S&P Dow Jones Indices
A Division of S&P Global

EDUCATION
Indexing 201

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Understanding the S&P Managed Risk Indices

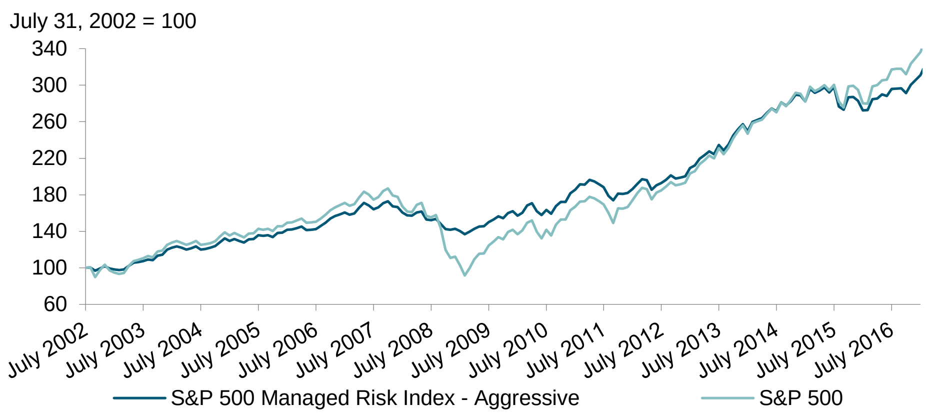
The S&P Managed Risk Indices seek to measure a particular equity market while controlling the level of risk, using a two-step risk management overlay. The first step limits the volatility to a certain level, much like the traditional S&P Risk Control Indices, and the second step is a capital protection strategy, which is implemented using a delta adjustment to the equity exposure to replicate a put option in order to further reduce the downside risk.

By implementing a put option, the framework attempts to mitigate the risk of sustained declines in the underlying equity index. Options on broad market indices are usually expensive, while put option replication in the presence of volatility management tends to have lower and more stable performance costs.

The S&P Managed Risk Indices seek to measure a particular equity market while controlling the level of risk using a two-step risk management overlay.

Currently, the S&P Managed Risk Index Series consists of 48 indices.[1] Each index has a fixed allocation to an underlying bond index and a dynamic allocation to an underlying equity index with a specific target volatility. For example, the S&P 500® Managed Risk Index–Aggressive has a 10% allocation to the S&P U.S. Aggregate Bond Index and dynamically allocates to the S&P 500 with a 16% target volatility.

Exhibit 1: The S&P 500 Managed Risk Index–Aggressive



Source: S&P Dow Jones Indices LLC. Data as of May 31, 2017. 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.

[1] See Exhibit 10 in the Appendix for a complete list and see Exhibits 11-13 for the corresponding parameters.

WHY DOES THE INDEX MATTER?

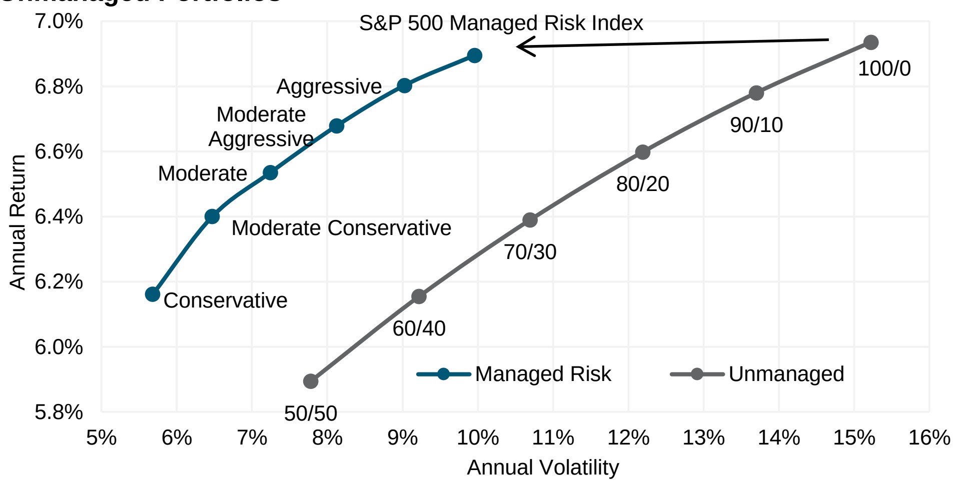
Relative to a portfolio that maintains a fixed stock and bond allocation, the approach behind the S&P Managed Risk Indices offers the potential to generate a higher return with a similar level of long-term volatility or to reduce volatility with a similar long-term return.

