S&P Dow Jones Indices

A Division of S&P Global

Index Education

Blending Factors in Your Smart Beta Portfolio

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In recent years, smart beta strategies have seen a significant increase in popularity. These systematic strategies seek to measure factors in order to harvest the associated long-term risk premium. Many empirical studies show that smart beta strategies have historically outperformed their cap-weighted benchmarks. However, different single factors tend to outperform in different market environments.[1] Therefore, holding a combination of factor strategies in a blended portfolio could provide a powerful source of diversification and more stable excess returns.

This paper briefly reviews the definition and performance characteristics of the S&P 500® Single-Factor Indices, demonstrates their historical cyclicality and correlation, and presents a few examples of how market participants could potentially use investment vehicles tracking these single-factor indices as part of their own factor allocation, either as strategic or tactical plays. These examples expand the traditional asset allocation frameworks to factors, including optimal allocation frameworks, heuristic allocation frameworks, and a trend-based timing framework.

1. SINGLE FACTORS

The S&P Single-Factor Indices comprise four key factors: low volatility, momentum, value, and quality. A rules-based selection and non-market-cap-weighting approach is used to construct the indices, and diversification and investability are taken into consideration.

The indices are constructed from the universe of S&P Dow Jones Indices' (S&P DJI) headline global indices, including the S&P 500, S&P Europe 350®, S&P Global BMI, and regional and country benchmarks. Approximately one-fifth of the universe is selected by applying liquidity criteria. The constituents are then weighted two ways: by the inverse of volatility in the case of low volatility indices, and by the product of factor score and market cap for the momentum, value, and quality factors. The indices are rebalanced semiannually except for the low volatility indices,

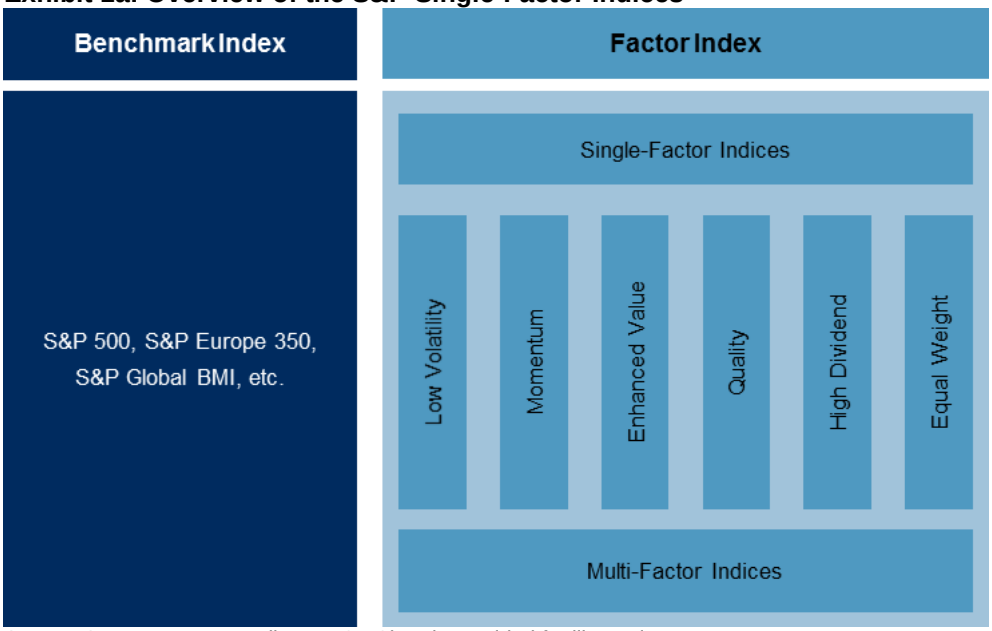
[1] Harvey (1989); Asness (1992); Cohen, Polk, and Vuolteenaho (2003).
Harvey, C. R., "Time-Varying Conditional Covariances in Tests of Asset Pricing Models," *Journal of Financial Economics*, Vol. 24 (1989), pp. 289-317.
Asness, C., "Changing Equity Risk Premia and Changing Betas over the Business Cycle and January," University of Chicago Working Paper (1992).
Cohen, R.B., C. Polk, and T. Vuolteenaho, "The Value Spread," *Journal of Finance*, Vol. 58, No. 2 (2003), pp. 609-642.

some of which are rebalanced quarterly. Exhibit 1a provides an overview of the S&P Single-Factor Indices.

A blended factor portfolio could provide diversification and more stable excess return.

In this paper, we will focus on the S&P 500 Single-Factor Indices. Exhibit 1b provides the description of the four long-only, single-factor indices, together with a dividend index and an equal-weight index, built on the S&P 500 universe.

Exhibit 1a: Overview of the S&P Single-Factor Indices



Source: S&P Dow Jones Indices LLC. Chart is provided for illustrative purposes.

The S&P 500 Single-Factor Indices comprise four key factors: low volatility, momentum, value, and quality.

Exhibit 2b: Overview of the S&P 500 Single-Factor Indices

FACTOR	INDEX	DESCRIPTION
Low Volatility	S&P 500 Low Volatility Index	The 100 least volatile stocks in the S&P 500, weighted by inverse volatility
Momentum	S&P 500 Momentum	The 100 companies in the S&P 500 that exhibit persistence in their relative performance, weighted by momentum score times market cap
Value	S&P 500 Enhanced Value Index	The 100 companies in the S&P 500 with low price multiple ratios (price-to-book, price-to-earnings, and price-to-sales), weighted by value score times market cap
Quality	S&P 500 Quality Index	The 100 companies in the S&P 500 with high quality scores, weighted by quality score times market cap. Quality score is calculated based on return on equity, accruals ratio, and financial leverage ratio.
Dividend	S&P 500 High Dividend Index	The 80 highest-yielding companies in the S&P 500, equally weighted
Size	S&P 500 Equal Weight Index	The 500 companies in the S&P 500, equally weighted

Source: S&P Dow Jones Indices LLC. Table is provided for illustrative purposes.

