

## Understanding the S&P Managed Risk 2.0 Indices

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### SUMMARY

S&P Dow Jones Indices, in collaboration with Milliman, introduced the [S&P Managed Risk 2.0 Indices](#), which seek to provide core equity strategies with an embedded risk management feature. The key features of this strategy are the following.

1. The cost of the protection embedded in the strategy is stable and is financed through a reserve asset, the [S&P U.S. Treasury Bond Current 5-Year Index](#). During times when equity markets are under stress, the correlation effects between equities and the reserve asset class have historically provided a counterbalance through positive returns. This is in contrast to strategies that use cash, which do not provide that benefit.
2. Since protection is available, the strategy may provide the ability to participate more in the upside while keeping the overall risk at a low level. This shows up in the higher upside capture and similar or better downside capture than other risk management strategies.

Before diving into the details of the construction and performance of the strategy, it is helpful to consider why this strategy has been developed and the potential benefits it can provide.

### FROM RISK CONTROL TO MANAGED RISK

Many readers may be familiar with risk control strategies.<sup>1</sup> These strategies, which can use a single asset or multiple assets, dynamically adjust the exposure of a risky asset to target a predefined volatility level. They became popular as a solution to reduce risk while retaining much of the gains to be had from “risky” assets like equities.

However, risk control strategies have some major limitations. They transform the distribution of investment outcomes in a linear and symmetric way, meaning that downside could be significant, although reduced, during severe and sustained market declines.

<sup>1</sup> See the following two papers for more details. Banerjee, A., Srivastava, V., and Cheng, T., [Limiting Risk Exposure with S&P Risk Control Indices](#), 2016. Kim, J., Cheng, T., and Srivastava, V., [Understanding the S&P 500 Daily Risk Control \(RC\) 2 Indices](#), 2015.

*Managed risk strategies add a synthetic put hedge...*

Therefore, a number of managed risk strategies<sup>2</sup> have been created recently to improve the traditional risk control framework. These strategies add an additional layer of risk management using a synthetic put hedge, seeking to stabilize volatility around a target level and, on top that, defend against losses during sustained market declines.

*...seeking to stabilize volatility and defend against losses during sustained market declines.*

Note that this protection comes with a cost. Although options on broad market indices are usually expensive, put option replication in the presence of volatility management tends to have lower and more stable performance costs. Therefore, these strategies enable more upside participation compared with the traditional risk control strategies.

## **POTENTIAL BENEFITS**

There are two key potential benefits associated with the S&P Managed Risk 2.0 Indices.

### **Defense against Sequence-of-Return Effects**

*There are two key potential benefits associated with the S&P Managed Risk 2.0 Indices...*

Retirees often face a “retirement conundrum.” They require high returns over the long term to reduce the chance of outliving their savings, but they also need protection from short-term drawdowns, as withdrawals for annual living costs make it hard to recover from those losses, and an adverse sequence of market returns may accelerate the depletion of their accounts. The S&P Managed Risk 2.0 Indices could provide a solution that addresses both of these needs.

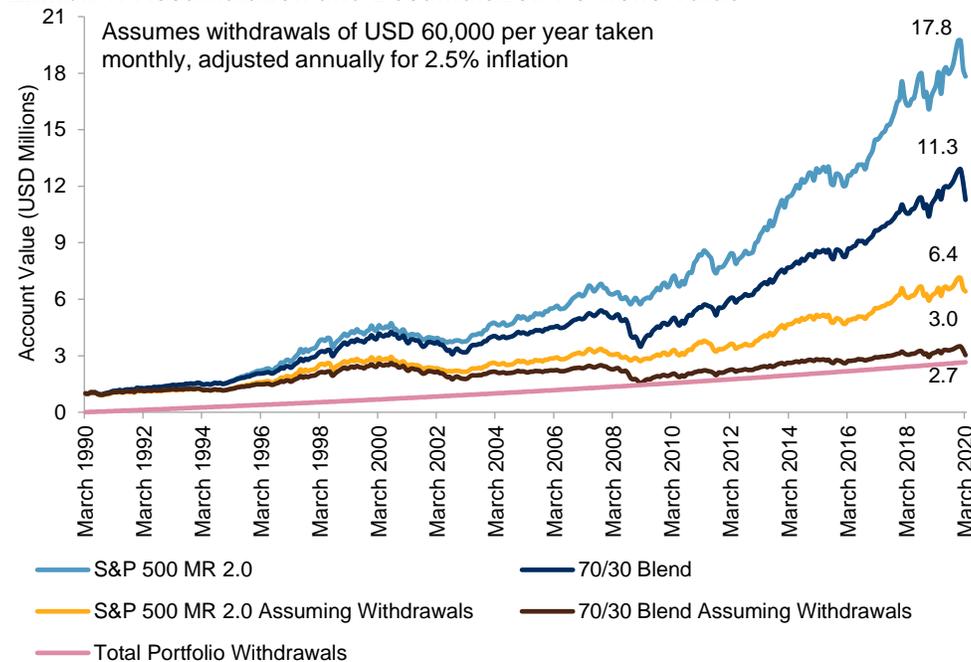
*...defense against sequence-of-return effects and improved efficient frontiers.*

Exhibit 1 depicts the account values over time of two hypothetical investors across two different life phases. One account uses a traditional 70/30 blend of stocks and bonds rebalanced monthly, while the other uses a managed risk approach, as measured by the [S&P 500® Managed Risk 2.0 Index](#). The first phase is accumulation, and the second is decumulation. In the decumulation phase, each investor begins with USD 1 million and makes monthly withdrawals beginning with USD 60,000 in year one and adjusted upward 2.5% annually for inflation.

<sup>2</sup> Before launching the S&P Managed Risk 2.0 Index Series, the S&P Dow Jones Indices launched the S&P Managed Risk Index Series in 2016. See white paper for more details. Cheng, T. and Srivastava, V., [Understanding the S&P Managed Risk Indices](#), 2016.

*At the end of the accumulation and decumulation phases...*

**Exhibit 1: Accumulation and Decumulation Portfolio Value**



*...the account value under the managed risk approach was higher.*

Source: S&P Dow Jones Indices LLC. Data from March 31, 1990, to March 31, 2020. 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.

At the end of both the accumulation and decumulation phases, the account value under the managed risk approach was higher. More noteworthy, however, are the relative differences at the end of each phase.

*After 30 years of accumulation, the account value under the managed risk approach was 58% higher than the account using the 70/30 blend.*

After 30 years of accumulation, the account value under the managed risk approach was 58% higher than the account using the traditional 70/30 blend. Following 30 years of decumulation, the account value under the managed risk approach was 111% more than the account value using the 70/30 blend. Exhibit 2 illustrates final portfolio values after 30 years of decumulation with different withdrawal rates.

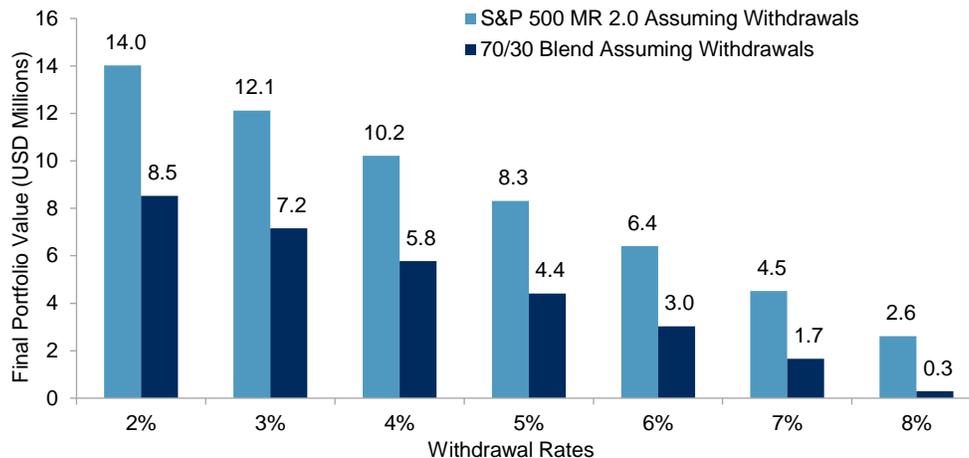
When withdrawals are factored in, the relative excess value generated by the managed risk approach was not merely maintained, but improved upon. This outcome illustrates the relationship of portfolio withdrawals with the market's sequence of returns, and it highlights the importance of mitigating drawdowns and volatility in the decumulation phase.

