S&P Dow Jones Indices

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EDUCATION
Strategy 101

CONTRIBUTORS

Tianyin Cheng
Director
Strategy and ESG Indices
tianyin.cheng@spglobal.com

Berlinda Liu
Senior Director
Global Research & Design
berlinda.liu@spglobal.com

Vinit Srivastava
Managing Director
Head of Strategy and
ESG Indices
vinit.srivastava@spglobal.com

Introducing the S&P Risk Parity Indices

The principles behind risk parity relate to answering a deceptively straightforward question: What is diversification? Traditionally, investors have allocated their capital among multiple asset classes to achieve diversification, such as the 60/40 equity/bond blend. Such an approach leads to a disproportionate allocation of risk across asset classes, with equities taking up most of the risk allocation.

A risk parity strategy aims for balanced risk contribution from all asset classes. We understand that asset class returns are generally proportional to the risk taken (according to Capital Market Pricing Model) and that a diversified portfolio consisting of relatively uncorrelated assets may reduce risk without foregoing return. Different economic cycles also expose different asset classes to different levels of risk. Risk parity strategies take these factors into account and aim to balance risk contribution from a mix of assets and apply leverage to the overall portfolio, which can help to meet the twin challenges of achieving higher returns, while reducing risk in a diversified portfolio.

Key advantages of the S&P Risk Parity Indices include transparency, investability, and no survivorship bias.

Since the first risk parity fund—Bridgewater's All Weather fund—premiered in 1996, many investment companies have begun offering risk parity funds to their clients, especially in the aftermath of the global financial crisis in 2008. Such strategies lacked an appropriate benchmark, and most investors used a traditional 60/40 mix to benchmark the returns of risk parity funds. The issue that can arise from this is that most of these benchmarks do not reflect either the construction or the risk/return expectations from such strategies. In addition, risk parity strategies have been largely in the domain of active management, even though these strategies are systematic and lend themselves well to passive implementation.

The purpose of the S&P Risk Parity Indices is to provide appropriate benchmarks for risk parity and to provide an alternative to investors who are looking for a passive investable solution. The benchmarks also reflect the risk/return characteristics of funds offered in this space. Key advantages of these indices include the following.

1. **Transparent Methodology:** As with every index published by S&P Dow Jones Indices (S&P DJI), the index methodology is available publicly online.

2. **Investable:** These indices are constructed bottom up using liquid futures instruments. S&P DJI publishes the allocation of the indices to each of these instruments daily, along with the pro-forma allocation prior to the roll of those contracts. We choose liquid, representative contracts in the index design in order to target investability. In addition to be being investable, the index returns are fully replicable for similar reasons. Fund-based benchmarks are not investable by design, nor are they replicable.
3. **No Survivorship Bias:** A fund-based benchmark, which is what was previously available in the market, is subject to survivorship bias.

The family consists of three subindices reflecting volatility targets of 10%, 12%, and 15%.

HOW S&P RISK PARITY WORKS

Risk parity as a concept is widely used, but there are variations in implementation. Differences arise from the asset classes (and the instruments) chosen in the strategy, the risk measurement used, and the handling of the assets' risk contribution to the portfolio.

The Asset Classes

To construct risk parity strategies, a wide range of assets can be included, such as equities, fixed income, currency, commodities, real estate, and hedge funds.

For the S&P Risk Parity Indices, we use three asset classes: equity, fixed income, and commodities.

For the S&P Risk Parity Indices, we use three asset classes: equity, fixed income, and commodities, which are generally considered the most liquid asset classes. Further, we use futures contracts to represent the three asset classes. For each futures contract that is used, we apply a minimum annual total dollar value traded (TDVT) of USD 5 billion to ensure replicability and tradability. Exhibit 1 shows the constituents and Appendix A provides further detail of the futures contracts associated with the subasset classes listed in Exhibit 1.

Exhibit 1: Constituents of the S&P Risk Parity Indices

EQUITY	FIXED INCOME	COMMODITIES
S&P 500®	U.S. T-Notes (5-year)	Natural Gas
Euro Stoxx 50	U.S. T-Notes (10-year)	Heating Oil #2
Nikkei 225 Futures	U.S. T-Bonds (30-year)	Gas Oil
	Long Gilt	Crude Oil
	Euro-Bund	Brent Crude
	Euro-Bobl	Gasoline
	JGB (10-year)	Sugar #11
		Live Cattle
		Coffee "C"
		Cotton #2
		Soybeans
		Corn
		Wheat
		Copper
		Gold (100 oz.)
		Silver

Source: S&P Dow Jones Indices LLC. Data as of July 2018. Table is provided for illustrative purposes.