Exhibits 2 and 3 show the efficient frontiers for portfolios of two assets represented by the S&P 500 and the S&P U.S. Aggregate Bond Index. The gray lines show portfolios with constant weight combinations; while the dark blue lines show the same combinations with the managed risk overlay. There is a clear improvement in the efficiency of the resulting asset allocations after applying the managed risk overlay. Historically, the managed risk overlay provided higher return for a defined level of risk and a higher Sharpe ratio for a defined level of drawdown.

The S&P Managed Risk headline index, which has 0% allocation to bonds and at most 100% exposure to equity, could be viewed as a large-cap core equity holding.

Moreover, the S&P Managed Risk headline index, which has 0% allocation to bonds and at most 100% exposure to equity, could be viewed as a large-cap core equity holding. For example, the S&P 500 Managed Risk Index provides full exposure to the S&P 500 when the market is less volatile and scales back exposure when volatility rises. This is different from the S&P 500 Low Volatility Index, which maintains full market exposure to the 100 stocks in the S&P 500 that have exhibited the lowest volatility. Furthermore, in terms of performance, the S&P 500 Managed Risk Index returned slightly more than the S&P 500 over the past 10-year period and reduced the volatility by one-third.

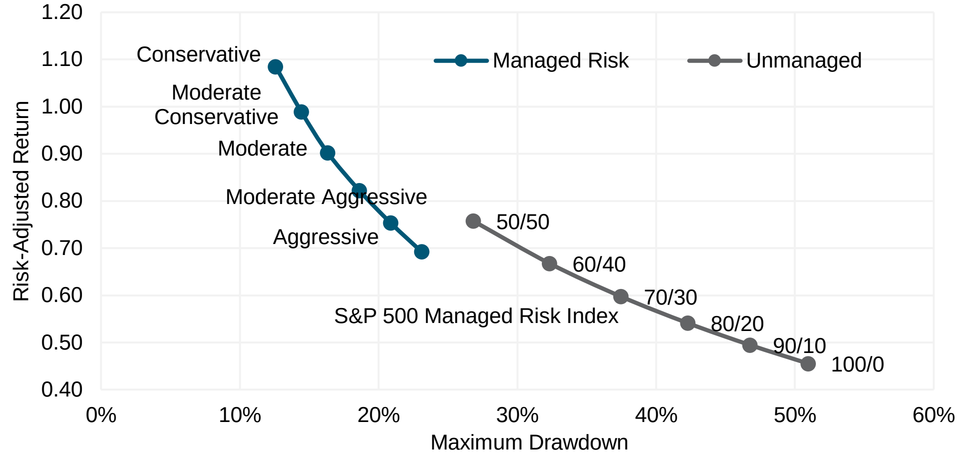
Exhibit 2: Historical Efficient Frontier: Managed Risk Indices Versus Unmanaged Portfolios



Source: S&P Dow Jones Indices LLC. Data from May 31, 2007 to May 31, 2017. Index performance based on daily 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.

The framework further adjusts the allocation to the equity index based on a put overlay calculation.