*When withdrawals are factored in...*

*...the relative excess value generated by the managed risk approach was improved upon.*

*There was a clear improvement in the efficiency of the resulting asset allocations after applying the managed risk 2.0 overlays.*

**Exhibit 2: Decumulation Final Portfolio Value Assuming Different Withdrawal Rates**



Source: S&P Dow Jones Indices LLC. Data from March 31, 1990, to March 31, 2020. 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.

**Improved Efficient Frontiers When Used in Asset Allocation**

The S&P Managed Risk 2.0 Indices could be used as core holdings within multi-asset strategies, because the risk management process offers the potential to generate a higher return with a similar level of long-term volatility, as well as lower drawdown with a similar level of long-term, risk-adjusted return.

Exhibits 3 and 4 show the efficient frontiers for portfolios of two assets represented by the [S&P 500](#) and the S&P U.S. Treasury Bond Current 5-Year Index. The yellow lines show portfolios with constant weight combinations, the dark blue lines show the same combinations with the risk control 2.0 overlays,<sup>3</sup> and the light blue lines show the same combinations with the managed risk 2.0 overlays.<sup>4</sup> Here, risk control 2.0 is added to the comparison, as it demonstrates the traditional multi-asset volatility target strategies without capital protection.

There was a clear improvement in the efficiency of the resulting asset allocations after applying the risk control 2.0 overlays, and there was further improvement with managed risk 2.0 overlays. Specifically, the managed risk overlay provided higher return for a defined level of risk and a higher risk-adjusted return for a defined level of drawdown, compared with the traditional fixed-weight, stock/bond portfolio mix.

<sup>3</sup> For like-on-like comparison with the S&P 500 Managed Risk 2.0 Index, the risk control 2.0 overlay is constructed to dynamically allocate to equity (represented by the S&P 500), bond (represented by the S&P U.S. Treasury Bond Current 5-Year Index), and cash (represented by the [S&P U.S. Treasury Bill 0-3 Month Index](#)). It targets a stable level of volatility of 16% and uses no leverage.

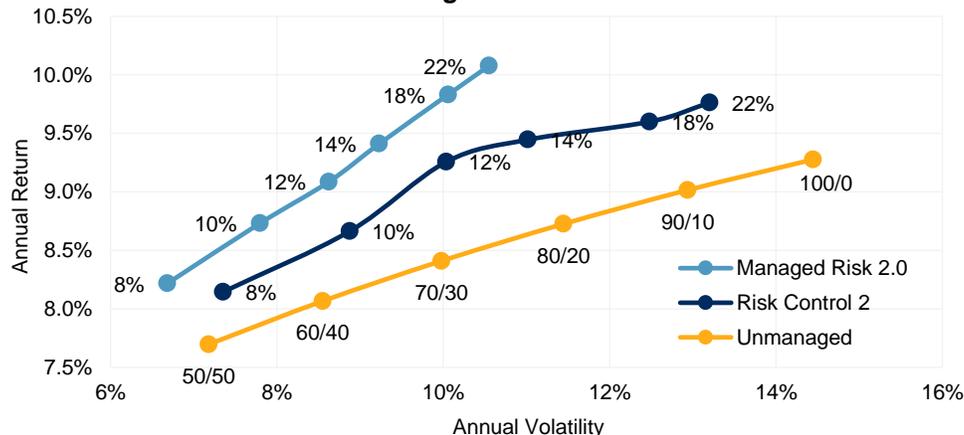
<sup>4</sup> The S&P 500 Managed Risk 2.0 Index has a volatility target set at 22%. We also demonstrate the other hypothetical strategies constructed exactly the same way as the S&P 500 Managed Risk 2.0 Index but with the volatility targets changed to 18%, 14%, 12%, 10%, and 8%.

*The managed risk overlay provided higher return for a defined level of risk...*

As a result, market participants, depending on their desired investment objective, can incorporate the managed risk process into their exposure to core asset classes, to either increase exposure to alternatives, if they have a fixed risk budget, or reduce the risk of the overall allocation.

*...and a higher risk-adjusted return for a defined level of drawdown, compared with the fixed-weight, stock/bond portfolio.*

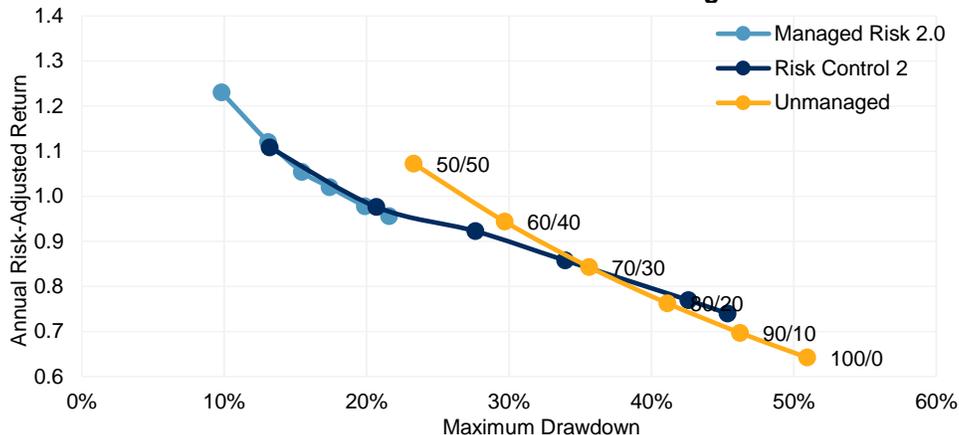
**Exhibit 3: Historical Efficient Frontier – Managed Risk 2.0 Indices and Risk Control 2.0 Indices versus Unmanaged Portfolios**



Source: S&P Dow Jones Indices LLC. Data from March 31, 1990, to March 31, 2020. 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.

*Investors can incorporate the managed risk process into their exposure to core asset classes...*

**Exhibit 4: Historical Sharpe Ratio and Maximum Drawdown – Managed Risk 2.0 Indices and Risk Control 2.0 Indices versus Unmanaged Portfolios**



Source: S&P Dow Jones Indices LLC. Data from March 31, 1990, to March 31, 2020. 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.

*...to increase exposure to alternatives, reduce the risk of the overall allocation, or decrease their bond allocation and use managed risk for equity segments.*

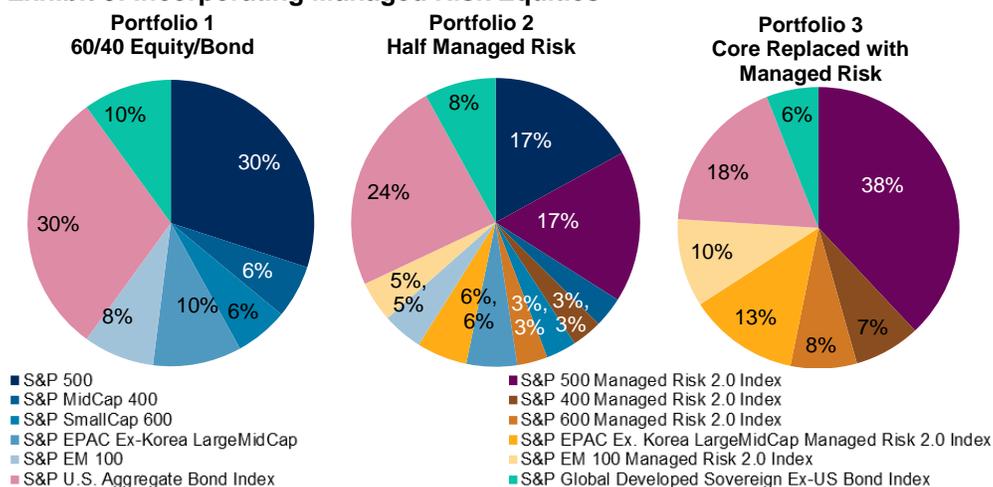
Another way that market participants could incorporate the managed risk process into an asset allocation is to decrease their bond allocation and use managed risk for equity segments, either partially or fully. This could improve the overall expected risk/return characteristics.

