



Methodology Summary: Target Date Strategies Study

March 2019

We examined the performance of 11 T. Rowe Price Retirement Funds (RFs) to determine the value added for clients by the firm's target date design process and investment implementation, both at the RF level and in the management of the underlying strategies.

The Study Universe

The 11 RFs included in the study (Figure 1) were those that had at least 10-year performance histories as of December 31, 2018. One RF with a relatively distant target date (2060) was excluded from the study because of its relatively short performance track record. The Retirement 2060 Fund inceptioned June 23, 2014. A separate set of target date funds using an alternative T. Rowe Price-designed glide path (the target glide path) also was excluded from the study because of the funds' extremely limited historical track records. See Figure 2 for a list of these funds and their inception dates. The T. Rowe Price funds included in the study held virtually all (more than 99%) of the Retirement Fund assets managed by the firm as of December 31, 2018.

As of December 31, 2018, each RF invested its assets in a portfolio of up to 21 underlying T. Rowe Price funds covering the major global equity and fixed income sectors (Figure 3). Twenty of the 21 underlying T. Rowe Price funds were actively managed, while one—a core large-cap U.S. stock allocation—used passive management to replicate the returns on the S&P 500 Index.

Performance Periods

The performance of each Retirement Fund in the study was examined across 1-, 3-, 5-, and 10-year rolling periods (rolled monthly) since each RF's inception through December 31, 2018. Because these inception dates—and thus, fund longevities—differed, the number of rolling performance periods also varied

for each RF. The total rolling periods in each time frame for each RF are shown in Figure 4.

It should be noted that the number of rolling performance periods declined as the time frames were lengthened. The number of rolling 10-year periods was relatively small, especially for Retirement Funds with 2045, 2050, and 2055 target dates. Accordingly, the performance results shown for 10-year rolling periods may have relatively limited statistical significance, particularly for the Retirement 2050 and Retirement 2055 Funds, both of which had only 25 10-year rolling performance periods as of December 31, 2018.

Full performance results for each RF over 1-, 3-, 5-, and 10-year rolling periods can be found in Figures 5, 6, and 7.

Performance Metrics

Our analysis used two specific measures to quantify RF performance:

- Active success rates: the percentage of all rolling periods in each time frame (one, three, five, and 10 years) in which an RF either outperformed a specific benchmark or a component of T. Rowe Price's target date process made a positive contribution to RF returns (see "Performance Benchmarks").
- Excess returns: the actual margin of relative RF performance (either positive or negative) against a specific benchmark or the contribution (positive or negative) that a component of the T. Rowe Price target date process made to RF returns, each in basis points. Excess returns for rolling periods of more than one year were annualized. The excess returns shown in the various tables in the study are the average results across all of the rolling time periods in each 1-, 3-, 5-, and 10-year time frame.

Performance Benchmarks

The objective of the study was to quantify the value added by tactical asset allocation and our management of the underlying strategies. Accordingly, active success rates and excess returns were calculated relative to:

- Combined index benchmarks created by T. Rowe Price for each RF.
- Hypothetical returns for the RFs based solely on their long-term strategic asset allocations and glide paths (in other words, excluding the effects of tactical allocation).
- The appropriate asset class, sector, and/or style benchmarks for the underlying T. Rowe Price funds in the RF portfolios. For each rolling period, the relative performances of the underlying funds were aggregated to determine if they collectively added to or detracted from RF performance.