Risk Measurement

The standard deviation of portfolio returns is the most widely used measure of risk. This works within the same framework as Harry Markowitz's mean-variance approach. Risk measurements are generally based on long-term historical behavior of different asset classes.

In S&P DJI's risk parity approach, we use long-term realized volatility to measure risk.

In S&P DJI's risk parity approach, we use long-term realized volatility to measure risk. The lookback window has a minimum five-year history at the beginning of our back-test period and is capped at 15 years as we accumulate more data. We chose the initial five-year minimum so that we could provide a long enough history for the index series. A longer lookback period is required to ensure that the asset class allocations are stable and not affected by shorter-term market movements. Hence, we use all the available data, up to a 15-year lookback window, in our testing.

To avoid dependence on volatility forecasting models, we use realized volatility rather than forecasted volatility in our calculations. To calculate realized volatility, the daily profit and loss of futures in U.S. dollars are used, which takes into consideration daily futures price change, relative current contract size, and foreign exchange moves (for futures not listed in U.S. dollars).

Risk Contribution Measurement

The contribution of each asset class to the total risk of the portfolio is well defined when risk is measured by volatility. Theoretically, we can use an optimizer to adjust the weights until the marginal contributions of all asset classes are equal. This also requires the estimation and use of a covariance matrix between the asset classes in order to account for the correlation effects. However, the computational complexity of the estimation of the covariance matrix increases drastically with the addition of asset classes and extension of the look-back period. In reality, investors have been looking for simplified alternatives to implement risk parity strategies, such as setting each asset's weight to be proportional to the inverse of the asset's standard deviation.

The approach used by the S&P Risk Parity Indices targets a similar amount of volatility from each asset class.

The approach used by the S&P Risk Parity Indices targets a similar amount of volatility from each asset class. In order to do this, we calculate the position weight simply as the predefined target volatility divided by the long-term realized volatility for each asset class.

Due to the correlation among asset classes, the realized volatility of the risk parity portfolio would usually be lower than the target volatility. We then apply a leverage factor to achieve the target volatility. This approach avoids estimating the variance-covariance matrix, while addressing the correlation effects.

Within each asset class, we then combine the futures contracts using the same approach to ensure equal risk contribution from futures to the asset class to which they belong. We repeat this process each month and rebalance to the new weights.

S&P RISK PARITY INDEX CONSTRUCTION

There are three major steps in the S&P DJI Risk Parity Index construction.