Exhibit 5 illustrates the effect with one example using hypothetical portfolios. Portfolio 1 shows the base case of a monthly rebalanced, fixed-

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

weight portfolio with 60/40 allocation to equity and bonds. For equities, we include large-, mid-, and small-cap U.S. equities, as well as international equities in developed and emerging markets. For bonds, we include both U.S. and international bonds. Portfolio 2 decreases the overall bond exposure from 40% to 32% and uses half managed risk for all equity segments. Portfolio 3 further decreases bond exposure to 24% and uses managed risk for all equity segments. Note that the higher allocation to managed risk equity strategies, at the expense of the bond allocation, resulted not only in better returns (which were expected), but lower volatility and drawdowns over the 3-, 5-, and 15-year periods ending March 31, 2020.

**Exhibit 5: Incorporating Managed Risk Equities**



The higher allocation to managed risk equity strategies resulted in better returns, lower volatility, and drawdowns over the past 3, 5, and 15 years.

RISK/RETURN PROFILE		PORTFOLIO 1: 60/40 EQUITY/BOND	PORTFOLIO 2: HALF MANAGED RISK	PORTFOLIO 3: CORE REPLACED WITH MANAGED RISK
Annual Return (%)	3-Year	2.85	3.50	4.32
	5-Year	3.76	3.91	4.04
	10-Year	6.12	6.10	5.96
	15-Year	5.92	6.37	6.79
Annual Volatility (%)	3-Year	9.61	9.20	8.84
	5-Year	8.71	8.29	7.88
	10-Year	8.63	8.25	7.86
	15-Year	9.61	8.59	7.67
Risk-Adjusted Return	3-Year	0.30	0.38	0.49
	5-Year	0.43	0.47	0.51
	10-Year	0.71	0.74	0.76
	15-Year	0.62	0.74	0.88
Maximum Drawdown (%)	15-Year	-33.65	-25.26	-14.21

Source: S&P Dow Jones Indices LLC. Data from March 31, 2004, to March 31, 2020. Index performance based on daily total return in USD. Past performance is no guarantee of future results. Charts and table are provided for illustrative purposes and reflect 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.

## HOW THE INDEX WORKS

### Components

*Each index has three components: targeted equity, the fixed income reserve asset, and the cash equivalent.*

Each index in the S&P Managed Risk 2.0 Index Series has three components:

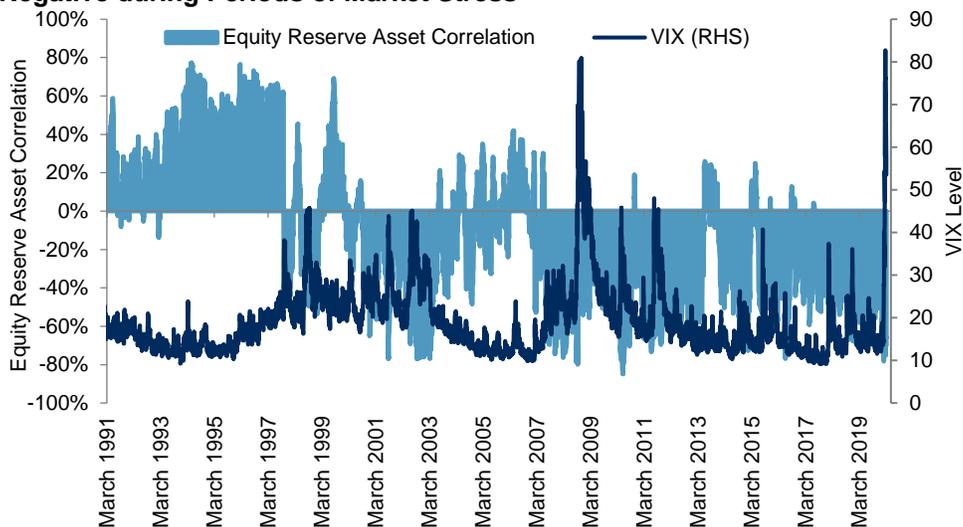
- The targeted equity component (e.g., the S&P 500);
- The fixed income reserve asset component (the S&P U.S. Treasury Bond Current 5-Year Index); and
- A cash equivalent component (the S&P U.S. Treasury Bill 0-3 Month Index).

Unlike many risk control or managed risk strategies that use cash for volatility management, the reserve asset is used here in place of cash in an effort to enhance performance. This is due to several effects.

*The reserve asset is used in place of cash for volatility control in an effort to enhance performance.*

First, the equity and reserve asset tend to be negatively correlated (see Exhibit 6). The negative correlation can contribute to lower volatility, enabling the index to maintain higher equity allocation levels than if it were using just cash.

**Exhibit 6: Correlation between Reserve Asset and Equities Tends to Be Negative during Periods of Market Stress**



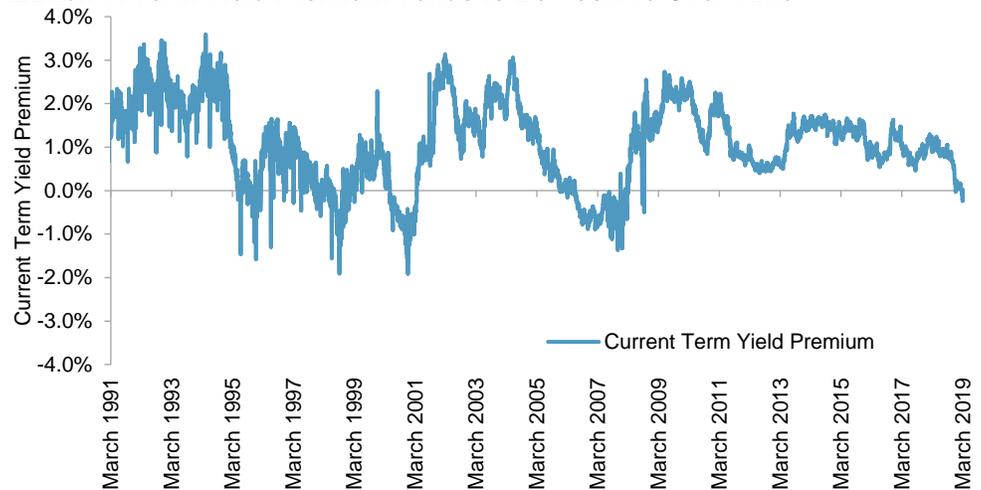
*The negative correlation between the equity and reserve asset can contribute to lower volatility.*

Source: S&P Dow Jones Indices LLC. Data as of March 29, 2018. Equity reserve asset correlation is defined as the average of the short-term and long-term exponentially weighted correlations with decay factors equal to 0.94 and 0.97. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

Second, the term yield premium tends to be positive over time (see Exhibit 7). As a result, long-term outperformance could be expected from the reserve asset over cash. In addition, allocation to a positive duration asset may provide capital gains during periods of market stress or high volatility, due to market “flight to quality.”

*The term yield premium tends to be positive over time...*

**Exhibit 7: Term Yield Premium Tends to Be Positive Over Time**



Source: S&P Dow Jones Indices LLC. Data as of March 29, 2018. The current term yield premium is calculated as the spread between the yield-to-maturity of the reserve asset and the cash money market rate. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

*...as a result, long-term outperformance can be expected from the reserve asset over cash.*

**Allocation Algorithm**

As illustrated in Exhibit 8, the S&P Managed Risk 2.0 Indices methodology starts with a headline equity index and then applies the following three-step managed risk overlay.

**Volatility Management:** In this component, it is assumed that there is a risk control model supplying both short- and long-term variance and covariance for the underlying equity and reserve asset indices. Volatility management is achieved by testing all combinations and seeking to identify a portfolio consisting of the two primary components (the equity and bond indices) with a historic volatility equal to the target.