(Fig. 1) Retirement Funds Included in Our Performance Study

Fund	Inception Date	Combined Index Portfolio*
Retirement Fund 2005	2/27/2004	Blended benchmark composed of 36.5% stocks (25.55% Russell 3000 Index and 10.95% MSCI All Country World Index ex USA) and 63.5% bonds (44.5% Bloomberg Barclays U.S. Aggregate Bond Index and 19% Bloomberg Barclays U.S. 1–5 Year Treasury Inflation Protected Securities (TIPS) Index). The percentages will vary over time, and the indexes may vary over time.
Retirement Fund 2010	9/30/2002	Blended benchmark composed of 42.0% stocks (29.4% Russell 3000 Index and 12.6% MSCI All Country World Index ex USA) and 58.0% bonds (41.5% Bloomberg Barclays U.S. Aggregate Bond Index and 16.5% Bloomberg Barclays U.S. 1–5 Year Treasury Inflation Protected Securities (TIPS) Index). The percentages will vary over time, and the indexes may vary over time.
Retirement Fund 2015	2/27/2004	Blended benchmark composed of 49% stocks (34.30% Russell 3000 Index and 14.70% MSCI All Country World Index ex USA) and 51.0% bonds (38% Bloomberg Barclays U.S. Aggregate Bond Index and 13% Bloomberg Barclays U.S. 1–5 Year Treasury Inflation Protected Securities (TIPS) Index). The percentages will vary over time, and the indexes may vary over time.
Retirement Fund 2020	9/30/2002	Blended benchmark composed of 58.50% stocks (40.95% Russell 3000 Index and 17.55% MSCI All Country World Index ex USA) and 41.5% bonds (33.5% Bloomberg Barclays U.S. Aggregate Bond Index and 8% Bloomberg Barclays U.S. 1–5 Year Treasury Inflation Protected Securities (TIPS) Index). The percentages will vary over time, and the indexes may vary over time.
Retirement Fund 2025	2/27/2004	Blended benchmark composed of 67% stocks (46.90% Russell 3000 Index and 20.10% MSCI All Country World Index ex USA) and 33% bonds (28.5% Bloomberg Barclays U.S. Aggregate Bond Index and 4.5% Bloomberg Barclays U.S. 1–5 Year Treasury Inflation Protected Securities (TIPS) Index). The percentages will vary over time, and the indexes may vary over time.
Retirement Fund 2030	9/30/2002	Blended benchmark composed of 75% stocks (52.50% Russell 3000 Index and 22.50% MSCI All Country World Index ex USA) and 25% bonds (23.0% Bloomberg Barclays U.S. Aggregate Bond Index and 2% Bloomberg Barclays U.S. 1–5 Year Treasury Inflation Protected Securities (TIPS) Index). The percentages will vary over time, and the indexes may vary over time.
Retirement Fund 2035	2/27/2004	Blended benchmark composed of 81.5% stocks (57.05% Russell 3000 Index and 24.45% MSCI All Country World Index ex USA) and 18.5% bonds (Bloomberg Barclays U.S. Aggregate Bond Index). The percentages will vary over time, and the indexes may vary over time.
Retirement Fund 2040	9/30/2002	Blended benchmark composed of 86.5% stocks (60.55% Russell 3000 Index and 25.95% MSCI All Country World Index ex USA) and 13.5% bonds (Bloomberg Barclays U.S. Aggregate Bond Index). The percentages will vary over time, and the indexes may vary over time.
Retirement Fund 2045	5/31/2005	Blended benchmark composed of 90% stocks (63% Russell 3000 Index and 27% MSCI All Country World ex USA Index) and 10% bonds (Bloomberg Barclays U.S. Aggregate Bond Index). The percentages will vary over time, and the indexes may vary over time.
Retirement Fund 2050	12/29/2006	Blended benchmark composed of 90% stocks (63% Russell 3000 Index and 27% MSCI All Country World ex USA Index) and 10% bonds (Bloomberg Barclays U.S. Aggregate Bond Index). The percentages will vary over time, and the indexes may vary over time.
Retirement Fund 2055	12/29/2006	Blended benchmark composed of 90% stocks (63% Russell 3000 Index and 27% MSCI All Country World ex USA Index) and 10% bonds (Bloomberg Barclays U.S. Aggregate Bond Index). The percentages will vary over time, and the indexes may vary over time.

* Benchmark weightings as of December 31, 2018. Each index is weighted at the appropriate strategic neutral allocation of its respective asset class, which is predetermined and changes over time. The combined index portfolio is a blended benchmark.

Sources: T. Rowe Price, Bloomberg Index Services Ltd. (see Important Information); MSCI (see Important Information); and Russell.¹

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(Fig. 2)

Not Included in the
Performance Study

Source: T. Rowe Price.