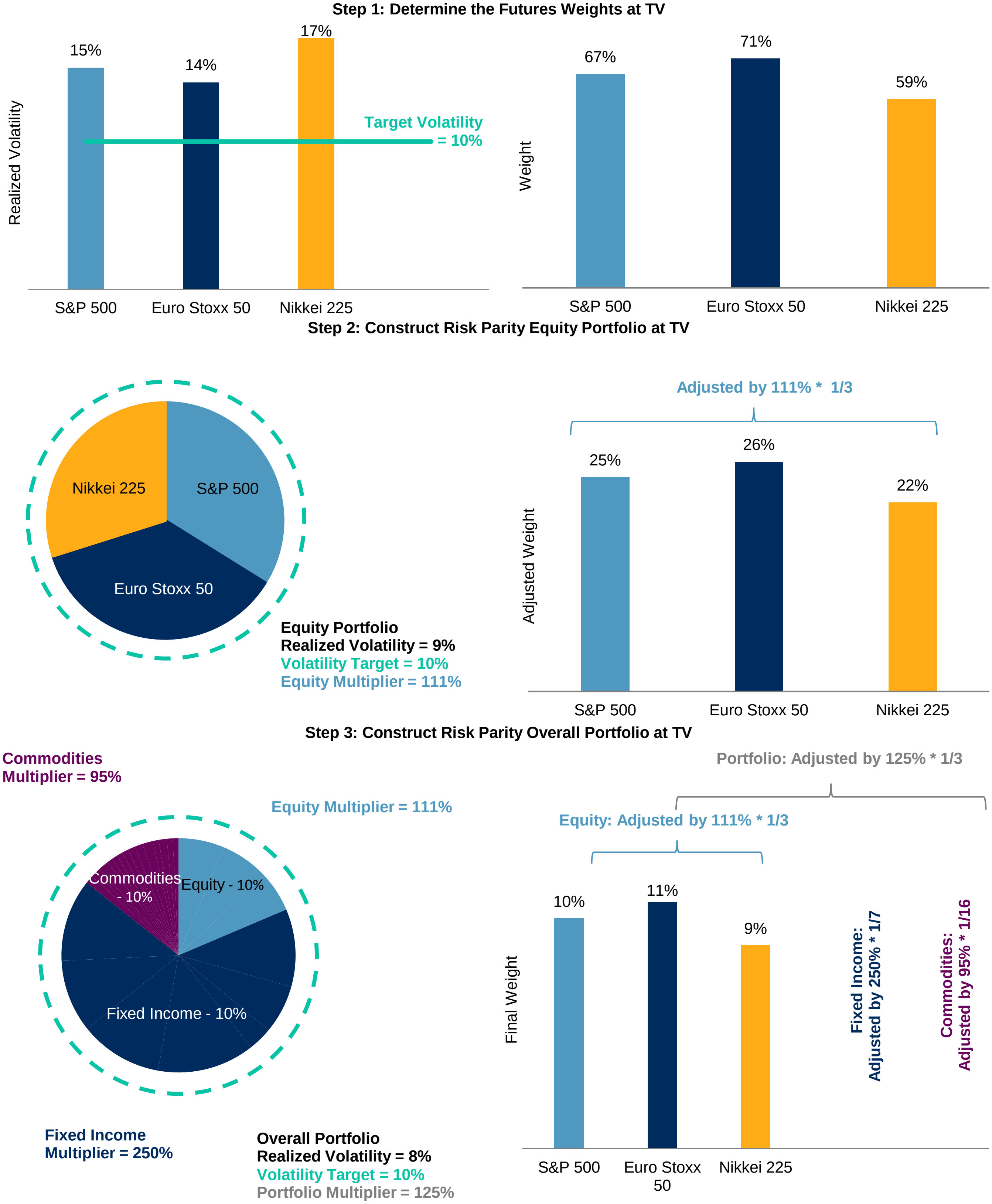
In this section, we will illustrate the index construction process of the S&P Risk Parity Index – 10% Target Volatility (TV). The futures' and asset classes' realized volatility used in the illustration are hypothetical. The TV number is set at 10% for the overall portfolio in this instance, but we also set other targets, such as 12% and 15%.

As shown in Exhibit 2, there are three major steps.

1) We use a bottom-up approach to determine the weight of each futures contract. We begin by calculating the long-term realized volatility for each futures contract. The contract position weight calculated at the beginning of each month then is simply the target volatility divided by the realized volatility for that futures contract.
2) We then group these securities into three asset classes: equity, fixed income, and commodities. For each asset class, all the futures contracts leveraged or deleverage to the target volatility are combined with an equal weight. That means the weights calculated in the previous step are divided by the number of futures in the asset class. We then compute the realized volatility of the asset class. Due to correlation among securities, the asset class' realized volatility is usually lower than the target volatility. We then derive a multiplier for the asset class that is the ratio of the target volatility to the volatility of the asset class. The weights of all the securities within that asset class are then multiplied by that multiplier so that the asset class' overall risk equals the target volatility.
3) We combine all the asset classes and compute the realized volatility of the portfolio, which is usually lower than the target volatility due to the correlation among asset classes. We again calculate a portfolio multiplier in the same manner as we did on the asset class level, which is then applied to the weights of all the futures contracts. Note that this final step was not required for the purpose of equal risk allocation among assets. We add this step to keep the portfolio's long-term risk in line with our target. The portfolio multiplier represents the dynamic leverage applied to the overall portfolio based on cross-asset correlation.

Positions of each constituent are calculated at the end of each month, using data from the end of the prior business day, and become effective on the second trading day of the next month.

Exhibit 2: Hypothetical Weighting of the S&P Risk Parity Index – 10% TV



Source: S&P Dow Jones Indices LLC. Charts are provided for illustrative purposes.

Exhibits 3 and 4 show the back-tested historical risk weights and capital weights of the S&P Risk Parity Index – 10% TV. In terms of risk allocation, the equity, fixed income, and commodities asset classes historically contributed almost equally to the overall portfolio risk, despite some fluctuations over time (see Exhibit 3). Within each asset class, futures contributed roughly the same amount of risk as well (see Appendix B for details).

Equal risk allocation did not equate to equal capital allocation.