Exhibit 3: Historical Sharpe Ratio and Maximum Drawdown: Managed Risk Indices Versus Unmanaged Portfolios



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HOW THE INDEX WORKS

As Exhibit 4 illustrates, the S&P Managed Risk Indices have three components: an underlying equity index, a bond index, and a cash component. The allocation to these components is determined in three steps.

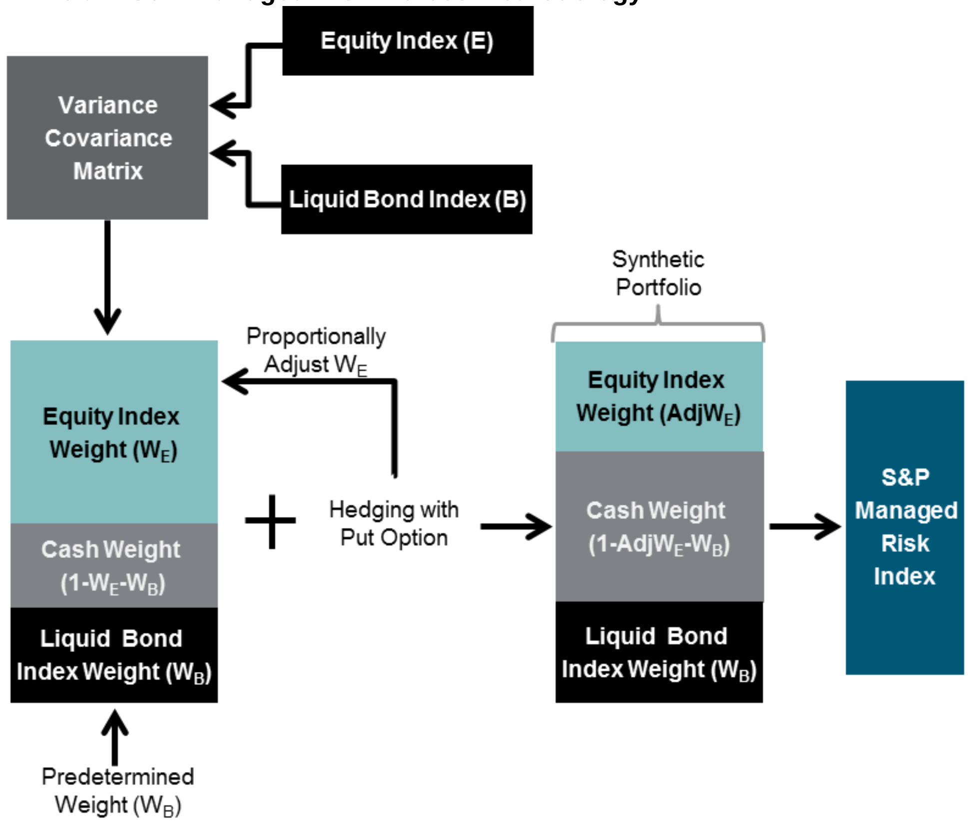
First, allocation to the bond index (W_B) is kept at a predetermined constant level, as avoiding adjustments to these levels minimizes trading costs in this asset class.

Second, an exponentially weighted risk model is used to determine the realized variance of both the underlying equity and bond indices and the realized covariance between the two underlying indices. Then target allocation to the underlying equity index (W_E) can be calculated by solving quadratic equations that equate the portfolio realized volatility to the target volatility.

Third, the framework further adjusts the allocation to the equity index based on a put overlay calculation. It calculates the delta of the put position with regard to the index and then proportionally adjusts the effective weight of the underlying equity index. It also applies a cap so that the combined weight of the underlying equity and bond indices are less than or equal to the maximum leverage of the index.

The parameters and formulas used to price the option are transparent and public. Typically, the put option has a constant maturity of five years. The put strike (expressed in "forward moneyness") is determined each day by multiplying the moving average of the index level with a strike multiplier of 0.875. The Black-Scholes option model is used for the pricing of the put.