The full-sample-period risk/return profile of the S&P 500 Single-Factor Indices is shown in Exhibits 2 and 3. Although a single-period snapshot could introduce bias into analysis due to the cyclicality of the factors, this

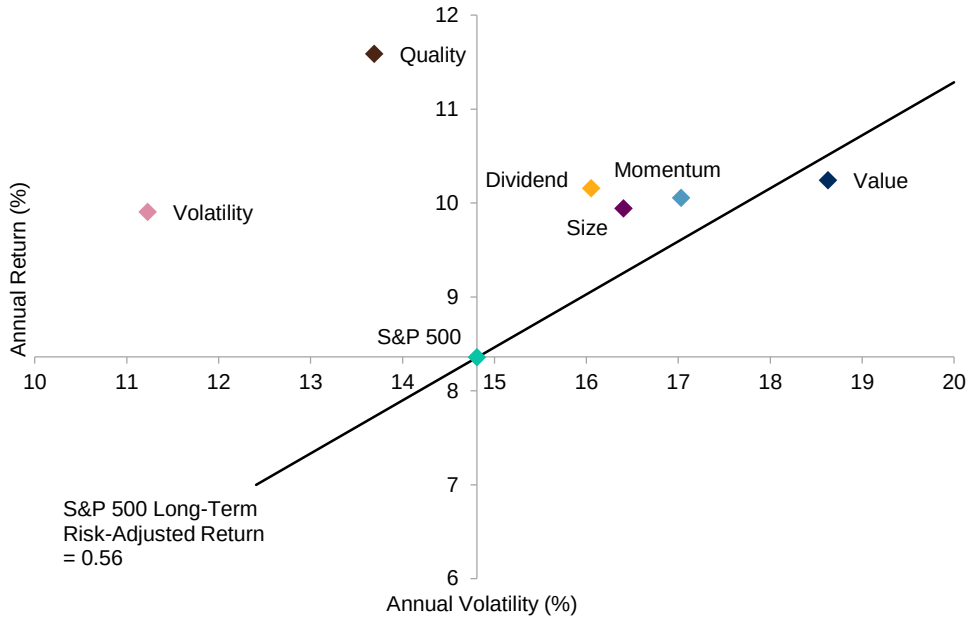
sample period of more than 20 years should be long enough to mitigate some endpoint effects.

Most factor strategies offered better returns than the benchmark.

Over the period from Dec. 31, 1994, to Dec. 31, 2018, all six single-factor indices outperformed the S&P 500. Of the six indices, the S&P 500 Low Volatility Index and S&P 500 Quality Index had lower total risk than the benchmark over the period. Five of the factor strategies offered better returns per unit of risk when compared with the benchmark; the only exception was the S&P 500 Enhanced Value Index. The S&P 500 Low Volatility Index had the highest risk-adjusted return and the S&P 500 Quality Index had the highest information ratio. Historically, the low volatility, dividend, and quality factors have been defensive, while enhanced value, momentum, and size have been procyclical, which is evident from the upside and downside capture ratios (see Exhibit 4).

Exhibit 3: Full-Period Risk/Return Profile of the S&P 500 Single-Factor Indices

Different factors have been either defensive or procyclical.



Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1995, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Factor indices can underperform the benchmark for extended periods of time…

…and seem to follow unique cycles, having little correlation with each other.

Exhibit 4: Statistical Summary of the S&P 500 Single-Factor Indices

RETURN CHARACTERISTICS	DEFENSIVE			PROCYCLICAL			S&P 500
	S&P 500 LOW VOLATILITY INDEX	S&P 500 QUALITY INDEX	S&P 500 HIGH DIVIDEND INDEX	S&P 500 MOMENTUM	S&P 500 ENHANCED VALUE INDEX	S&P 500 EQUAL WEIGHT INDEX	
Monthly Alpha to S&P 500 (%)	0.41	0.33	0.29	0.17	0.14	0.11	-
Beta to S&P 500	0.56	0.87	0.82	0.98	1.08	1.05	-
Correlation With S&P 500	0.74	0.94	0.75	0.85	0.86	0.95	-
Annual Return (%)	9.90	11.59	10.15	10.05	10.24	9.94	8.36
Annual Volatility (%)	11.23	13.69	16.06	17.03	18.63	16.40	14.81
Annual Risk-Adjusted Return	0.88	0.85	0.63	0.59	0.55	0.61	0.56
Annual Excess Return (%)	1.55	3.23	1.80	1.69	1.88	1.58	-
Annual Tracking Error (%)	10.00	5.02	10.92	8.87	9.55	5.40	-
Information Ratio	0.15	0.64	0.16	0.19	0.20	0.29	-
Maximum Drawdown (%)	-35.36	-44.40	-66.31	-59.94	-67.86	-54.88	-50.95
MAR	0.28	0.26	0.15	0.17	0.15	0.18	0.16
Upside Capture	0.65	0.96	0.86	1.08	1.12	1.08	-
Downside Capture	0.52	0.81	0.77	1.00	1.03	1.01	-

Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1995, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. The annual risk-adjusted return is calculated as the annual return divided by the annual volatility. The information ratio is calculated as the annual excess return divided by annual tracking error. The MAR ratio measures the annualized return over the maximum drawdown over the measurement period.

2. WHY BLEND FACTORS?

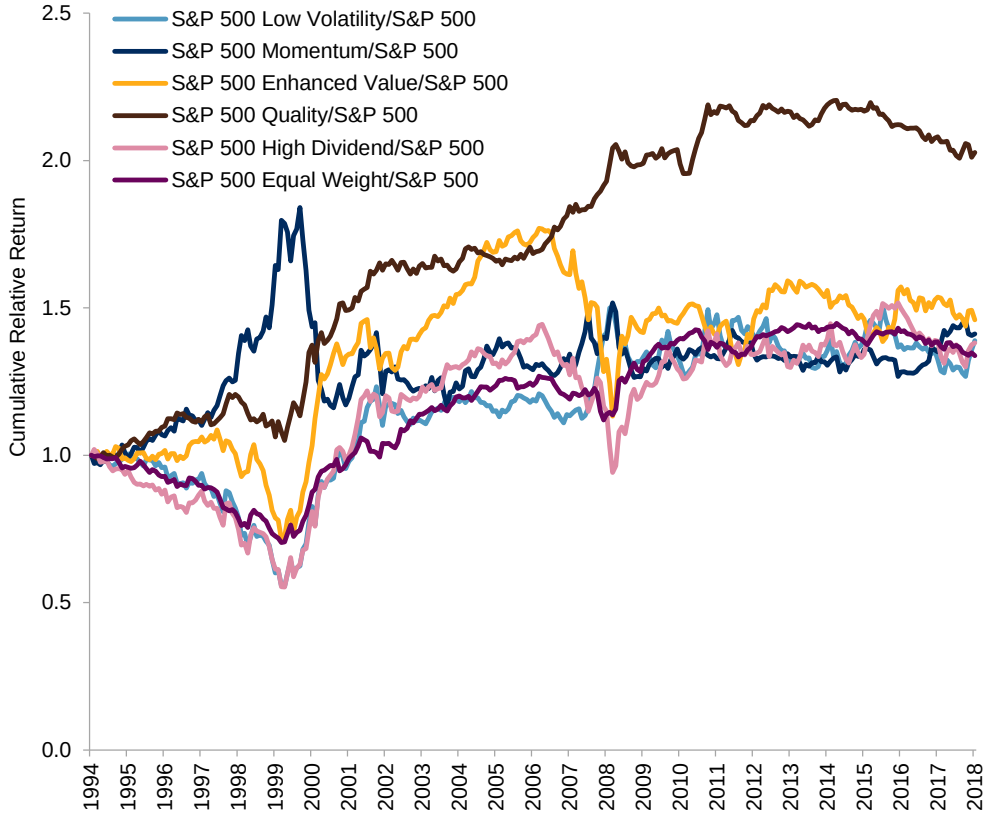
Factor indices can underperform their benchmark index for extended periods of time, but they seem to follow unique cycles and have little correlation with each other. As a result, diversifying factor exposure can reduce the effect of underperforming factor cycles, and increase the opportunity of outperformance for market participants with shorter horizons.