**Capital Protection Strategy:** This component uses Black Scholes theory to calculate synthetic self-financing put option premiums and hedge allocations. In other words, instead of buying an OTC put option on the managed risk 2.0 index at a price generated by the Black Scholes model, we are trying to find a combination of the underlying equity and reserve asset indices (long or short tenor) that has the same cash flow properties as the put option. This “replicated” put needs to be financed by the strategy itself and involves no extra cost.

**Final Adjustment:** This component combines volatility management with put option replication to determine the target asset weights, subject to a minimum exposure of 0% and a maximum exposure of 100% for each constituent. Additional adjustments are made to avoid underperformance due to a persistent negative term yield premium and to limit frequent or concentrated allocation shifts (see Appendix B for more details).

The calculations are performed daily and the indices are rebalanced daily, subject to volatility and position limits (long-only and no leverage).

**Exhibit 8: S&P Managed Risk 2.0 Indices Methodology\***

*The methodology starts with a headline equity index, then applies the three-step managed risk overlay.*

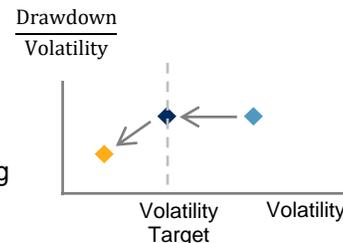
**1 BEGIN WITH HEADLINE INDEX**

- ✓ Broad market access (e.g., U.S. large cap, U.S. mid cap, U.S. small cap, international, emerging)



**2 APPLY MANAGED RISK OVERLAY**

- ✓ **Volatility management:** seeks to stabilize portfolio volatility around a target level
- ✓ **Capital protection strategy:** seeks to defend against losses during sustained market declines.
- ✓ Risk management calculations are performed daily.



**3 RESULT: RISK MANAGED EXPOSURE**

- ✓ Hedge asset positions within a portfolio are continuously changed in an effort to stabilize volatility and reduce the impact of sustained market declines.



Source: S&P Dow Jones Indices LLC. Chart is provided for illustrative purposes. Please refer to the [S&P Managed Risk 2.0 Index Series Methodology](#) for more details.

**Allocation Visual Illustration**

At the heart of the managed risk overlay is an optimization process that maximizes equity exposure, subject to the volatility target and position constraints. Exhibit 9 provides a visualization of the process and charts a few hypothetical solutions under different market conditions.

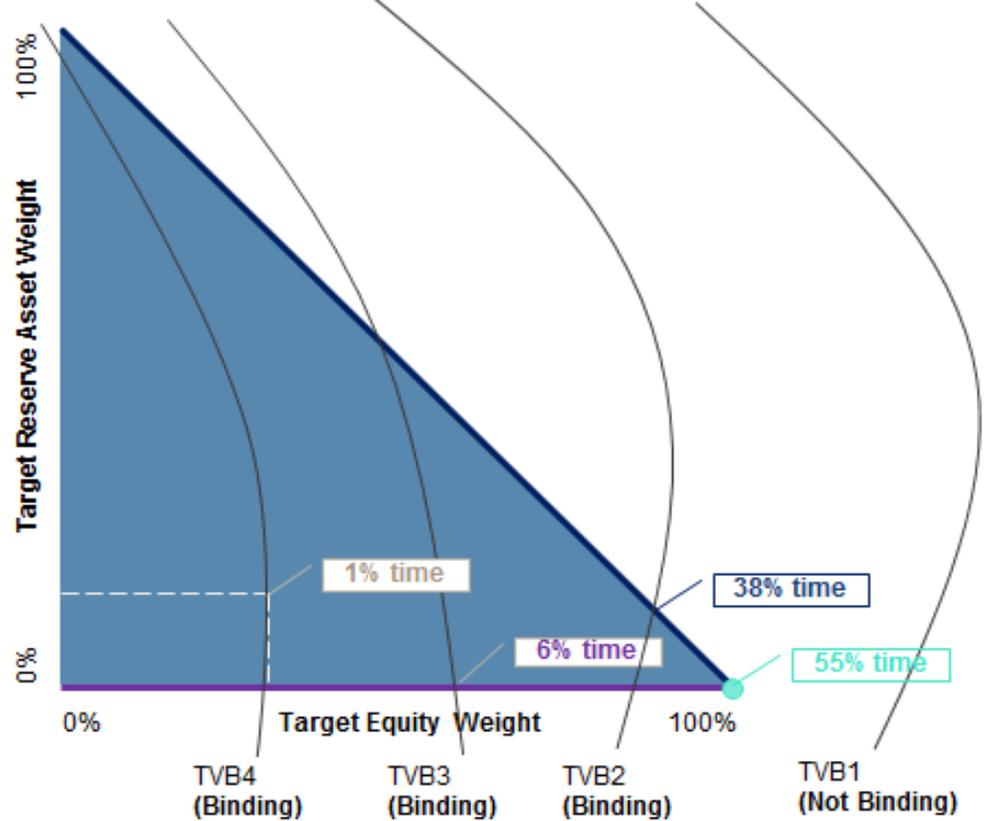
*An optimization process maximizes equity exposure.*

In Exhibit 9, the blue triangle includes all solutions that satisfy long-only and no-leverage constraints. The curves represent the target volatility boundary (TVB) under different market conditions.

When equity volatility is relatively low and the volatility target constraints are not binding, as is the case for TVB1, 100% weight is allocated to equity. When equity volatility is relatively high and volatility management is triggered, as for TVB2-4, equity exposure is reduced. Negative correlation between equity and the reserve asset can lead to higher equity allocation levels, as we see for TVB2 and TVB4. Historically, the correlation was positive only 6% of the time; and just cash, without a reserve asset, was used to blend with equity in order to manage risk.

**Exhibit 9: When Volatility Constraints Are Binding (45% of the Time), a Negative Correlation between Equities and the Reserve Asset Generally Led to Higher Equity Allocation Levels (39% of the Time)**

*Negative correlation between equity and the reserve asset can lead to higher equity allocation levels.*



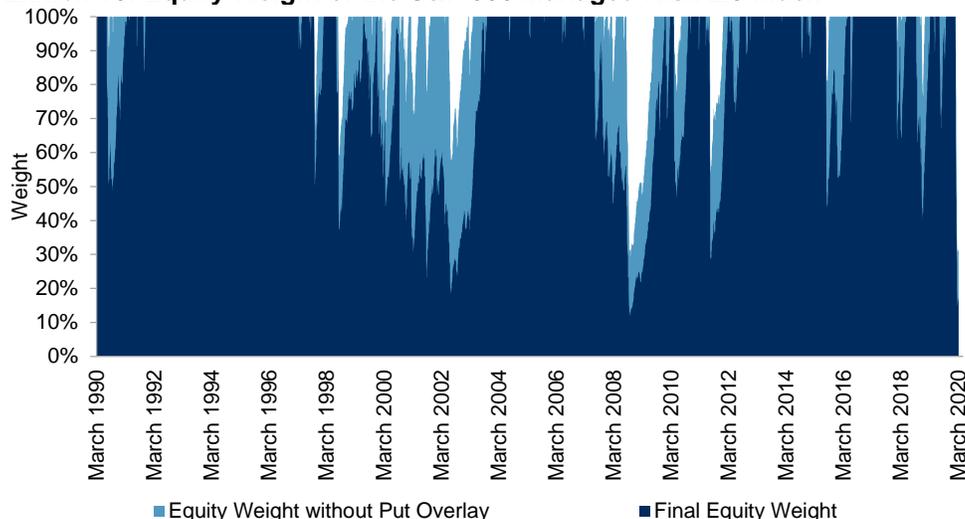
Source: S&P Dow Jones Indices LLC. Data from March 28, 1990, to March 31, 2020. Chart is provided for illustrative purposes.

**Allocation History**

Exhibit 10 shows how the equity exposures of the S&P 500 Managed Risk 2.0 Index change over time. It shows the exposures with and without the option replication overlay.

The weight difference tells you how much exposure adjustment is needed in order to replicate the put synthetically—i.e., the price paid for the protection. For example, on March 9, 2009, the equity weight (to be implemented on T+2) without the put overlay was 52%, while the final equity weight was 22%. Another more recent example was during the coronavirus market sell-off. On the opening of March 9, 2020, the equity weight without the put overlay was 56%, while the final equity weight was 31%.