T. Rowe Price Target Funds

Fund	Inception Date
Target 2005 Fund	8/20/2013
Target 2010 Fund	8/20/2013
Target 2015 Fund	8/20/2013
Target 2020 Fund	8/20/2013
Target 2025 Fund	8/20/2013
Target 2030 Fund	8/20/2013
Target 2035 Fund	8/20/2013
Target 2040 Fund	8/20/2013
Target 2045 Fund	8/20/2013
Target 2050 Fund	8/20/2013
Target 2055 Fund	8/20/2013
Target 2060 Fund	6/23/2014

(Fig. 3)

As of December 31, 2018

Source: T. Rowe Price.

*Not included: U.S. Treasury
Money Fund.

**From inception to 2006, our conservative fixed income allocation was a mix of the T. Rowe Price Short-Term Bond Fund and the T. Rowe Price Summit Cash Reserves Fund (renamed the Cash Reserves Fund on August 1, 2016). In 2006, the T. Rowe Price Short-Term Income Fund replaced these two funds. In May 2011, the name and investment objective of the T. Rowe Price Short-Term Income Fund changed to the T. Rowe Price Inflation Focused Bond Fund, which is now known as the T. Rowe Price Limited Duration Inflation Focused Bond Fund.

Underlying T. Rowe Price Funds in Retirement Fund Portfolios*

Fund	Date Included
U.S. Equity	
Equity Index 500	9/30/2002
Growth Stock	9/30/2002
Value	9/30/2002
Mid-Cap Growth	9/30/2002
Mid-Cap Value	2/1/2004
Small-Cap Stock	9/30/2002
New Horizons	11/1/2005
Small-Cap Value	11/1/2005
Non-U.S. Equity	
Overseas Stock	12/1/2006
International Stock	9/30/2002
International Value Equity	2/1/2004
Emerging Markets Stock	5/1/2007
Fixed Income	
New Income	9/30/2002
International Bond (U.S. Dollar Hedged)	10/1/2017
Dynamic Global Bond	10/1/2017
High Yield	9/30/2002
Floating Rate	10/1/2017
Emerging Markets Bond	5/1/2008
U.S. Treasury Long-Term	10/1/2017
Limited Duration Inflation Focused Bond**	9/30/2002
Other	
Real Assets	7/1/2010

(Fig. 4) Rolling Periods in Each Time FrameFund Inceptions Through
December 31, 2018**Source:** T. Rowe Price.

Fund	1-Year	3-Year	5-Year	10-Year
Retirement Fund 2005	167	143	119	59
Retirement Fund 2010	184	160	136	76
Retirement Fund 2015	167	143	119	59
Retirement Fund 2020	184	160	136	76
Retirement Fund 2025	167	143	119	59
Retirement Fund 2030	184	160	136	76
Retirement Fund 2035	167	143	119	59
Retirement Fund 2040	184	160	136	76
Retirement Fund 2045	152	128	104	44
Retirement Fund 2050	133	109	85	25
Retirement Fund 2055	133	109	85	25

(Fig. 5) Active Success Rates and Value Added by Tactical AllocationFund Inceptions Through
December 31, 2018

Fund	Active Success Rates				Average Annualized Value Added (Basis Points)			
	Rolling Periods				Rolling Periods			
	1-Year	3-Year	5-Year	10-Year	1-Year	3-Year	5-Year	10-Year
Retirement Fund 2005	66%	85%	95%	100%	16	17	18	18
Retirement Fund 2010	72	87	96	100	19	19	20	19
Retirement Fund 2015	71	84	95	100	17	18	18	19
Retirement Fund 2020	73	84	94	100	19	19	20	20
Retirement Fund 2025	67	80	93	100	16	16	16	16
Retirement Fund 2030	72	81	94	100	16	16	16	16
Retirement Fund 2035	66	73	92	100	13	12	12	12
Retirement Fund 2040	68	75	93	100	14	13	14	13
Retirement Fund 2045	62	66	91	100	10	9	11	9
Retirement Fund 2050	56	61	87	100	6	7	10	5
Retirement Fund 2055	56	63	89	100	7	8	11	6

Sources: Bloomberg Index Services Ltd.; MSCI; Russell (see footnote 1); and T. Rowe Price. Data analysis by T. Rowe Price.**(Fig. 6) Active Success Rates and Value Added by Security Selection**Fund Inceptions Through
December 31, 2018