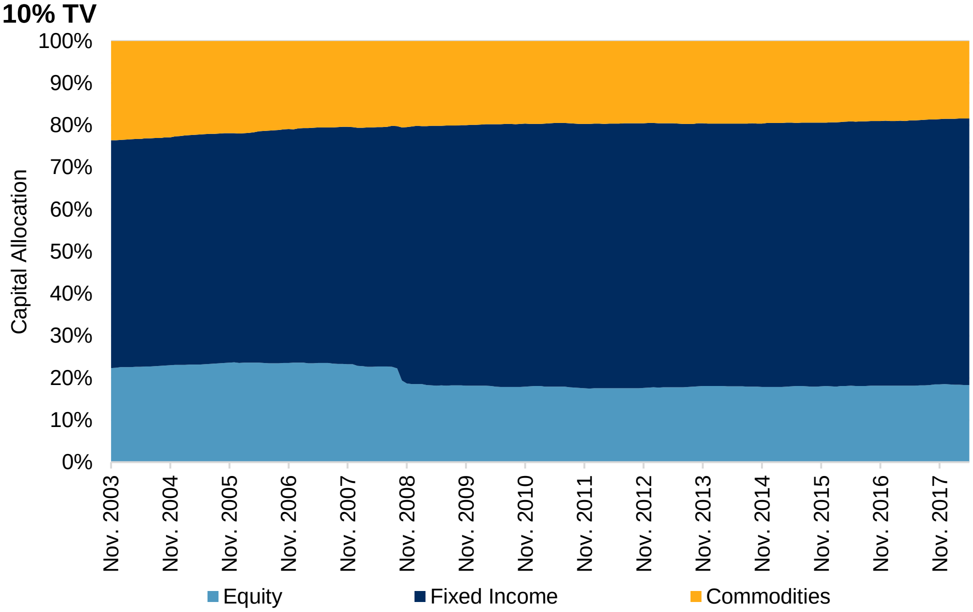
Exhibit 3: Annual Risk Allocation by Asset Class for the S&P Risk Parity Index – 10% TV

ANNUAL RISK ALLOCATION (%)	EQUITY	FIXED INCOME	COMMODITIES
Mean	33.9	32.8	33.3
Median	34.0	34.1	32.6
Maximum	42.8	38.8	43.5
Minimum	25.9	24.0	24.5
Full Period (January 2004 to May 2018)	35.9	30.1	34.0

Source: S&P Dow Jones Indices LLC. Data as of May 31, 2018. Table is provided for illustrative purposes.

Historical capital allocation is shown in Exhibit 4. As expected, equal risk allocation did not equate to equal capital allocation. Fixed income, as the least volatile asset class among the three, had the largest capital allocation to ensure its equal risk contribution to the portfolio. In the 14-year testing period, about 60% of the capital was allocated to fixed income securities (mean was 60.0%, median was 62.3%). The remaining 40% of capital was split between equities (mean was 19.8%, median was 18.2%) and commodities (mean was 20.2%, median was 19.7%) almost evenly. The allocation among the three asset classes was stable over time.

Exhibit 4: Capital Allocation by Asset Class of the S&P Risk Parity Index – 10% TV



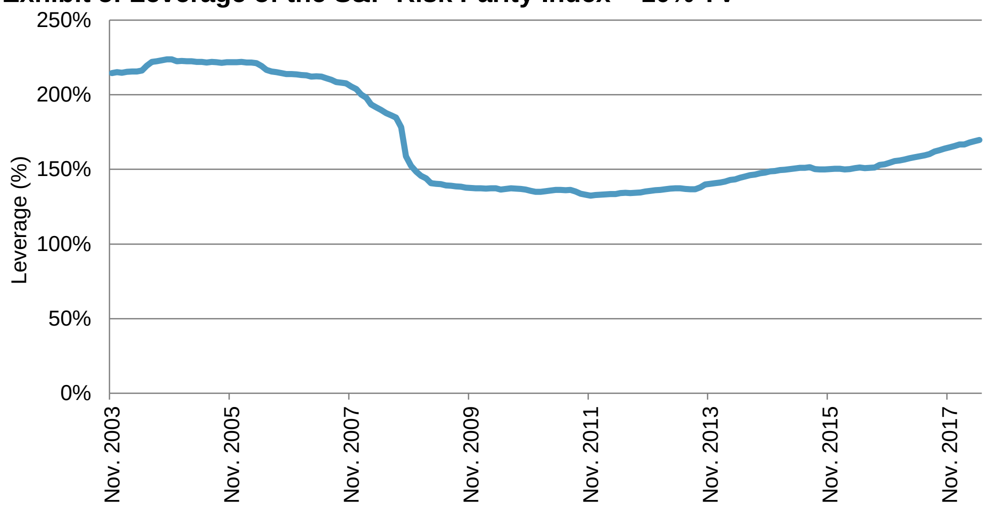
Source: S&P Dow Jones Indices LLC. Data as of May 31, 2018. Chart is provided for illustrative purposes.