Exhibit 4: S&P Managed Risk Indices Methodology



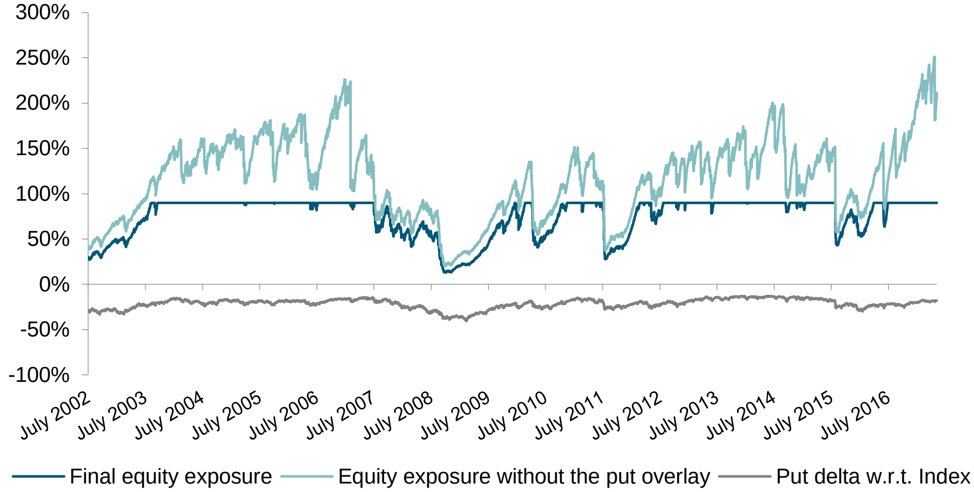
Source: S&P Dow Jones Indices LLC. Chart is provided for illustrative purposes.

Exhibit 5 shows how the equity exposure of the S&P 500 Managed Risk Index–Aggressive changes over time. It shows the exposure before and after applying the option overlay and capping, as well as the put delta with respect to the index.

The put delta measures a proportional change in equity exposure.

The put delta measures a proportional change in equity exposure. For example, the put delta was -0.40 on March 9, 2009. Given that the initial equity weight was 0.37 on March 9, 2009, an increase of one point by the S&P 500 would cause a 0.15 drop in value of the put option (0.37 times 0.40), again assuming that no other variables changed in the short run, including the bond index level. The final equity exposure is then calculated as 0.22 (0.37 minus 0.15) in the synthetic portfolio.

Exhibit 5: Equity Exposure of the S&P 500 Managed Risk Index–Aggressive



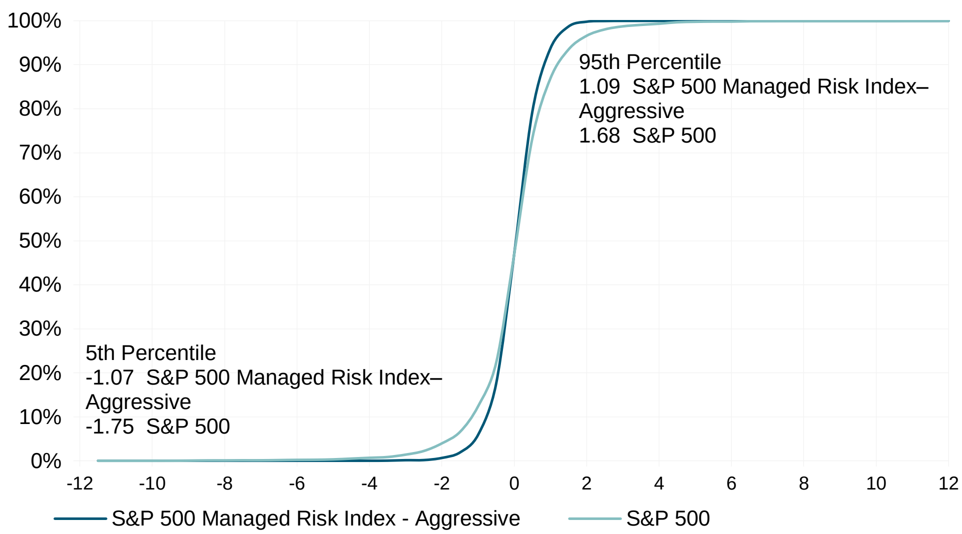
Source: S&P Dow Jones Indices LLC. Data as of May 31, 2017. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