Fund	Active Success Rates				Average Annualized Value Added (Basis Points)			
	Rolling Periods				Rolling Periods			
	1-Year	3-Year	5-Year	10-Year	1-Year	3-Year	5-Year	10-Year
Retirement Fund 2005	51%	45%	61%	100%	17	17	22	22
Retirement Fund 2010	53	51	60	100	11	15	18	22
Retirement Fund 2015	61	77	87	100	27	25	30	30
Retirement Fund 2020	61	76	89	100	26	28	31	35
Retirement Fund 2025	65	83	100	100	42	37	43	42
Retirement Fund 2030	61	83	94	100	40	39	43	47
Retirement Fund 2035	65	87	100	100	55	48	55	54
Retirement Fund 2040	61	84	94	100	46	45	50	53
Retirement Fund 2045	64	86	100	100	60	52	58	58
Retirement Fund 2050	63	89	100	100	62	57	54	59
Retirement Fund 2055	63	89	100	100	62	57	54	59

Sources: Bloomberg Index Services Ltd.; MSCI; Standard & Poor's (see Important Information); Russell (see footnote 1); J.P. Morgan²; Credit Suisse³; and T. Rowe Price; Data analysis by T. Rowe Price.

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(Fig. 7) Active Success Rates and Value Added by Total ImplementationFund Inceptions Through
December 31, 2018

Fund	Active Success Rates				Average Annualized Value Added (Basis Points)			
	Rolling Periods				Rolling Periods			
	1-Year	3-Year	5-Year	10-Year	1-Year	3-Year	5-Year	10-Year
Retirement Fund 2005	62%	76%	82%	100%	47	39	46	45
Retirement Fund 2010	65	76	81	100	51	40	39	44
Retirement Fund 2015	62	78	84	100	51	38	44	43
Retirement Fund 2020	63	79	84	100	60	46	44	49
Retirement Fund 2025	59	80	86	100	55	39	45	44
Retirement Fund 2030	64	85	87	100	59	46	45	50
Retirement Fund 2035	61	83	87	100	56	39	47	45
Retirement Fund 2040	63	83	87	100	57	45	45	49
Retirement Fund 2045	55	79	88	100	51	36	46	43
Retirement Fund 2050	53	82	85	100	48	44	41	42
Retirement Fund 2055	53	83	85	100	48	44	41	42

Sources: Bloomberg Index Services Ltd.; MSCI; Russell (see footnote 1); and T. Rowe Price. Data analysis by T. Rowe Price.

(Fig. 8) Excess Returns Contributed by Out-of-Benchmark Allocations (Basis Points)Fund Inceptions Through
December 31, 2018Sources: Bloomberg Index Services
Ltd.; MSCI; Russell (see footnote 1);
J.P. Morgan (see footnote 2);
Credit Suisse (see footnote 3);
and T. Rowe Price. Data analysis
by T. Rowe Price.

Fund	Rolling Periods			
	1-Year	3-Year	5-Year	10-Year
Retirement Fund 2005	9	-4	0	-1
Retirement Fund 2010	20	4	-1	1
Retirement Fund 2015	7	-6	-6	-7
Retirement Fund 2020	16	-1	-7	-5
Retirement Fund 2025	-1	-13	-13	-14
Retirement Fund 2030	4	-8	-13	-11
Retirement Fund 2035	-8	-18	-18	-18
Retirement Fund 2040	-2	-12	-16	-15
Retirement Fund 2045	-17	-23	-20	-22
Retirement Fund 2050	-19	-18	-22	-20
Retirement Fund 2055	-19	-19	-22	-20

**T. Rowe Price Combined
Index Benchmarks**

Because glide-path effects—such as the level of equity exposure—can heavily influence relative performance versus third-party indexes, T. Rowe Price has created combined index performance benchmarks for its Retirement Funds. These benchmarks are constructed from four indexes that reflect the broad asset classes in the underlying RF portfolios:

- U.S. Equity: Russell 3000 Index.
- Non-U.S. Equity: MSCI All Country World Index ex USA.