Exhibit 5 shows the historical overall leverage level of the S&P Risk Parity Index – 10% TV. Leverage is calculated as the sum of the position weights of all the underlying futures contracts divided by 100%. Since we set the target volatility to 10% and the risk parity portfolio is heavily allocated to the lower volatility asset class, it is natural that the portfolio is leveraged up to achieve its target risk. Over our back-tested period, the leverage ranged between 132% and 224%. On average, the portfolio had a leverage of 168%.

Leverage is created so that the overall portfolio volatility matches the target volatility each month.

Note that leverage is created so that the overall portfolio volatility matches the target volatility each month. As such, the leverage rose in a low volatility or low-correlation market and dropped in a high-volatility or high-correlation market.

Exhibit 5: Leverage of the S&P Risk Parity Index – 10% TV



Source: S&P Dow Jones Indices LLC. Data as of May 31, 2018. Chart is provided for illustrative purposes.

How Does S&P Risk Parity Work?

The benefits of using S&P DJI's risk parity approach come from three aspects: a balanced risk exposure across asset classes, a balanced risk exposure across time for each asset, and a dynamic leverage based on cross-asset correlation.

First, a balanced risk exposure across asset classes helps to achieve the minimum-variance portfolio when the assets are uncorrelated. Assuming that the correlation between any two asset classes is zero and no leverage is allowed, then the solution to the minimum-variance optimization model that follows is an inverse volatility weighting. The minimum-variance portfolio sits on the efficient frontier and gives investors a chance to maximize the benefit of diversification.

$$\min w'\Sigma w \text{, subject to } \sum_{i=1}^{n} w_i = 1,$$

where w is the asset's weight vector and Σ is the variance-covariance matrix of the asset's returns.

Second, a balanced risk exposure across time for each asset may take advantage of the negative relationship between volatility and return, as well as the persistence of volatility. When realized volatility is high, the future volatility tends to be high as well; and when future volatility is high, the expected futures return tends be low. As such, we expect the dynamic exposure adjustment to a volatility target to add value over time.

Third, a dynamic leverage based on cross-asset correlation helps to manage overall portfolio risk. Cross-asset correlation is proportional to levels of macro volatility and shows cyclical behavior. A high level of correlation usually points to a common source of risk for asset prices. When correlation increases across asset classes, the portfolio volatility increases if everything else remains equal. Whenever this happens, it is common that risk and portfolio managers respond by reducing leverage and liquidating assets. Quite simply, leverage is a function of the correlation between asset classes—when it is low, overall portfolio risk is reduced and there is an opportunity to leverage up to the target; in times of stress, when correlations are high, such leverage is marginal, as overall portfolio risk isn't affected much by correlation effects.

One point to note is that the S&P Risk Parity Indices use a long-term lookback period to calculate the realized volatility—a minimum of a five-year history and capped at 15 years as we accumulate more data. This implies a slow adjustment to the overall portfolio leverage and the risk exposure for each asset class, as the main focus is on constructing a stable portfolio with low turnover.

S&P RISK PARITY PERFORMANCE CHARACTERISTICS

The S&P Risk Parity Indices had a Sharpe ratio 41% higher and a return over maximum drawdown 49% higher than the traditional 60/40 portfolio.

Exhibit 6 compares the historical performance of the S&P Risk Parity Indices to a hypothetical traditional 60/40 equity/bond portfolio,[1] over the period from January 2003 to May 2018. There are three key observations.

First, the S&P Risk Parity Indices with different volatility targets delivered similar Sharpe ratios and return over maximum drawdown during the period studied. This was expected, as they are essentially based on the same weighting, but with different leverage levels.

Second, the S&P Risk Parity Indices had a Sharpe ratio 41% higher and a return over maximum drawdown 49% higher than the traditional 60/40 portfolio. This significant increase in risk-adjusted returns was likely due to improved risk diversification.