Diversifying factor exposure can reduce the effect of underperforming factor cycles.

2.1 Factor Cycles Exist

To illustrate factor cycles, Exhibit 4 shows the cumulative return of the six S&P 500 Single-Factor Indices relative to the S&P 500. When the cumulative relative return line slopes upward, it shows that the factor index is outperforming, and vice versa.

Exhibit 5: Cumulative Relative Performance of the S&P 500 Single-Factor Indices



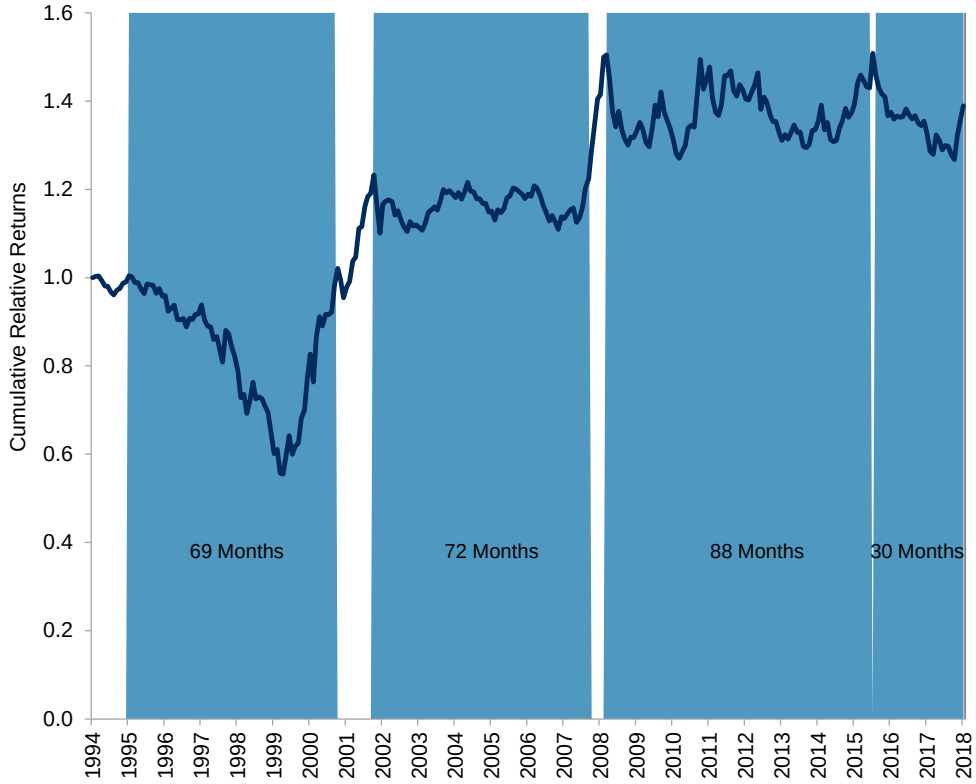
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1994, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Although the factor indices experienced long cyclical drawdowns…

…their cycles were generally unique, with different lengths and different peak and trough dates.

For example, the S&P 500 Low Volatility Index outperformed the benchmark (see Exhibit 5). However, it also underperformed the benchmark during protracted periods. The cumulative relative return peaked in September 2002 in the aftermath of the "internet bubble." It then began to drop before recovering over the next 72 months and then reached its peak again in August 2008. We see a similar period from February 2009 to March 2016, during which the index did not outperform its benchmark. In the 69-month period from December 1995 to August 2001, the S&P 500 Low Volatility Index experienced long cyclical drawdowns. It should be noted that over those periods, the risk reduction relative to the benchmark was significant. Similar periods of over- and underperformance can be seen in other factor indices over the 20-year period (see Exhibits 12-16 in the Appendix).

Exhibit 6: The S&P 500 Low Volatility Index/S&P 500



Notes: Shaded areas represent time course for recovery of peak for the cumulative relative return.
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1994, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Factors are driven by different market anomalies and tend to pay off at different times.

2.2 Correlations Low but Stable

Although the factor indices experienced long cyclical drawdowns, their cycles were generally unique, with different lengths and different peak and trough dates (see Exhibit 4). This is because factors are driven by different market anomalies and tend to pay off at different times of the market cycle, economic cycle, and investment sentiment regime.[2]

Low correlations among factors were stable even in times of crisis.

We present the long-term correlations in excess returns of the S&P 500 Single-Factor Indices in Exhibit 6. It shows that, with only a few exceptions, most of the factor indices had low correlations that were negative or close to zero over the period from Dec. 31, 1995, to Dec. 31, 2018.

Exhibit 6 also illustrates the factor correlation during the financial crisis of 2008-2009. It is worth noting that the low correlations among factors were stable even in times of crisis, when asset class correlations often converged toward one.

[2] Ung, Daniel and Priscilla Luk, "What Is in Your Smart Beta Portfolio? A Fundamental and Macroeconomic Analysis," 2016.