- Fixed Income: Bloomberg Barclays U.S. Aggregate Bond Index.
- Inflation Focused Fixed Income: Bloomberg Barclays 1–5 Year TIPS Index.

The relative weights of these asset class indexes in the T. Rowe Price combined index benchmarks reflect where each RF stands on its glide path. Comparing RF performance with the performance of the combined index benchmarks enables us to quantify the total contribution to RF performance from T. Rowe Price implementation, including both tactical asset allocation at the RF level and excess returns achieved by the underlying funds.

The real assets component within equities and the international bond (U.S. dollar hedged and unhedged), dynamic global bond, high yield, floating rate, emerging markets bond, and long-term U.S. Treasury components within fixed income are not represented in the indexes used to create the T. Rowe Price combined index benchmarks. These out-of-benchmark allocations may materially affect RF excess returns relative to the combined index benchmarks. Excess returns attributable to out-of-benchmark assets are included in the results shown in Figure 7 but are not broken out separately. A table showing the aggregate contribution of out-of-benchmark assets (positive or negative) to RF performance can be found in Figure 8.

Tactical Asset Allocation

Actual returns for the underlying T. Rowe Price funds in the RF portfolios, net of fees and costs, were used to calculate returns for each RF based on the strategic allocation weights in the RF glide path. These returns were then compared with actual RF returns, which reflected tactical allocation changes designed to take advantage of shorter-term valuation anomalies and other market opportunities. This comparison enabled us to isolate the contribution to performance made by the tactical allocation decisions.

Security Selection

Historical returns, net of fees and other costs, for the underlying T. Rowe Price funds in the Retirement Fund portfolios were measured relative to their specific asset class, sector, or style benchmarks. One of these underlying funds, the Equity Index 500 Fund, is a passively managed U.S. large-cap fund with an investment objective of tracking the performance of the S&P 500 Index. The other funds are all actively managed investment vehicles.

The indexes used to calculate excess returns in this analysis were the style-appropriate benchmarks used by the T. Rowe Price Asset Allocation Committee to evaluate the performance of the underlying funds in the RF portfolios (see Figure 9). Because T. Rowe Price does not charge an overlay fee on its target date funds, and excess returns for the underlying portfolio funds are based on daily net asset values (i.e., net of costs), all of the RF performance numbers shown in our study

represent the true after-cost results for investors. Returns were based on reported net asset values and SEC standardized returns for the underlying funds from which management fees and operating expenses were subtracted. In other words, returns for the underlying funds were based on the after-cost performance of the Investor Class for each underlying fund, which is the class invested in by the Retirement Funds.

Excess returns for the underlying funds were aggregated for each rolling period to show the total contribution (positive or negative) made to the performance of each RF by security selection. Active success rates for positive aggregate return contributions (i.e., value added) and average aggregate excess returns (annualized) were calculated for each 1-, 3-, 5-, and 10-year time frame for each RF. Returns on the underlying funds were included in these aggregate performance calculations as of the date of their addition to the RF portfolio (see Figure 3). Those calculations reflected the changing weights for the underlying funds as the RFs moved along their glide paths.

Performance Averages

To provide a high-level summary of the effectiveness of T. Rowe Price's target date process, we calculated performance averages for all 11 RFs in the study across all three of the metrics used in our analysis. Average performance over rolling 1-, 3-, 5-, and 10-year periods since RF inception can be found in Figures 10, 11, and 12. To account for the differing inception dates (and thus, longevities) of each fund, these averages were time weighted—that is, the results were based on the percentage of the total performance periods in each time frame provided by each fund. Weights for each fund in each time frame are shown in Figure 13. Overall, time weighting had relatively little impact on average performance results.

Data Sources

Fund and benchmark return data were taken from T. Rowe Price's internal performance database, which is used by the firm to calculate returns for quarterly, semiannual, and annual client reports; marketing materials; and regulatory disclosures. Benchmark returns in the T. Rowe Price database are collected from index managers. All results were based on total returns, including dividends reinvested.