**Exhibit 10: Equity Weight of the S&P 500 Managed Risk 2.0 Index**



*The equity weight difference tells you how much exposure adjustment is needed to replicate the put synthetically.*

Source: S&P Dow Jones Indices LLC. Data as of March 31, 2020. 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.

**Parameters**

All parameters are displayed in Appendix C. Here we highlight only a few important parameters used across all S&P Managed Risk 2.0 Indices.

*Parameters can be customized based on product issuer or market participant requirements.*

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 0.80. The short- and long-term variance and covariance are calculated using exponential weighting with decay factors equal to 0.94 and 0.97, respectively. The volatility target is set at 22%.

Although these parameters are currently fixed, they can be customized based on product issuer or market participant requirements.

**INDEX PERFORMANCE**

Historically, by using the efficient two-step risk management strategy, the S&P 500 Managed Risk 2.0 Index has generally proven to be effective in stabilizing short-term volatility, providing downside protection against sustained market declines, and upside participation.

*The S&P 500 Managed Risk 2.0 Index has proven to be effective in stabilizing short-term volatility.*

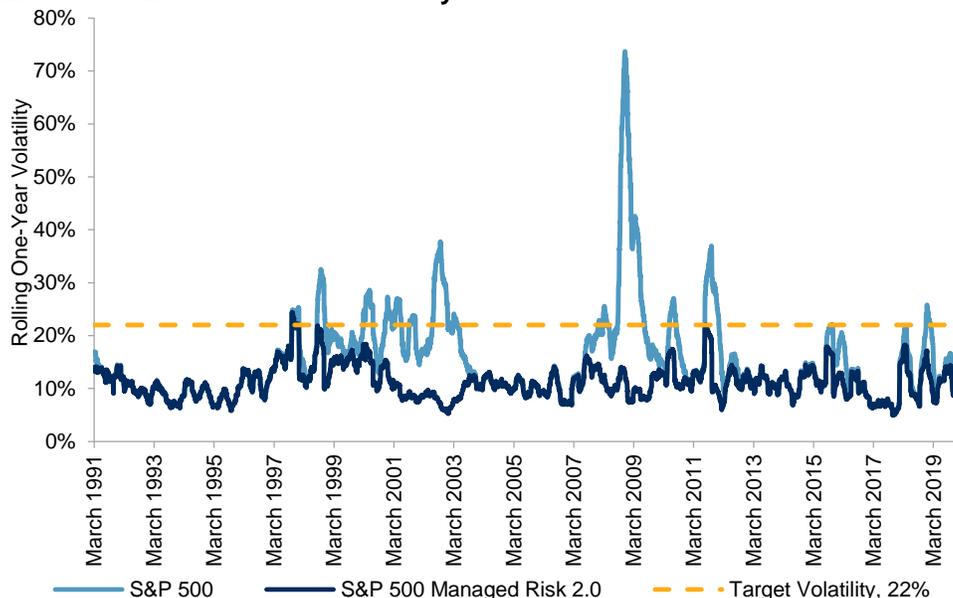
**Stable Volatility**

The ex-post volatility of the S&P 500 Managed Risk 2.0 Index was consistently lower than or equivalent to the S&P 500 during the period studied (see Exhibit 11). Looking at rolling 60-day volatility, it ranged from 5% to 24%, generally below the 22% volatility target, because of the additional downside protection mechanism. In the stressed markets of 2008, the S&P 500 Managed Risk 2.0 Index had less than one-fifth the

volatility of the equity market. Over the first quarter of 2020, the S&P 500 Managed Risk 2.0 Index had a realized volatility of 22%, while market volatility was 58%.

*The S&P 500 Managed Risk 2.0 Index clearly beat the S&P 500 in terms of drawdown size and recovery length.*

**Exhibit 11: Low and Stable Volatility**



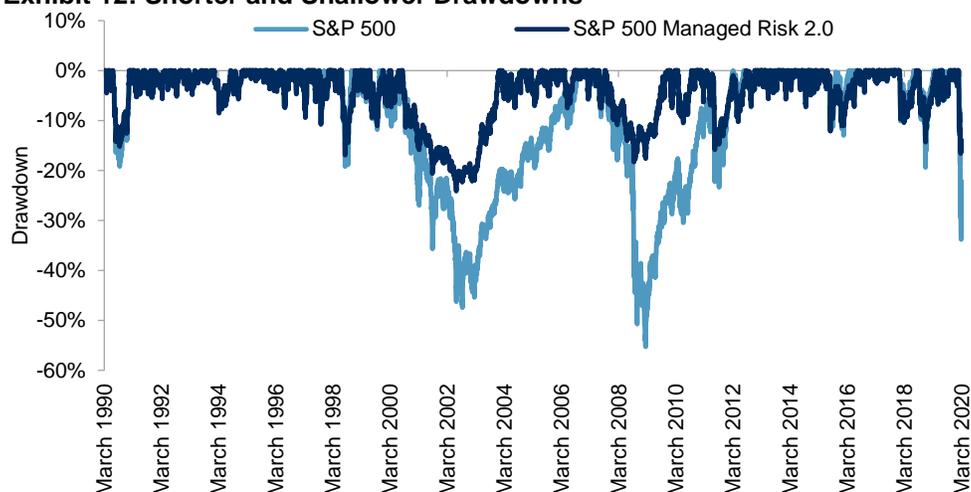
Source: S&P Dow Jones Indices LLC. Data as of March 31, 2020. Volatility is calculated as standard deviation of daily total return over the past 250 trading days, which is then annualized. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

**Downside Protection**

*During the global financial crisis, the drawdown was cut by 69% and recovery length was reduced by 62%.*

The S&P 500 Managed Risk 2.0 Index clearly beat the S&P 500 in terms of drawdown size and recovery length (see Exhibits 12 and 13). During the global financial crisis, the drawdown was cut by 69% and recovery length was reduced by 62%. During the dot-com bubble, the drawdown was cut by 52% and recovery length was reduced by 61%. The drawdown from the most recent market peak on Feb. 19, 2020, to March 23, 2020, was cut by 51%, although the complete effect of the coronavirus market sell-off is yet to be played out.

**Exhibit 12: Shorter and Shallower Drawdowns**



*The S&P 500 Managed Risk 2.0 Index had a beta lower than one and tended to outperform in down markets and underperform in up markets.*

Source: S&P Dow Jones Indices LLC. Data as of March 31, 2020. Drawdown is calculated as cumulative return since the most recent high water mark. 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: Shorter and Shallower Drawdowns**

METRIC	S&P 500 MANAGED RISK 2.0 INDEX	S&P 500	PERCENTAGE REDUCTION
<b>Global Financial Crisis Drawdown</b>	<b>-18.2</b>	<b>-55.3</b>	<b>67</b>
Peak Date	Oct. 5, 2007	Oct. 5, 2007	-
Trough Date	Oct. 9, 2008	March 9, 2009	-
Number of Trading Days from Peak to Trough	255	357	29
Recovery Length (Number of Months)	303	869	65
<b>Dot-com Bubble Drawdown</b>	<b>-24.1</b>	<b>-47.4</b>	<b>49</b>
Peak Date	Sept. 1, 2000	Sept. 1, 2000	-
Trough Date	July 23, 2002	Oct. 9, 2002	-
Number of Trading Days from Peak to Trough	470	525	10
Recovery Length (Number of Months)	377	1017	63
<b>COVID-19 Market Sell-off (data as of March 31, 2020)</b>	<b>-16.6</b>	<b>-33.8</b>	<b>51</b>
Peak Date	Feb. 19, 2020	Feb. 19, 2020	-
Trough Date	March 18, 2020	March 23, 2020	-
Number of Trading Days from Peak to Trough	20	23	13

Source: S&P Dow Jones Indices LLC. Data from March 28, 1990, to March 31, 2020. 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 upside capture ratio was 0.70, higher than the 0.68 downside capture ratio.*

### Upside Participation

The S&P 500 Managed Risk 2.0 Index had a beta lower than one and tended to outperform in down markets and underperform in up markets, evident by the average monthly excess return shown in Exhibit 14. However, it is worth noting that the upside capture ratio was 0.78, higher