PERFORMANCE CHARACTERISTICS: S&P 500 MANAGED RISK INDEX–AGGRESSIVE

The distribution of the daily return of the S&P 500 Managed Risk Index–Aggressive is more concentrated in the middle with a smaller left tail than the S&P 500.

Exhibit 6 provides a visual illustration of the return distribution of the S&P 500 Managed Risk Index–Aggressive. It is clear that the distribution of the daily return of the S&P 500 Managed Risk Index–Aggressive is more concentrated in the middle with a smaller left tail than the S&P 500.

Exhibit 6: Sample Cumulative Distribution Function: Daily Return of the S&P 500 Managed Risk Index–Aggressive



Source: S&P Dow Jones Indices LLC. Data from July 26, 2002 to May 31, 2017. Index performance based on daily 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 7 provides the same analysis with a statistical summary over the past 10 years. It also offers a comparative overview of the S&P 500 Managed Risk Index–Aggressive with an alternative risk control index—the S&P 500 Daily RC2 10% Index concept.

This index concept is created to demonstrate a traditional multi-asset risk control strategy with a predefined volatility target and without a capital protection mechanism. It uses the same underlying instruments as the S&P 500 Managed Risk Indices: the S&P 500, the S&P 10-Year U.S. Treasury Note Futures Index, and the U.S. Overnight Federal Funds Rate as cash. It dynamically rebalances to a target 10% volatility and uses 100% as the maximum leverage. This index concept had ex-post volatility similar to the S&P 500 Managed Risk 2.0 Index over the 10-year period studied.

The risk reduction in the S&P 500 Managed Risk Index–Aggressive from the S&P 500 is not symmetric.

We can make four observations. First, due to the downside hedging with an option, the ex-post volatility would be lower than the ex-ante target volatility. The S&P 500 Managed Risk Index–Aggressive had an ex-post volatility of 9.1% over the past 10-year period.

Second, the risk reduction in the S&P 500 Managed Risk Index–Aggressive from its benchmark (the S&P 500) is not symmetric. This is evident from the improvement of skewness, 99% value at risk (VaR), as well as the Sharpe, Sortino, and MAR ratios.

Third, the S&P 500 Managed Risk Index–Aggressive slightly underperformed the S&P 500 Daily RC2 10% Index concept, where a big bulk of the return would have been contributed by the bull market seen in bonds over the 10-year period studied.

Fourth, the S&P 500 Managed Risk Index–Aggressive had significantly less negative skewness and 99% VaR compared to the S&P 500 Daily RC2 10% Index concept, although the maximum drawdown was higher. This shows that the index is indeed a risk control solution with more focus on the tail and that there is a cost associated with buying insurance to protect against black swan events.

Exhibit 7: Statistical Summary of the S&P 500 Managed Risk Index–Aggressive Versus Alternatives