Exhibit 6: Pairwise Correlation of Single-Factor Excess Returns

STRATEGY	DEFENSIVE			PROCYCLICAL		
	LOW VOLATILITY	QUALITY	DIVIDEND	MOMENTUM	VALUE	SIZE
PERIOD FROM DEC. 31, 1995, TO DEC. 31, 2018						
Low Volatility	-	0.45	0.67	-0.25	0.18	0.23
Quality	0.45	-	0.16	-0.15	-0.02	0.00
Dividend	0.67	0.16	-	-0.50	0.59	0.59
Momentum	-0.25	-0.15	-0.50	-	-0.47	-0.47
Value	0.18	-0.02	0.59	-0.47	-	0.72
Size	0.23	0.00	0.59	-0.47	0.72	-
PERIOD FROM DEC. 31, 2007, TO DEC. 31, 2009						
Low Volatility	-	0.57	-0.54	0.42	-0.66	-0.65
Quality	0.57	-	-0.72	0.53	-0.62	-0.38
Dividend	-0.54	-0.72	-	-0.83	0.82	0.67
Momentum	0.42	0.53	-0.83	-	-0.82	-0.61
Value	-0.66	-0.62	0.82	-0.82	-	0.76
Size	-0.65	-0.38	0.67	-0.61	0.76	-

Source: S&P Dow Jones Indices LLC. Index performance based on total return in USD. Data from Dec. 31, 1995, to Dec. 31, 2018. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Liquidity requirements, investment horizon, volatility, drawdowns, turnover, and factor cycle lengths can be important.

3. STRATEGIC FACTOR ALLOCATION

Strategic allocation to factors requires the consideration of a variety of variables, and the expected return is only one of them. Liquidity requirements, investment horizon, volatility, drawdowns, turnover, and factor cycle lengths can be important, depending on risk appetite.

In this section, we focus on three variables in the context of strategic factor allocation: return, volatility, and tracking error. We expand some of the traditional asset allocation frameworks to factors in order to study how market participant objectives affect allocation.

3.1 Optimal Allocation Approaches

Recognition that many investors evaluate performance relative to a benchmark led to the idea of portfolio selection based on return and relative risk.

Markowitz introduced the concept of portfolio selection based on return and variance.[3] Evaluating performance relative to a benchmark led to the idea of portfolio selection based on return and relative risk. Benchmarks are important, but the variance of absolute return requires attention as well.

We examine the optimal multi-factor portfolios by applying full-period, in-sample mean-variance optimizations (MVOs) and two extensions to the

[3] Markowitz, Harry, "Portfolio Selection", *The Journal of Finance*, Vol. 7, No. 1, (March 1952), pp. 77-91.

mean-variance approaches. The objective functions are presented in Exhibit 7. The mean-tracking error (MTE) approach optimizes mean return against tracking error rather than variance. The mean-variance-tracking error (MVTE) approach adds a tracking risk penalty to the MVO objective function.

When using the MVO method to target maximum Sharpe ratio…

Exhibit 7: Overview of the Optimization Methods

ABBREVIATION	MODEL	UTILITY FUNCTION	SOURCE
MVO	Mean-Variance Optimization	$\text{Expected Return} - \text{Risk Tolerance} * \text{Variance}$	Markowitz (1952)
MTE	Mean-Tracking Error Optimization	$\text{Expected Return} - \text{Tracking Error Tolerance} * \text{Expected Tracking Error}^2$	Roll (1992)
MVTE	Mean-Variance-Tracking Error Optimization	$\text{Expected Return} - \text{Tracking Error Tolerance} * \text{Expected Tracking Error}^2 - \text{Risk Tolerance} * \text{Expected Variance}$	Chow (1995)

Source: S&P Dow Jones Indices LLC. Table is provided for illustrative purposes.

…maximized utility was achieved with 55% to low volatility, 43% to quality, and 2% to momentum.

The optimization results are presented in Exhibits 8 and 9. The maximized utility was achieved with 55% allocation to low volatility, 43% allocation to quality, and 2% to momentum when using the MVO method to target maximum Sharpe ratio. On the other hand, the optimal allocation was 44% to quality, 24% to size, 23% to momentum, 7% to value, and 1% to dividend when the MTE approach was used to target maximum information ratio.

When using the MTE approach to target maximum information ratio…

…the optimal allocation was 44% to quality, 24% to size, 23% to momentum, 7% to value, and 1% to dividend.

Factor allocation can change as market participants' objectives change.

Exhibit 8: Full-Period, In-Sample Optimization Results

ALLOCATION	MVO (MAXIMUM SHARPE RATIO)	MTE (MAXIMUM INFORMATION RATIO	MVTE*	S&P 500
S&P 500 Low Volatility Index	0.55	-	0.33	-
S&P 500 Momentum	0.02	0.23	0.14	-
S&P 500 Enhanced Value Index		0.07	-	-
S&P 500 Quality Index	0.43	0.44	0.53	-
S&P 500 High Dividend Index	-	0.01	-	-
S&P 500 Equal Weight Index	-	0.24	-	-
RETURN CHARACTERISTICS				
Monthly Alpha to S&P 500 (%)	0.37	0.23	0.34	-
Beta to S&P 500	0.70	0.95	0.78	-
Correlation With S&P 500	0.90	0.98	0.95	-
Annual Return (%)	10.75	10.92	11.00	8.36
Annual Volatility (%)	11.56	14.37	12.19	14.81
Annual Risk-Adjusted Return	0.93	0.76	0.90	0.56
Annual Excess Return (%)	2.40	2.57	2.64	-
Annual Tracking Error (%)	6.73	2.74	4.95	-
Information Ratio	0.36	0.94	0.53	-
Maximum Drawdown (%)	-38.57	-48.63	-40.83	-50.95
MAR	0.28	0.22	0.27	0.16
Upside Capture	0.79	1.03	0.87	-
Downside Capture	0.65	0.92	0.74	-

Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1995, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. *Assume same level of risk tolerance and tracking error tolerance. For this analysis, a risk tolerance factor of 0.03185 was used, which corresponds to the maximum Sharpe ratio portfolio in the MVO. We assume long-only portfolios, no leverage, and monthly rebalancing.

There was always some allocation to momentum, ranging from 4% to 24%...

This implies that the factor allocation should change as market participants' objectives change—whether they are seeking broad exposure across multiple rewarded factors to enhance risk-adjusted returns, blending factors to improve diversification and reduce tracking error to the benchmark, or both.

…as momentum tends to provide a diversification benefit given its negative correlation to low volatility and quality.

Exhibit 9 illustrates this point by varying the tolerance to risk relative to tracking error. As the penalty to tracking error increased, more weight was allocated to quality. When the penalty to risk increased, a higher allocation to low volatility was desired.