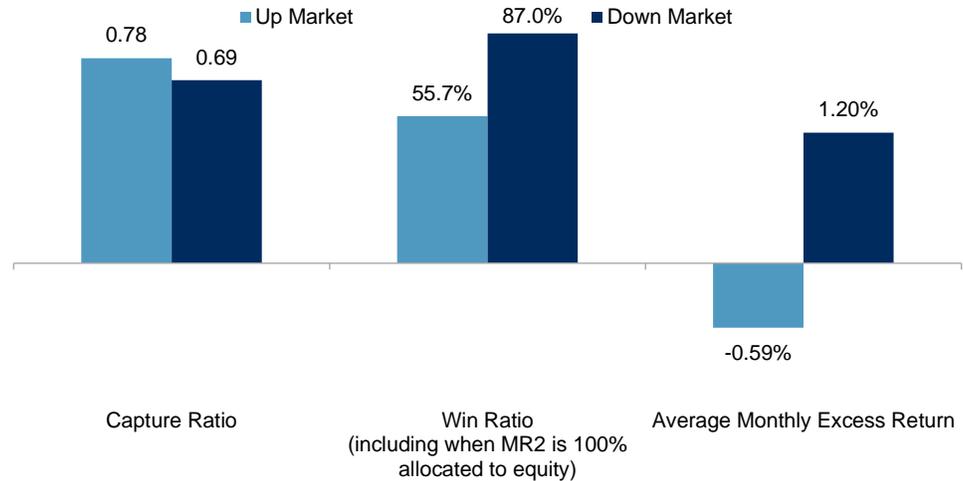
*The S&P 500 Managed Risk 2.0 Index outperformed in terms of metrics of risk-adjusted returns...*

*...including the Sharpe, Sortino, and MAR ratios.*

*Since the 2008 financial crisis, risk management strategies have gained popularity and greater acceptance among market participants.*

than the 0.69 downside capture ratio, proving the asymmetry of the return distribution. The risk management process controlled more on the downside and allowed more upside participation.

**Exhibit 14: Performance in Up and Down Markets**



Source: S&P Dow Jones Indices LLC. Data from March 28, 1990, to March 31, 2020. The upside capture ratio is calculated by dividing the annualized returns of the S&P 500 Managed Risk 2.0 Index by the annualized returns of the S&P 500 during the up markets of the S&P 500. The downside capture ratio is calculated in the same way but during down markets. The win ratio is calculated as the percentage of months when the total return of the S&P 500 Managed Risk 2.0 Index is greater than or equal to that of the S&P 500. 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.

**Better Risk-Adjusted Return**

The S&P 500 Managed Risk 2.0 Index outperformed the S&P 500 in terms of different metrics of risk-adjusted returns, including the Sharpe, Sortino, and MAR ratios, during the 25-, 20-, and 15-year periods ending March 31, 2020 (see Exhibit 15). It also outperformed the S&P 500 in terms of absolute return. Monthly alpha during the period was significantly positive, at the 90% level or higher.

**Exhibit 15: Statistical Summary**

METRIC	25 YEARS		20 YEARS		15 YEARS	
	S&P 500 MANAGED RISK 2.0 INDEX	S&P 500	S&P 500 MANAGED RISK 2.0 INDEX	S&P 500	S&P 500 MANAGED RISK 2.0 INDEX	S&P 500
<b>RISK/RETURN PROFILE</b>						
Return (%)	9.90	8.85	6.99	4.79	8.85	7.58
Volatility (%)	10.39	14.88	9.49	14.72	9.83	14.36
Skewness	-0.16	-0.21	-0.14	-0.20	-0.18	-0.25
Excess Kurtosis	-0.19	-0.15	-0.24	-0.16	-0.23	-0.10
<b>RATIOS</b>						
Sharpe Ratio	0.73	0.44	0.56	0.21	0.77	0.44
Sortino Ratio	1.54	0.87	1.14	0.45	1.41	0.75
MAR Ratio	0.46	0.17	0.32	0.09	0.56	0.15
<b>PERFORMANCE RELATIVE TO S&amp;P 500</b>						
Monthly Alpha (%)	0.34	-	0.34	-	0.34	-
T-Stats of Alpha	4.09	-	3.63	-	3.11	-
Beta to the S&P 500	0.61	-	0.55	-	0.59	-

*Since the 2008 financial crisis, risk management strategies have gained popularity and greater acceptance among market participants.*

Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1992, to March 31, 2020. 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.

## HOW IT COMPARES WITH PEERS

Since the 2008 financial crisis, risk management strategies have gained popularity and greater acceptance among market participants. The common feature among the various types of risk management strategies is that they are designed to provide a degree of upside participation in the market while also limiting downside exposure. However, different volatility-reducing indices have different risk/return profiles, and the S&P Managed Risk 2.0 Indices are no exception.

## Alternative Risk Management Strategies

### LOW AND MINIMUM VOLATILITY INVESTMENT STRATEGIES

*Low or minimum volatility strategies aim to increase risk-adjusted return by constructing a portfolio of stocks that exhibit low volatility or low beta or based on mean variance.*

The past decade has seen a proliferation of low volatility and minimum volatility strategies. Sometimes called “smart beta,” these strategies aim to increase risk-adjusted return, either by constructing a portfolio of stocks that exhibit low volatility or low beta, or based on mean variance. Regardless of how the portfolio is constructed, these strategies generally deliver lower total portfolio volatility than a market-cap-weighted benchmark. One example is the [S&P 500 Low Volatility Index](#), which is designed to measure the 100 least volatile stocks in the S&P 500, with each stock weighted relative to the inverse of its realized volatility.

### TAIL RISK PROTECTION STRATEGIES WITH VOLATILITY FUTURES

*Periods of market stress are often associated with a spike in volatility and buying volatility futures can hedge against a fall in markets.*

Exchange-traded futures on the CBOE Volatility Index® (VIX®) are the most commonly traded volatility instrument. Periods of market stress are often associated with a spike in volatility and, as a result, buying volatility futures can hedge against a fall in markets. One example of such strategies is the [S&P 500 Dynamic VEQTOR Index](#), which allocates dynamically to equity (represented by the S&P 500), volatility (represented by the [S&P 500 VIX Short-Term Futures Index](#)), and cash by monitoring the realized volatility as well as the trend of implied volatility.

### RISK-CONTROLLED STRATEGIES ON EQUITIES

*Risk-controlled or target volatility strategies set an explicit risk level for the portfolio.*

Risk-controlled or target volatility strategies set an explicit risk level for the portfolio. Typically, these risk-controlled strategies dynamically allocate between a risky asset and a relatively risk-free asset—for example, cash or liquid bonds. During periods of relatively low volatility, allocation to the risky asset increases (sometimes over 100%, if leverage is used), and vice versa. One example is the S&P Daily Risk Control Index Series. For a like-on-like comparison with the S&P 500 Managed Risk 2.0 Index, we construct an S&P 500 Risk Control 1 (RC1) 12% concept, which dynamically allocates to equity and cash<sup>5</sup> to target a stable volatility of 12% and assumes no leverage. This index had ex-post volatility similar to the S&P 500 Managed Risk 2.0 Index over the 10-year period studied.

### RISK CONTROL STRATEGIES ON EQUITIES AND BONDS

This represents the second generation of risk control strategies. These strategies replace the cash portion of the investment that is seen in the standard risk control strategy with a liquid bond allocation. The equity and bond exposures are adjusted based on historical realized volatilities and the correlation of the two underlying asset classes. One example is the S&P Daily Risk Control 2 Index Series (S&P RC2 Indices). For a like-on-like

<sup>5</sup> Equity is represented by the S&P 500. Cash is represented by the S&P U.S. Treasury Bill 0-3 Month Index.

*The second generation of risk control strategies replace the cash portion with a liquid bond allocation.*

comparison with the S&P 500 Managed Risk 2.0 Index, we construct a hypothetical S&P 500 RC2 12% concept that dynamically allocates to equity, bond, and cash<sup>6</sup> to target a stable volatility of 12% and uses no leverage. This index had ex-post volatility similar to the S&P 500 Managed Risk 2.0 Index over the 10-year period studied.