CATEGORY	S&P 500 MANAGED RISK INDEX–AGGRESSIVE	S&P 500 DAILY RC2 10% INDEX CONCEPT	S&P 500
COMPONENTS			
Equity		S&P 500	-
Fixed Income		S&P 10-Year U.S. Treasury Note Futures	-
Cash		U.S. Overnight Federal Funds Rate	-
RISK MANAGEMENT OVERLAY			
Volatility Management	Yes	Yes	-
Capital Protection Strategy	No	Yes	-
No Leverage Allowed	Yes	Yes	-
Long Only	Yes	Yes	-
SUMMARY STATS			
Annual Return (%)	6.80	6.90	6.94
Maximum Drawdown (%)	-20.87	-18.73	-50.95
Annual Volatility (%)	9.03	8.68	15.23
Annual Skewness	-0.13	-0.21	-0.20
99% VaR (%)	-6.79	-7.83	-15.57
Monthly Alpha Against the S&P 500 (%)	0.24	0.26	-
T-Stats Of Alpha	2.16	2.01	-
Beta to the S&P 500	0.53	0.50	-
Correlation With the S&P 500	0.89	0.88	-
Sharpe Ratio	0.70	0.74	0.42
Sortino Ratio	1.19	1.22	0.66
MAR Ratio	0.33	0.37	0.14

Source: S&P Dow Jones Indices LLC. Data from May 31, 2007, to May 31, 2017. Index performance based on monthly 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 risk-adjusted return of the S&P 500 Managed Risk Index–Aggressive is slightly higher than that of the other two risk control indices over the shorter horizons.

Exhibit 8 provides the risk/return profile of the S&P 500 Managed Risk Index–Aggressive versus that of the S&P 500 Daily RC2 10% Index concept over the past 3-, 5-, and 10-year periods. Note that the risk-adjusted return of the S&P 500 Managed Risk Index–Aggressive is slightly higher than that of the S&P 500 Daily RC2 10% Index over the shorter horizons, such as the three- and five-year periods. Refer to the Appendix (Exhibit 9) for the risk/return profile of the S&P 500 Managed Risk Index Series, from the most aggressive to the most conservative versions.

The S&P Managed Risk Index Series seeks to provide a means to reduce the downside risk of a typical risk control strategy by replicating a constant maturity put option on the index.

Exhibit 8: Risk/Return Profile of the S&P 500 Managed Risk Index–Aggressive Versus Alternatives

NUMBER OF YEARS	S&P 500 MANAGED RISK INDEX–AGGRESSIVE	S&P 500 DAILY RC2 10% INDEX	S&P 500
ANNUAL RETURN (%)			
3	7.00	6.62	10.14
5	12.22	10.62	15.42
10	6.80	7.05	6.94
ANNUAL VOLATILITY (%)			
3	8.60	7.95	10.37
5	8.21	7.64	9.64
10	9.03	8.81	15.23
RISK-ADJUSTED RETURN			
3	0.81	0.83	0.98
5	1.49	1.39	1.60
10	0.75	0.80	0.46
MAXIMUM DRAWDOWN (%)			
10	-20.87	-15.29	-50.95

Source: S&P Dow Jones Indices LLC. Data from May 31, 2007 to May 31, 2017. Index performance based on monthly 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.

CONCLUSION

The S&P Managed Risk Index Series seeks to provide a means to reduce the downside risk of a typical risk control strategy by adding a simulated constant-maturity put option. The historical performance shows that this strategy has at times been effective in delivering lower volatility and lower tail risk.

APPENDIX

Exhibit 9: Risk/Return Profiles

NUMBER OF YEARS	S&P 500 MANAGED RISK INDEX	S&P 500 MANAGED RISK INDEX– AGGRESSIVE	S&P 500 MANAGED RISK INDEX– MODERATE AGGRESSIVE	S&P 500 MANAGED RISK INDEX– MODERATE	S&P 500 MANAGED RISK INDEX– MODERATE CONSERVATIVE	S&P 500 MANAGED RISK INDEX– CONSERVATIVE	S&P 500
Target Volatility (%)	18	16	14	12	10	8	-
W_B	0	10	20	30	40	50	-
ANNUAL RETURN (%)							
3	7.33	7.00	6.65	6.29	6.05	5.67	10.14
5	13.20	12.22	11.24	10.23	9.34	8.28	15.42
10	6.90	6.80	6.68	6.54	6.40	6.16	6.94
ANNUAL VOLATILITY (%)							
3	9.54	8.60	7.67	6.77	5.93	5.08	10.37
5	9.12	8.21	7.32	6.45	5.63	4.81	9.64
10	9.96	9.03	8.12	7.25	6.47	5.68	15.23
RISK-ADJUSTED RETURN							
3	0.77	0.81	0.87	0.93	1.02	1.12	0.98
5	1.45	1.49	1.54	1.59	1.66	1.72	1.60
10	0.69	0.75	0.82	0.90	0.99	1.08	0.46
99% VaR (%)							
10	-7.58	-6.84	-6.10	-5.36	-4.59	-3.95	-15.72
MAXIMUM DRAWDOWN (%)							
10	-7.52	-6.79	-6.06	-5.34	-4.58	-3.95	-7.52