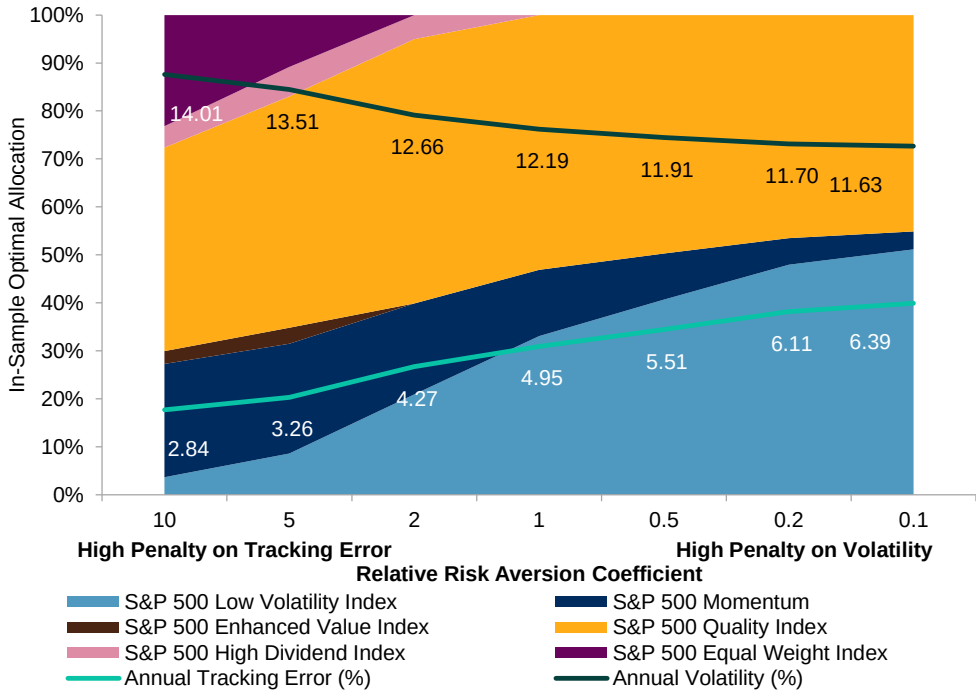
There was always some allocation to momentum, ranging from 4% to 24%, as momentum tends to provide a diversification benefit given its negative correlation to low volatility and quality. Note that the only constraints we applied here were long-only allocation and no leverage. This approach may not be preferred by many market participants.

All the optimized portfolios outperformed the benchmark and earned annual excess returns ranging from 2.4% to 2.7% over the period studied. There was a tradeoff between tracking error and volatility. When MVO was used to target maximum Sharpe ratio, the portfolio volatility was 11.6% and the tracking error was 6.7%. When MTE was used to target maximum information ratio, the portfolio tracking error was as low as 2.7%, while volatility was 14.4%.

As the penalty to tracking error increases, higher weight is allocated to quality.

When the penalty to risk increases, a higher allocation to low volatility is desired.

Exhibit 9: MVTE Optimal Allocation with Different Relative Risk Tolerance



Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1995, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Assume same level of risk tolerance and tracking error tolerance. We assume long-only portfolios, no leverage, and monthly rebalancing.

3.2 Heuristic Allocation Approaches

Asset allocation can use heuristic methods like equal-weighted, risk parity, and relative risk parity portfolios.

Although MVO has been widely used to manage asset portfolios and to build strategic asset allocations, some argue that it faces serious stability issues. Alternatively, asset allocation can use heuristic methods like equal-weighted, risk parity, and relative risk parity portfolios. These portfolios are special cases of a more general allocation approach based on risk budgeting methods.

To illustrate, we built three hypothetical portfolios from the S&P 500 Single-Factor Indices by using three heuristic approaches. The equal-weight portfolio allocates 16.7% to each of the factor indices. In the risk parity portfolio, the weight of each factor index is proportional to the inverse of its full-period volatility. In the relative risk parity portfolio, the weight of each

factor index is proportional to the inverse of its full-period tracking error against the S&P 500.

Tactical factor allocation is a useful tool to get the right exposure at the right time.

The results are presented in Exhibit 10. From Dec. 31, 1995, to Dec. 31, 2018, the three hypothetical portfolios outperformed the S&P 500, with an annual excess return of about 2.3% and a tracking error ranging from 3.9% to 4.6%. The annual risk-adjusted returns were improved by 20 bps to 22 bps. In terms of drawdowns, these portfolios had levels similar to those of the S&P 500.

Only the portfolio constructed using the worst-performing factor underperformed the S&P 500 over the full period.

All others outperformed.

Exhibit 10: Factor Allocation Results Using Heuristic Approaches

ALLOCATION	EQUAL WEIGHT	RISK PARITY	RELATIVE RISK PARITY	S&P 500
S&P 500 Low Volatility Index	0.17	0.23	0.13	-
S&P 500 Momentum	0.17	0.15	0.14	-
S&P 500 Enhanced Value Index	0.17	0.13	0.13	-
S&P 500 Quality Index	0.17	0.18	0.25	-
S&P 500 High Dividend Index	0.17	0.16	0.12	-
S&P 500 Equal Weight Index	0.17	0.15	0.23	-
RETURN CHARACTERISTICS				
Monthly Alpha to S&P 500 (%)	0.24	0.26	0.24	-
Beta to S&P 500	0.89	0.86	0.91	-
Correlation with S&P 500	0.95	0.95	0.97	-
Annual Return (%)	10.61	10.62	10.69	8.36
Annual Volatility (%)	13.85	13.46	13.96	14.81
Annual Risk-Adjusted Return	0.77	0.79	0.77	0.56
Annual Excess Return (%)	2.26	2.26	2.33	-
Annual Tracking Error (%)	4.41	4.62	3.89	-
Information Ratio	0.51	0.49	0.60	-
Maximum Drawdown (%)	-52.42	-50.80	-51.13	-50.95
MAR	0.20	0.21	0.21	0.16
Upside Capture	0.96	0.94	0.98	-
Downside Capture	0.86	0.83	0.87	-

Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1995, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

4. TACTICAL FACTOR ALLOCATION

The distinct cyclicality of factor returns provides great temptation for timing exposures. Indeed, factor strategies may provide a useful tactical tool to get the right exposure at the right time. Though it is difficult to predict exactly when a specific strategy is likely to out- or underperform the market-cap-weighted index, timing questions should not be ignored.