**Performance Comparison**

Exhibits 16 and 17 show the performance of the aforementioned strategies as compared with the S&P 500 Managed Risk 2.0 Index over the 14.25-year period. When compared with the other four volatility-reducing indices, the S&P 500 Managed Risk 2.0 Index has generally shown:

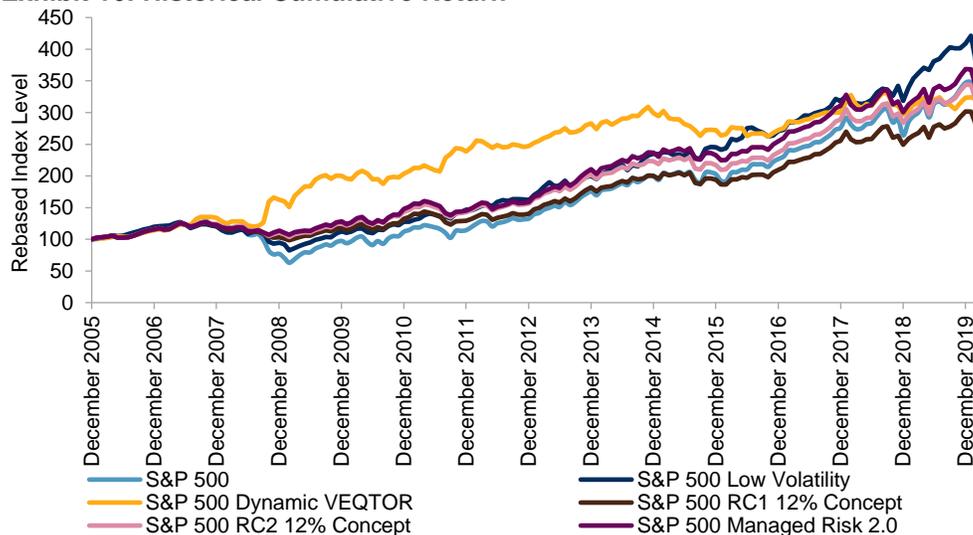
*The S&P 500 Managed Risk 2.0 Index has shown better or equivalent risk statistics in terms of volatility, maximum drawdown, and recovery time.*

- Better or equivalent risk statistics in terms of volatility, maximum drawdown, and recovery time;
- Better return to maximum drawdown ratio (except compared with the S&P 500 Dynamic VEQTOR Index, which is a tail hedge strategy); and
- The highest upside capture ratio.

Overall, the S&P 500 Managed Risk 2.0 Index posted lower and more stable volatility than the S&P 500 Low Volatility Index and S&P 500 Dynamic VEQTOR Index. As a volatility-reducing strategy, although it may lag during bull markets, it is the only index that had an upside capture ratio greater than 0.75 over the past 14.25 years.

*As a volatility-reducing strategy, it is the only index that had an upside capture ratio greater than 0.75.*

**Exhibit 16: Historical Cumulative Return**



Source: S&P Dow Jones Indices LLC. Data from Dec. 30, 2005, to March 31, 2020. 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.

<sup>6</sup> Equity is represented by the S&P 500. Bond is represented by the S&P U.S. Treasury Bond Current 5-Year Index. Cash is represented by the S&P U.S. Treasury Bill 0-3 Month Index.

**Exhibit 17: Statistical Summary – Risk Management Strategies**

METRIC	S&P 500	S&P 500 LOW VOLATILITY INDEX	S&P 500 DYNAMIC VEQTOR INDEX	S&P 500 RC1 12% CONCEPT	S&P 500 RC2 12% CONCEPT	S&P 500 MANAGED RISK 2.0 INDEX
<b>MOMENTS (ANNUALIZED)</b>						
Return (%)	7.47	8.77	8.93	7.32	8.42	8.81
Volatility (%)	14.64	11.30	11.65	9.62	9.61	9.94
Skewness	-0.25	-0.39	0.79	-0.20	-0.20	-0.18
Excess Kurtosis	-0.11	0.03	1.31	-0.23	-0.23	-0.23
<b>RATIOS</b>						
Risk-Adjusted Return	0.51	0.78	0.77	0.76	0.88	0.89
Sharpe Ratio	0.43	0.67	0.66	0.64	0.75	0.77
Sortino Ratio	0.72	1.10	1.67	1.14	1.34	1.37
MAR Ratio	0.15	0.25	0.59	0.33	0.45	0.55
<b>PERFORMANCE RELATIVE TO S&amp;P 500</b>						
Monthly Alpha (%)	-	0.30	0.63	0.22	0.31	0.34
T-Stats of Alpha (%)	-	2.28	2.50	2.28	3.08	3.03
Beta to the S&P 500	-	0.66	0.19	0.59	0.58	0.59
<b>UP AND DOWN MARKET PERFORMANCE</b>						
Upside Capture Ratio	-	0.71	0.47	0.72	0.73	0.77
Downside Capture Ratio	-	0.62	0.25	0.70	0.66	0.68
<b>DRAWDOWNS</b>						
Maximum Drawdown	-50.95	-35.36	-15.12	-21.91	-18.59	-15.91
Peak Date	October 2007	May 2007	November 2014	October 2007	October 2007	October 2007
Trough Date	February 2009	February 2009	October 2016	February 2009	February 2009	October 2008
Peak to Trough (Number of Months)	16	21	23	16	16	12
Recovery Length (Number of Months)	37	22	15	22	13	14

Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 2005, to March 31, 2020. 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 S&P 500 Managed Risk 2.0 Index had a better return to maximum drawdown ratio.*

*The managed risk 2.0 can be useful to help investors seeking to achieve long-term return goals while effectively managing risk.*

**CONCLUSION**

The S&P Managed Risk 2.0 Index Series seeks to provide a means to reduce the downside risk of a typical risk control strategy by adding a replicated constant-maturity put option. The historical performance shows that this strategy has at times been effective in delivering lower volatility and smaller drawdowns. Compared with some other volatility-reducing strategies, it has also tended to exhibit higher upside capture ratios. The performance characteristics of the managed risk 2.0 strategy make it a viable candidate for different uses in market participants' portfolios. Whether as part of strategic core equity allocation or as a complement to or replacement of a more traditional buy-and-hold stock or bond allocation, the managed risk 2.0 approach offers a useful tool to help market participants as they seek to achieve long-term return goals while effectively managing risk.

## APPENDIX A: S&P MANAGED RISK 2.0 INDEX SERIES TICKERS

**Exhibit 18: S&P Managed Risk 2.0 Index Series Tickers**

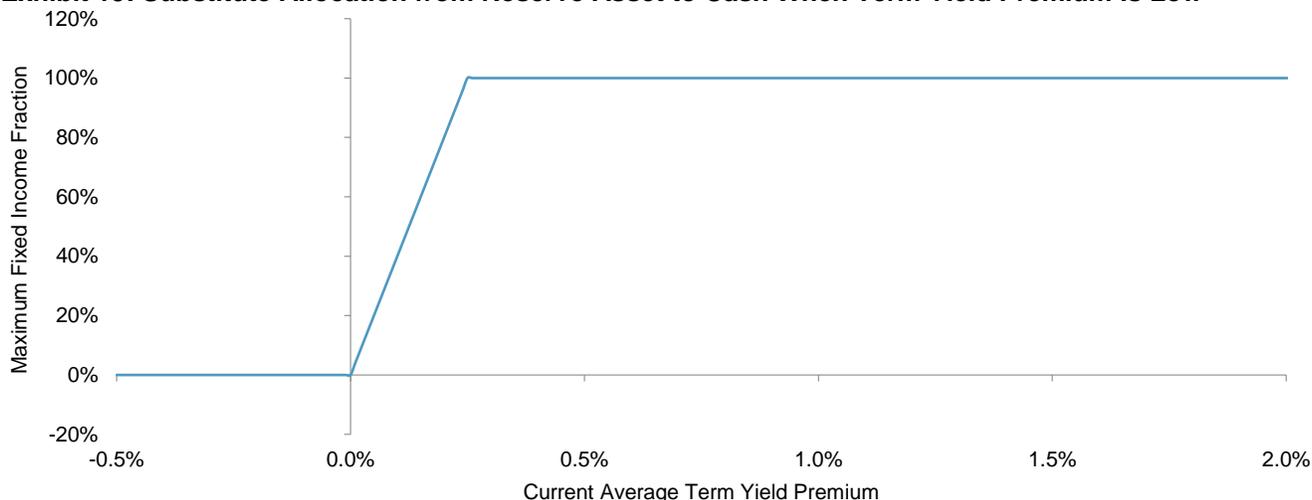
INDEX	BLOOMBERG
S&P 500 Managed Risk 2.0 Index	SPXMR2
S&P 400 Managed Risk 2.0 Index	SPMMR2
S&P 600 Managed Risk 2.0 Index	SPSMR2
S&P EM 100 Managed Risk 2.0 Index	SPEMMR2
S&P EPAC Ex. Korea LargeMidCap Managed Risk 2.0 Index	SPBEMR2