(Fig. 9)

As of December 31, 2018

Source: Sources: T. Rowe Price; Bloomberg Index Services Ltd.; MSCI; Standard & Poor's; S&P/LSTA (See Important Information); Russell (see footnote 1); J.P. Morgan (see footnote 2); Credit Suisse (see footnote 3); Wilshire.⁴ Data analysis by T. Rowe Price.

* Not included: U.S. Treasury Money Fund.

** The indexes shown here are the style-appropriate benchmarks used to calculate the active performance of the firm's target date portfolios. For the International Stock Fund (ISF) and the International Value Equity Fund (IVE), these benchmarks differ from the indexes used by the funds for their own performance reporting. The standard benchmark for the ISF is the MSCI All Country World Index ex USA (Net). The standard benchmark for the IVE is the MSCI EAFE Index (Net).

*** Effective May 1, 2011, the benchmark was changed to the Bloomberg Barclays U.S. 1-5 Year Treasury TIPS Index. For time periods prior to this date, returns are measured against a linked performance benchmark composed of 100% Citigroup 3-Month Treasury Bill Index.

Benchmarks for Underlying T. Rowe Price Funds*

Table with 2 columns: Fund, Benchmark. Categories include U.S. Equity, Non-U.S. Equity, Fixed Income, and Other. Lists various fund types and their corresponding benchmark indices.

**** As of December 31, 2018, the Real Assets Fund's combined index portfolio was composed of 25% MSCI All Country World Index Metals & Mining, 20% Wilshire RESI, 20% FTSE EPRA/NAREIT Developed Real Estate Index, 19.5% MSCI All Country World Index Energy, 10.5% MSCI All Country World Index Materials, 4% MSCI All Country World Index IMI Gold, and 1% MSCI All Country World Index IMI Precious Metals and Minerals. Prior to December 1, 2013, the Real Assets Fund's combined index portfolio was composed of 25% MSCI All Country World Index Metals & Mining, 20% Wilshire RESI, 20% FTSE EPRA/NAREIT Developed Real Estate Index, 16.25% MSCI All Country World Index Energy, 8.75% MSCI All Country World Index Materials, 5% UBS World Infrastructure and Utilities Index, 4% MSCI All Country World Index IMI Gold, and 1% MSCI All Country World Index IMI Precious Metals and Minerals.

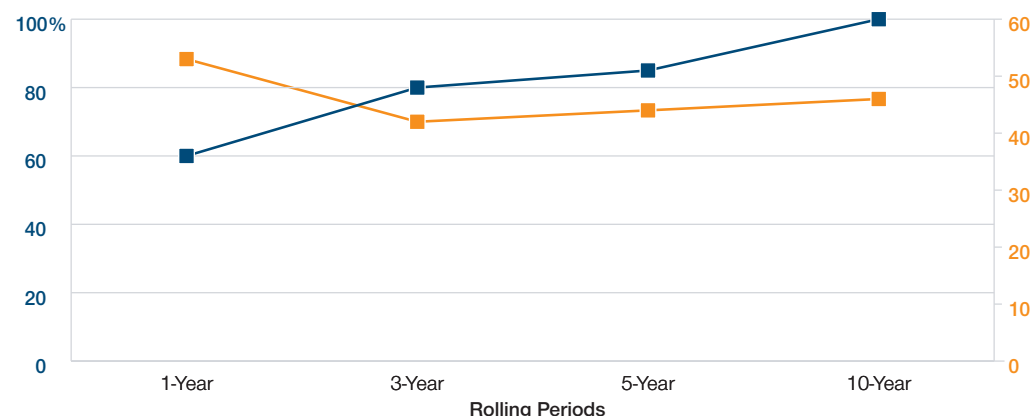
(Fig. 10)

Fund Inceptions Through December 31, 2018

Sources: Bloomberg Index Services Ltd.; MSCI; Russell (see footnote 1); and T. Rowe Price. Data analysis by T. Rowe Price.