4.1 Trend-Driven Factor Allocation

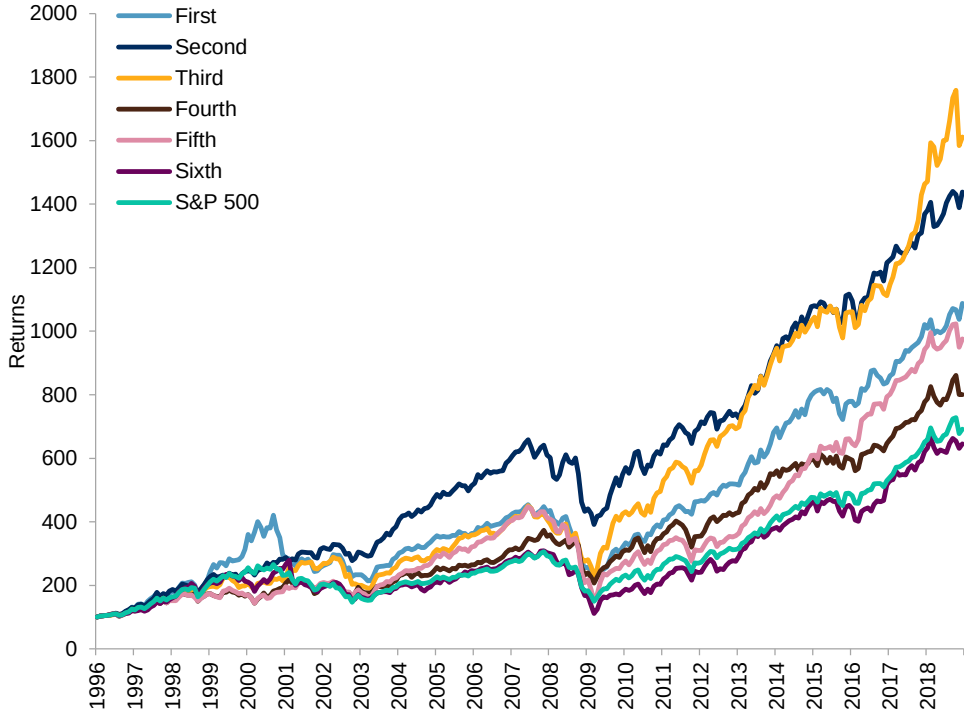
One approach is to apply a trend-following model to select factors. The goal is to utilize the past momentum signal as the basis for deciding which factors are in favor in the market.

We calculated the 12-month cumulative returns, excluding the most recent month, adjusted by the volatility during the same period of each of the S&P 500 Single-Factor Indices. This strategy allocates 100% of the weight to the best-performing factor and rebalances every quarter. In the same manner, we also built four other portfolios by allocating 100% weight to the second-best-performing factor, the third, the fourth, and the worst-performing factor.

The results of the trend-following factor selection model are shown in Exhibits 11a and 11b. Only the portfolio constructed using the worst-performing factor underperformed the S&P 500 over the full period; all others outperformed in absolute terms. It might make sense to avoid the factor with poor recent performance. The momentum factor did not seem to signal future performance in a linear way. The portfolio constructed using the second-best-performing factor had the highest return, risk-adjusted return, and information ratio over the period studied.

The portfolio constructed using the second-best-performing factor had the highest return, risk-adjusted return, and information ratio.

Exhibit 11a: Results of Trend-Following Factor Rotation Model with 12-Month Lookback Period and Quarterly Rebalancing



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1996, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

The pairwise correlations among factors were low, even during crises…

Exhibit 11b: Results of Trend-Following Factor Rotation Model with 12-Month Lookback Period and Quarterly Rebalancing

RETURN CHARACTERISTICS	RANK OF FACTOR BY PAST 12-MONTH CUMULATIVE RETURN						S&P 500
	FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH	
Monthly Alpha to S&P 500 (%)	0.28	0.45	0.40	0.15	0.19	-0.01	-
Beta to S&P 500	0.88	0.74	0.89	0.88	0.95	1.03	-
Correlation with S&P 500	0.84	0.83	0.87	0.87	0.83	0.85	-
Annual Return (%)	10.97	12.34	12.90	9.50	10.45	8.47	8.81
Annual Volatility (%)	15.50	13.06	15.24	14.98	16.82	18.04	14.81
Annual Risk-Adjusted Return	0.71	0.94	0.85	0.63	0.62	0.47	0.59
Annual Excess Return (%)	2.17	3.53	4.09	0.69	1.64	-0.33	-
Annual Tracking Error (%)	8.70	8.21	7.76	7.73	9.33	9.56	-
Information Ratio	0.25	0.43	0.53	0.09	0.18	-0.03	-
Maximum Drawdown (%)	-50.73	-40.49	-49.22	-44.51	-66.19	-63.77	50.95
MAR	0.22	0.30	0.26	0.21	0.16	0.13	0.17
Upside Capture	0.96	0.88	1.02	0.89	0.97	1.01	-
Downside Capture	0.85	0.70	0.83	0.86	0.90	1.03	-

Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1996, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

…which suggests potential for strategic and tactical factor allocation.

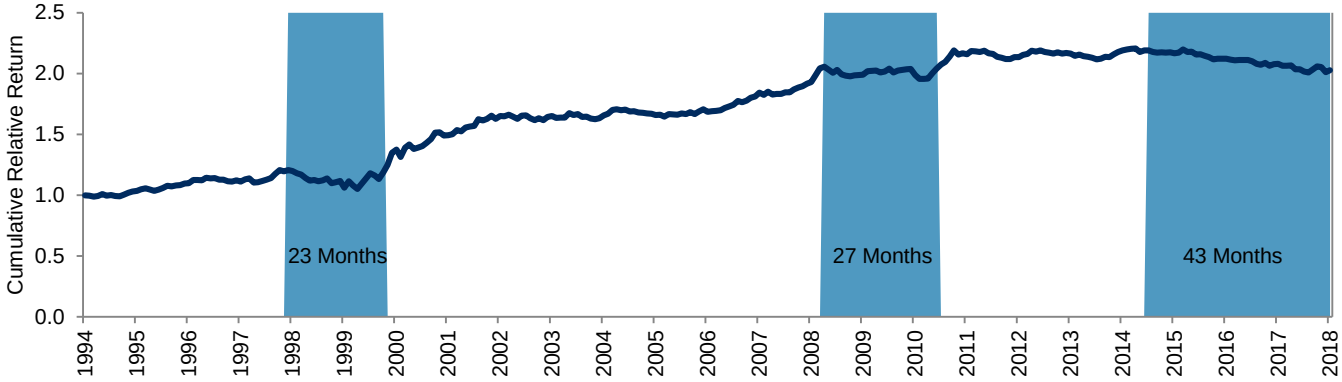
5. CONCLUSION

While single-factor smart beta strategies tend to outperform the market over the long term, there can be long periods where they underperform the standard market-cap-weighted benchmark. Evidence suggests that they perform on different cycles, and correlations among factors were low, even during crises. This suggests potential for strategic and tactical factor allocation. Market participants could seek broad exposure across multiple rewarded factors to enhance returns, and they could blend factors to improve diversification and reduce the tracking error to the benchmark. They could also benefit from changing exposure to one or more factors throughout market cycles.

