturity funds continues to be an important yet difficult issue. As disclosure requirements, investment policy statements, and due diligence processes for target maturity funds continue to be a focus in the industry, a viable technique for selecting an appropriate benchmark series is necessary.

From a qualitative standpoint, an appropriate target maturity benchmark should have a similar glide path philosophy, asset class set, and methodology for determining the detailed intra-stock and intra-bond allocations. From a quantitative standpoint, we have introduced three relatively simple-to-calculate measures for identifying a best-fit benchmark: Average Absolute Difference in Glide Paths, Average Historical Tracking Error, and Average Forward-Looking (or Current) Tracking Error.

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