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

## APPENDIX B: FINAL WEIGHTS ADJUSTMENT METHODOLOGY

There are two adjustments to the final exposure to equity and the reserve asset. First, underperformance may be experienced at times from the reserve asset index, particularly when the yield curve is inverted. Therefore, exposure to the reserve asset index is limited in whole or in part when its term yield premium is negative for a protracted period, as illustrated in Exhibit 19.

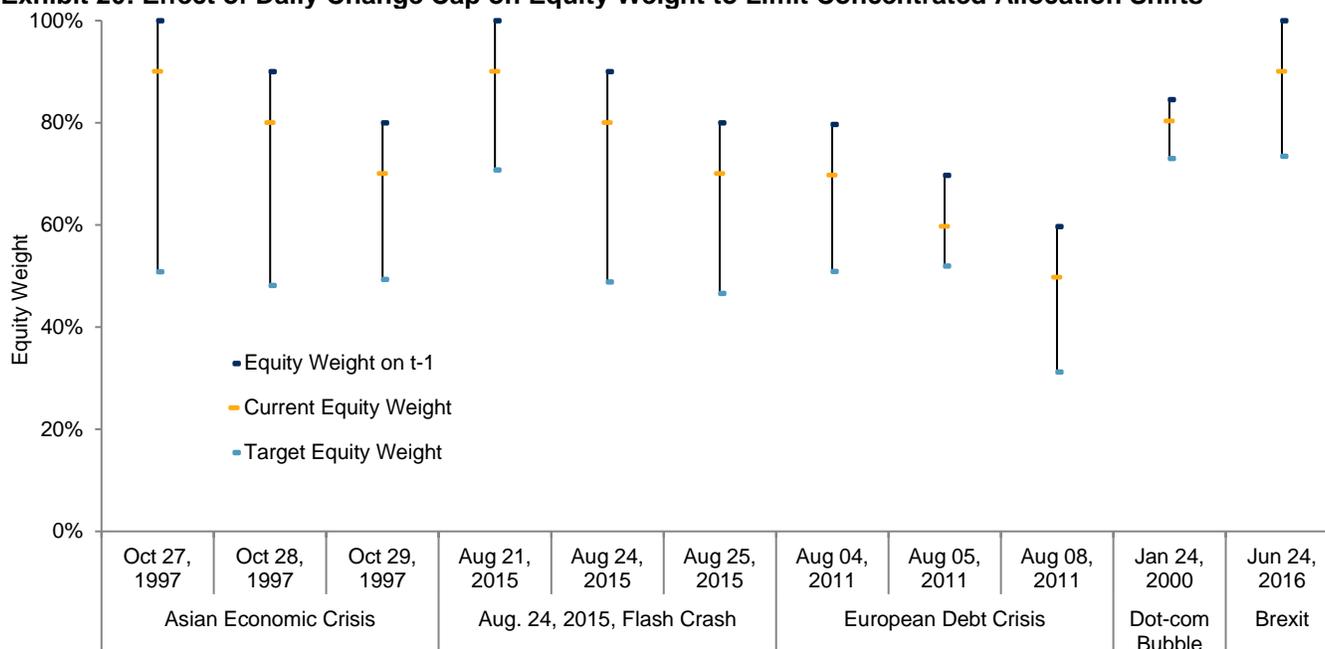
**Exhibit 19: Substitute Allocation from Reserve Asset to Cash When Term Yield Premium Is Low**



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

Second, daily changes in equity and reserve asset weights are capped to smooth the impact from idiosyncratic market timing that can result from concentrated allocation shifts. Exhibit 20 shows three incidences when this daily change cap kicks in. For example, on Aug. 24, 2015, the equity exposure to be implemented on T+2 was 80%, although the target exposure without smoothing was 49%.

**Exhibit 20: Effect of Daily Change Cap on Equity Weight to Limit Concentrated Allocation Shifts**



Source: S&P Dow Jones Indices LLC. Data from October 1997 to March 2020. Chart is provided for illustrative purposes.

## APPENDIX C: S&P MANAGED RISK 2.0 INDEX SERIES PARAMETERS

**Exhibit 21: S&P Managed Risk 2.0 Index Series Parameters**

METRIC	VALUE
<b>PUT OPTION REPLICATION CALCULATION</b>	
Time to Maturity (Put Option), $T$	5 Years
Strike Multiplier ( $k$ )	0.80
Protection Mean Reversion Period Down	2.00
Protection Mean Reversion Period Up	0.75
<b>EXPONENTIALLY WEIGHTED VARIANCE AND COVARIANCE CALCULATION</b>	
Short-Term Decay Factor ( $\lambda_s$ )	0.94
Long-Term Decay Factor ( $\lambda_L$ )	0.97
<b>VOLATILITY-MANAGED WEIGHTS CALCULATION</b>	
Target Volatility	22%
Target Volatility Band*	1%
<b>DAILY CHANGE CAP CALCULATION</b>	
Cash Money Market Rate	U.S. Overnight Federal Funds Rate
Yield Premium Mean Reversion Period	2.50
Lower Yield Premium	0.00%
Upper Yield Premium	0.25%
Minimum Daily Allocation Change*	3.0% - S&P 500 Managed Risk 2.0 Index and S&P EM 100 Managed Risk 2.0 Index
	5.0% - S&P 400 Managed Risk 2.0 Index, S&P 600 Managed Risk 2.0 Index, and S&P EPAC Ex. Korea LargeMidCap Managed Risk 2.0 Index
Maximum Daily Allocation Change	10%

Source: S&P Dow Jones Indices LLC. Table is provided for illustrative purposes. \* On March 20, 2020, the Target Volatility Threshold was expanded from 0.5% to 1%, and the Minimum Daily Allocation Change was introduced.

## PERFORMANCE DISCLOSURE

The S&P 500 Managed Risk 2.0 Index, S&P 400 Managed Risk 2.0 Index, S&P 600 Managed Risk 2.0 Index, and S&P EPAC Ex. Korea LargeMidCap Managed Risk 2.0 Index were launched January 23, 2017. The S&P EM 100 was launched August 27, 2018. The S&P EM 100 Managed Risk 2.0 Index was launched September 4, 2018. The S&P U.S. Treasury Bond Current 5-Year Index was launched September 13, 2013. The S&P U.S. Treasury Bill 0-3 Month Index was launched March 24, 2010. The S&P EPAC Ex-Korea LargeMidCap was launched December 7, 2015. The S&P U.S. Aggregate Bond Index was launched July 15, 2014. The S&P Global Developed Sovereign Ex-U.S. Bond Index was launched January 22, 2017. The S&P 500 Dynamic VEQTOR Index was launched November 18, 2009. The S&P 500 Low Volatility Index was launched April 4, 2011. 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. However, when creating back-tested history for periods of market anomalies or other periods that do not reflect the general current market environment, index methodology rules may be relaxed to capture a large enough universe of securities to simulate the target market the index is designed to measure or strategy the index is designed to capture. For example, market capitalization and liquidity thresholds may be reduced. Complete index methodology details are available at [www.spdji.com](http://www.spdji.com). 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.

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.

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](http://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.

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