Source: S&P Dow Jones Indices LLC. Data from May 31, 2007 to May 31, 2017. Index performance based on monthly 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.

Exhibit 10: S&P Managed Risk Index Series Tickers	
INDEX	**BLOOMBERG**
S&P 500 Managed Risk Index	SPXMR
S&P 500 Managed Risk Index–Aggressive	SPXMRA
S&P 500 Managed Risk Index–Moderate Aggressive	SPXMRMA
S&P 500 Managed Risk Index–Moderate	SPXMRM
S&P 500 Managed Risk Index–Moderate Conservative	SPXMRMC
S&P 500 Managed Risk Index–Conservative	SPXMRC
S&P 400 Managed Risk Index	SPMMR
S&P 400 Managed Risk Index–Aggressive	SPMMRA
S&P 400 Managed Risk Index–Moderate Aggressive	SPMMRMA
S&P 400 Managed Risk Index–Moderate	SPMMRM
S&P 400 Managed Risk Index–Moderate Conservative	SPMMRMC
S&P 400 Managed Risk Index–Conservative	SPMMRC
S&P 600 Managed Risk Index	SPSMR
S&P 600 Managed Risk Index–Aggressive	SPSMRA
S&P 600 Managed Risk Index–Moderate Aggressive	SPSMRMA
S&P 600 Managed Risk Index–Moderate	SPSMRM
S&P 600 Managed Risk Index–Moderate Conservative	SPSMRMC
S&P 600 Managed Risk Index–Conservative	SPSMRC
S&P Emerging Plus LargeMidCap Managed Risk Index	SPEMMR
S&P Emerging Plus LargeMidCap Managed Risk Index–Aggressive	SPEMMRA
S&P Emerging Plus LargeMidCap Managed Risk Index–Moderate Aggressive	SPEMMRMA
S&P Emerging Plus LargeMidCap Managed Risk Index–Moderate	SPEMMRM
S&P Emerging Plus LargeMidCap Managed Risk Index–Moderate Conservative	SPEMMRMC
S&P Emerging Plus LargeMidCap Managed Risk Index–Conservative	SPEMMRC
S&P EPAC Ex. Korea LargeMidCap Managed Risk Index	SPBEMR
S&P EPAC Ex. Korea LargeMidCap Managed Risk Index–Aggressive	SPBEMRA
S&P EPAC Ex. Korea LargeMidCap Managed Risk Index–Moderate Aggressive	SPBEMRMA
S&P EPAC Ex. Korea LargeMidCap Managed Risk Index–Moderate	SPBEMRM
S&P EPAC Ex. Korea LargeMidCap Managed Risk Index–Moderate Conservative	SPBEMRMC
S&P EPAC Ex. Korea LargeMidCap Managed Risk Index–Conservative	SPBEMRC
S&P/ASX 200 Managed Risk Index	SPA2MR
S&P/ASX 200 Managed Risk Index–Aggressive	SPA2MRA
S&P/ASX 200 Managed Risk Index–Moderate Aggressive	SPA2MRMA
S&P/ASX 200 Managed Risk Index–Moderate	SPA2MRM
S&P/ASX 200 Managed Risk Index–Moderate Conservative	SPA2MRMC
S&P/ASX 200 Managed Risk Index–Conservative	SPA2MRC
S&P Global LargeMidCap Managed Risk Index	SPGLMR
S&P Global LargeMidCap Managed Risk Index–Aggressive	SPGLMRA
S&P Global LargeMidCap Managed Risk Index–Moderate Aggressive	SPGLMRMA
S&P Global LargeMidCap Managed Risk Index–Moderate	SPGLMRM
S&P Global LargeMidCap Managed Risk Index–Moderate Conservative	SPGLMRMC
S&P Global LargeMidCap Managed Risk Index–Conservative	SPGLMRC
S&P Global Ex. Australia LargeMidCap Managed Risk Index	SPGXAR
S&P Global Ex. Australia LargeMidCap Managed Risk Index–Aggressive	SPGXARA
S&P Global Ex. Australia LargeMidCap Managed Risk Index–Moderate Aggressive	SPGXARMA
S&P Global Ex. Australia LargeMidCap Managed Risk Index–Moderate	SPGXARM
S&P Global Ex. Australia LargeMidCap Managed Risk Index–Moderate Conservative	SPGXARMC
S&P Global Ex. Australia LargeMidCap Managed Risk Index–Conservative	SPGXARC