Active Success Rates (Left Axis)
Value Added in Basis Points (Right Axis)

Time-Weighted Average Active Success Rates and Value Added by Total Implementation



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(Fig. 11)

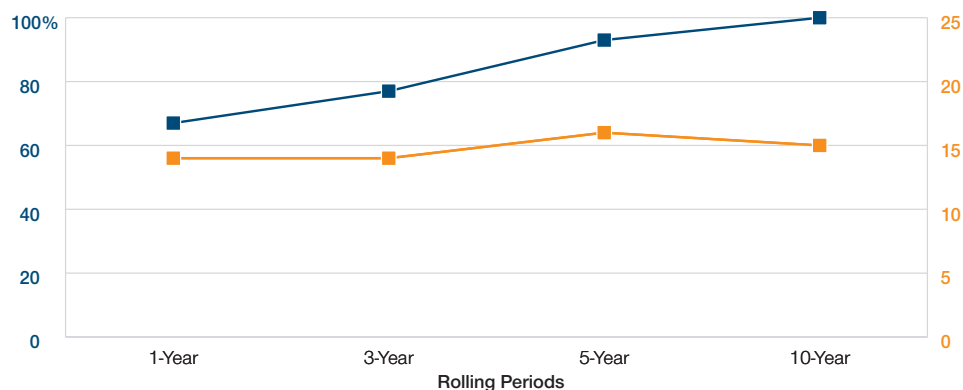
Fund Inceptions Through
December 31, 2018

Sources: Bloomberg Index Services
Ltd.; MSCI; Russell (see footnote 1);
and T. Rowe Price. Data analysis by
T. Rowe Price.

Active Success Rates ■
(Left Axis)

Value Added in Basis Points ■
(Right Axis)

Time-Weighted Average Active Success Rates and Value Added by Tactical Asset Allocation



(Fig. 12)

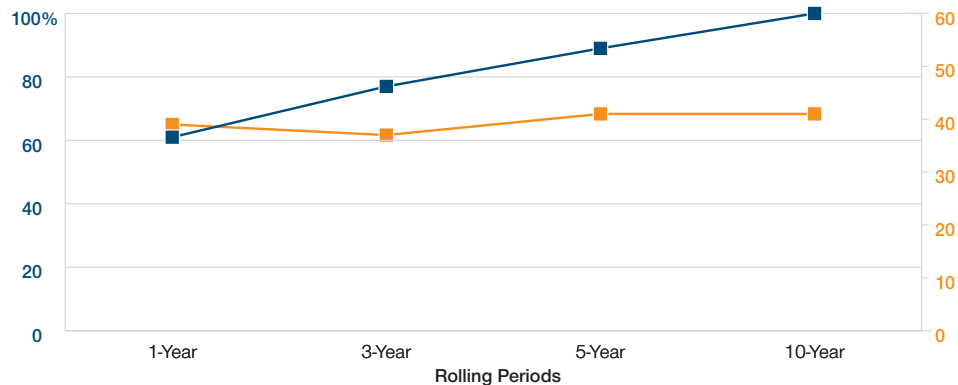
Fund Inceptions Through
December 31, 2018

Sources: Bloomberg Index Services
Ltd.; MSCI; Russell (see footnote 1);
J.P. Morgan (see footnote 2); Credit
Suisse (see footnote 3); and T. Rowe
Price. Data analysis by T. Rowe Price.

Active Success Rates ■
(Left Axis)

Value Added in Basis Points ■
(Right Axis)

Time-Weighted Average Active Success Rates and Value Added by Security Selection



(Fig. 13)

Percentage of Total Rolling
Performance Periods

Source: T. Rowe Price.

Time Weights Used in Performance Averages

Fund	1-Year	3-Year	5-Year	10-Year
Retirement Fund 2005	9.35%	8.65%	8.83%	9.31%
Retirement Fund 2010	10.89	9.69	10.02	11.99
Retirement Fund 2015	9.44	8.97	9.11	9.31
Retirement Fund 2020	10.53	10.09	10.38	11.99
Retirement Fund 2025	8.98	9.21	9.29	9.31
Retirement Fund 2030	10.71	10.89	10.75	11.99
Retirement Fund 2035	9.26	9.45	9.47	9.31
Retirement Fund 2040	10.53	10.65	10.75	11.99
Retirement Fund 2045	7.53	8.09	8.29	6.94
Retirement Fund 2050	6.44	7.13	6.56	3.94
Retirement Fund 2055	6.35	7.21	6.56	3.94

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