Market participants could blend factors to improve diversification and reduce the tracking error to the benchmark.

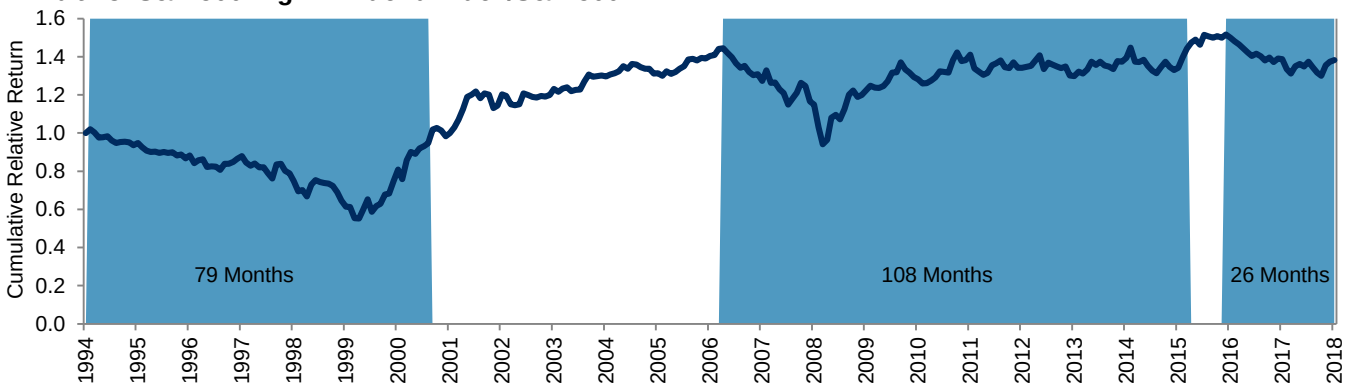
6. APPENDIX

Exhibit 12: S&P 500 Quality Index/S&P 500



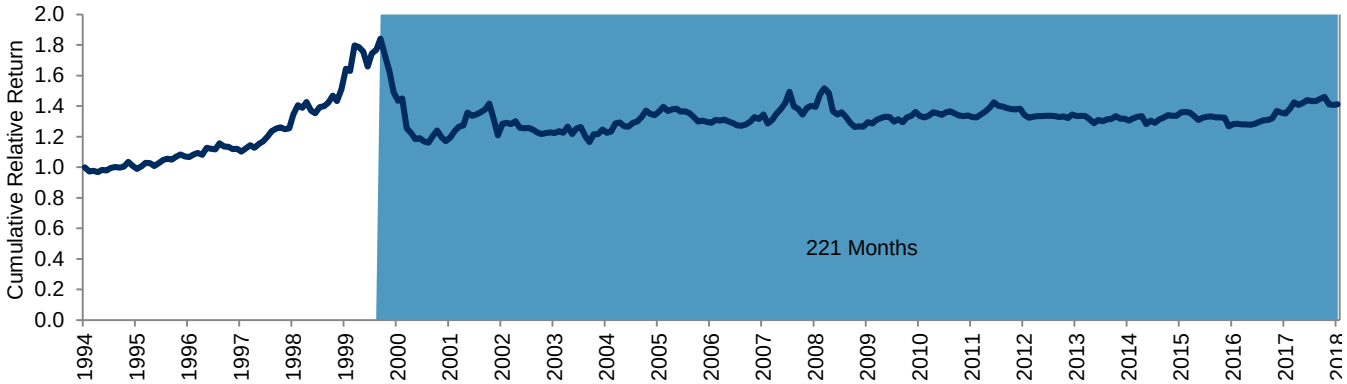
Notes: Shaded areas represent time course for recovery of peak for the cumulative relative return.
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1994, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 13: S&P 500 High Dividend Index/S&P 500



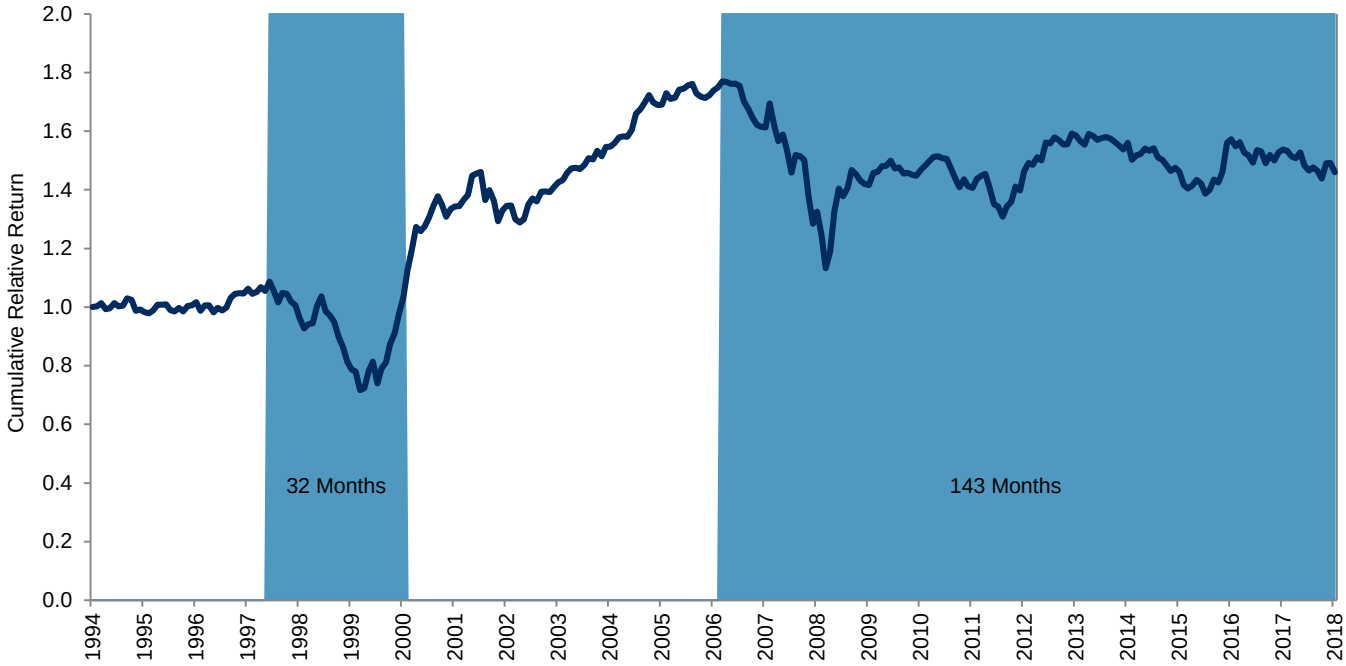
Notes: Shaded areas represent time course for recovery of peak for the cumulative relative return.
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1994, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 14: S&P 500 Momentum/S&P 500