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

Exhibit 11: S&P Managed Risk Index Series General Parameters

INTEREST RATE:	U.S. OVERNIGHT FEDERAL FUNDS RATE
Short-Term Decay Factor (λ_S):	0.94
Long-Term Decay Factor (λ_L):	0.97
Time to Maturity (Put Option), T:	5 Years
Strike Multiplier (k):	0.875

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

Exhibit 12: Index Series-Specific Parameters

INDEX SERIES	EQUITY INDEX	BOND INDEX	INTEREST RATE
S&P 500 Managed Risk Index Series	S&P 500	S&P U.S. Aggregate Bond Index	U.S. Overnight Federal Funds Rate
S&P 400 Managed Risk Index Series	S&P MidCap 400®		
S&P 600 Managed Risk Index Series	S&P SmallCap 600®		
S&P Emerging Plus LargeMidCap Managed Risk Index Series	S&P Emerging Plus LargeMidCap		
S&P EPAC Ex. Korea LargeMidCap Managed Risk Index Series	S&P EPAC Ex-Korea LargeMidCap		
S&P Global LargeMidCap Managed Risk Index Series	S&P Global LargeMidCap		
S&P/ASX 200 Managed Risk Index Series	S&P/ASX 200	S&P/ASX Australian Fixed Interest Index	RBA Overnight Cash Rate
S&P Global Ex. Australia LargeMidCap Managed Risk Index Series	S&P Global Ex. Australia LargeMidCap		

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

Exhibit 13: Index Type-Specific Parameters

INDEX TYPE	WEIGHT OF BOND INDEX (W_B) (%)	TARGET VOLATILITY (TV) (%)	MEAN REVERSION SPEED IN YEARS (AVERAGE PERIOD)
Managed Risk Index	0	18	1.375
Managed Risk Index–Aggressive	10	16	1.375
Managed Risk Index–Moderate Aggressive	20	14	1.375
Managed Risk Index–Moderate	30	12	1.375
Managed Risk Index–Moderate Conservative	40	10	1.75
Managed Risk Index–Conservative	50	8	2.125

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

PERFORMANCE DISCLOSURE

The S&P 500 Managed Risk Index, S&P 500 Managed Risk Index–Aggressive, S&P 500 Managed Risk Index–Moderate Aggressive, S&P 500 Managed Risk Index–Moderate, S&P 500 Managed Risk Index–Moderate Conservative, and the S&P 500 Managed Risk Index–Conservative were launched on April 11, 2016. The S&P 500 Daily RC2 10% Index was launched on May 26, 2011. The S&P 500 Daily Risk Control 10% Index was launched on May 13, 2009. 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).

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