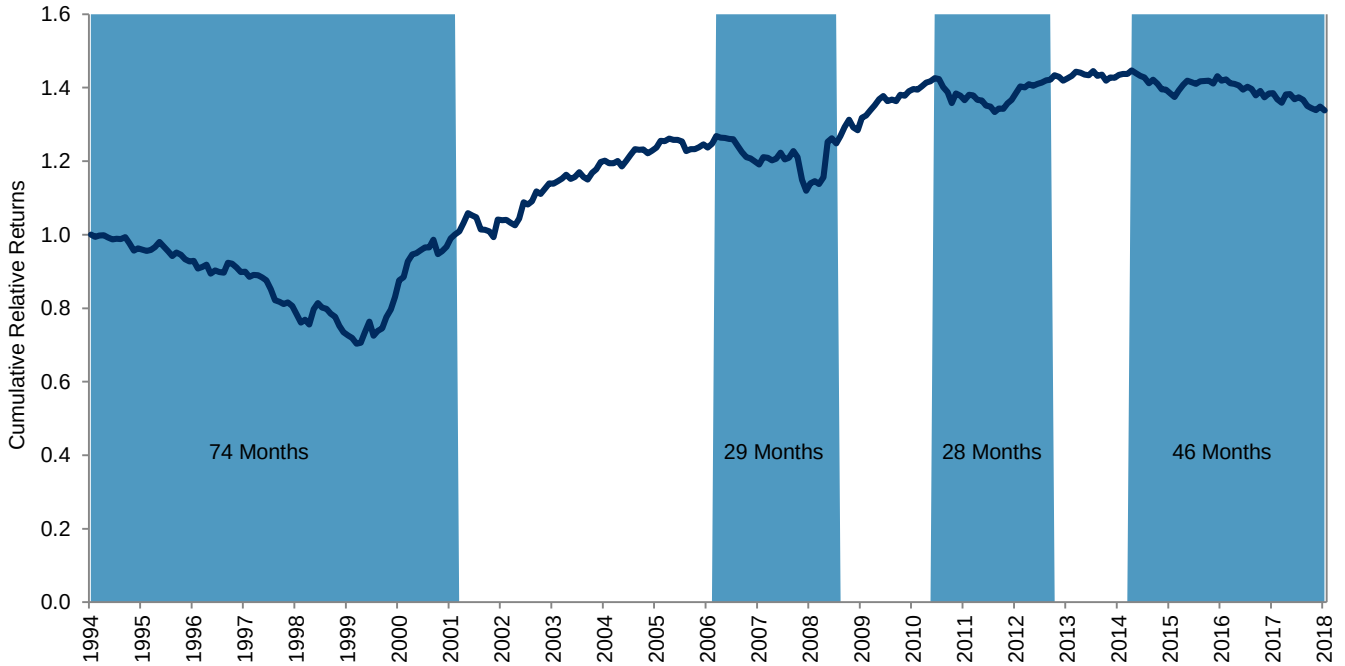
Notes: Shaded areas represent time course for recovery of peak for the cumulative relative return.
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1994, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 15: S&P 500 Enhanced Value Index/S&P 500



Notes: Shaded areas represent time course for recovery of peak for the cumulative relative return.
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1994, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit 16: S&P 500 Equal Weight Index/S&P 500



Notes: Shaded areas represent time course for recovery of peak for the cumulative relative return.
Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1994, to Dec. 31, 2018. Index performance based on total return in USD. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

PERFORMANCE DISCLOSURE

The S&P 500 Low Volatility Index was launched April 4, 2011. The S&P 500 Momentum was launched November 18, 2014. The S&P 500 Enhanced Value Index was launched April 27, 2015. The S&P 500 Quality Index was launched July 8, 2014. The S&P 500 High Dividend Index was launched September 21, 2015. The S&P 500 Equal Weight Index was launched January 8, 2003. All information presented prior to an index's Launch Date is hypothetical (back-tested), not actual performance. The back-test calculations are based on the same methodology that was in effect on the index Launch Date. Complete index methodology details are available at www.spdji.com.

S&P Dow Jones Indices defines various dates to assist our clients in providing transparency. The First Value Date is the first day for which there is a calculated value (either live or back-tested) for a given index. The Base Date is the date at which the Index is set at a fixed value for calculation purposes. The Launch Date designates the date upon which the values of an index are first considered live: index values provided for any date or time period prior to the index's Launch Date are considered back-tested. S&P Dow Jones Indices defines the Launch Date as the date by which the values of an index are known to have been released to the public, for example via the company's public website or its datafeed to external parties. For Dow Jones-branded indices introduced prior to May 31, 2013, the Launch Date (which prior to May 31, 2013, was termed "Date of introduction") is set at a date upon which no further changes were permitted to be made to the index methodology, but that may have been prior to the Index's public release date.

Past performance of the Index is not an indication of future results. Prospective application of the methodology used to construct the Index may not result in performance commensurate with the back-test returns shown. The back-test period does not necessarily correspond to the entire available history of the Index. Please refer to the methodology paper for the Index, available at www.spdji.com for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

Another limitation of using back-tested information is that the back-tested calculation is generally prepared with the benefit of hindsight. Back-tested information reflects the application of the index methodology and selection of index constituents in hindsight. No hypothetical record can completely account for the impact of financial risk in actual trading. For example, there are numerous factors related to the equities, fixed income, or commodities markets in general which cannot be, and have not been accounted for in the preparation of the index information set forth, all of which can affect actual performance.

The Index returns shown do not represent the results of actual trading of investable assets/securities. S&P Dow Jones Indices LLC maintains the Index and calculates the Index levels and performance shown or discussed, but does not manage actual assets. Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the Index or investment funds that are intended to track the performance of the Index. The imposition of these fees and charges would cause actual and back-tested performance of the securities/fund to be lower than the Index performance shown. As a simple example, if an index returned 10% on a US $100,000 investment for a 12-month period (or US $10,000) and an actual asset-based fee of 1.5% was imposed at the end of the period on the investment plus accrued interest (or US $1,650), the net return would be 8.35% (or US $8,350) for the year. Over a three year period, an annual 1.5% fee taken at year end with an assumed 10% return per year would result in a cumulative gross return of 33.10%, a total fee of US $5,375, and a cumulative net return of 27.2% (or US $27,200).

GENERAL DISCLAIMER