Third, the S&P Risk Parity Indices delivered reduced downside compared with the traditional 60/40 portfolio during almost every major market shock event since the end of 2003, especially during the global financial crisis, the

[1] The 60/40 equity/bond portfolio is hypothetically constructed by combining the S&P Developed BMI with 60% weight and the S&P Global Developed Aggregate Ex-Collateralized Bond Index with 40% weight, rebalanced monthly.

Europe/Greece debt crisis in 2010, and the downgrade of U.S. debt in 2011. Note that these events include equity and bond market shocks. During the two oil price shocks in 2008 and 2014-2016, the S&P Risk Parity Index – 10% TV reduced downside compared with the 60/40 portfolio.

Exhibit 6: Historical Performance of the S&P Risk Parity Indices Versus a 60/40 Portfolio

METRIC	S&P RISK PARITY INDEX – 10% TV	S&P RISK PARITY INDEX – 12% TV	S&P RISK PARITY INDEX – 15% TV	60/40 EQUITY/BOND PORTFOLIO
Annual Return (%)	7.30	8.52	10.37	6.31
Annual Volatility (%)	8.34	10.03	12.59	9.90
Sharpe Ratio	0.731	0.730	0.729	0.516
Maximum Peak-to-Trough Drawdown (%)	-28.17	-33.19	-40.26	-36.42
Return Over Maximum Drawdown	0.259	0.257	0.258	0.173
CUMULATIVE RETURNS (%) – SELECT PERIODS				
Global Financial Crisis (October 2007-February 2009)	-23.6	-28.3	-34.9	-36.4
Oil Price Decline (June 2008-January 2009)	-24.1	-28.5	-34.8	-26.1
Europe/Greece Debt Crisis (March-June 2010)	0.9	1.1	1.3	-7.2
Downgrade of U.S. Debt (August-November 2011)	-1.4	-1.7	-2.2	-2.2
Oil Price Decline (June 2014-Febuary 2016)	-6.4	-7.7	-9.6	-7.0
China's Black Monday (May-September 2015)	-5.7	-6.9	-8.7	-6.1
Inflation Fears (January-March 2018)	-2.0	-2.4	-3.1	-3.4

The 60/40 equity/bond portfolio is a hypothetical portfolio.
Source: S&P Dow Jones Indices LLC. Data from January 2003 to May 2018. 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.

Performance in Different Economic Regimes

The S&P Risk Parity Indices delivered smoother performance and reduced drawdowns over the long run. However, they did not outperform the 60/40 portfolio in every environment.

Historically, the S&P Risk Parity Indices delivered smoother performance and reduced drawdowns over the long run. However, they did not outperform the 60/40 portfolio in every environment.

Theoretically, when inflation rises, risk parity strategies should tend to outperform, benefiting from a material allocation to a broad basket of commodities. When we have experienced equity bear markets, risk parity strategies have historically outperformed, given their higher allocation to reserve assets like treasury and gold, considered flight-to-safety assets. In equity bull markets, equities tended to be the best-performing asset on a risk-adjusted basis, so risk parity strategies would have a tough time outperforming the 60/40 portfolio, given the lower allocation to equities.

To study how the indices performed during different business cycle regimes, we broke down U.S. business cycles into four regimes—

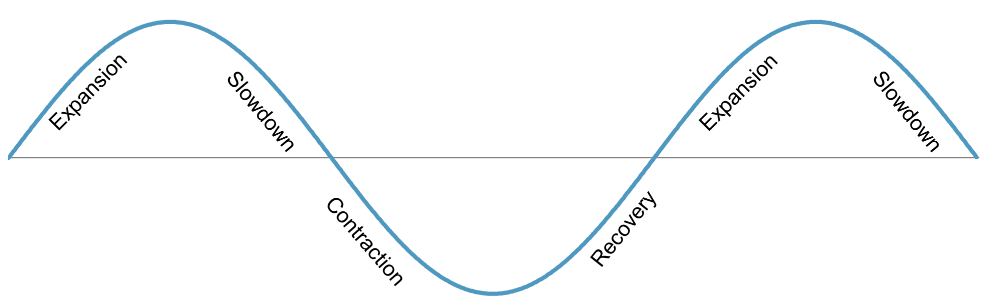
expansion, slowdown, contraction, and recovery—and looked at performance in these four regimes.

For simplicity, the U.S. business cycles were defined using the Chicago Fed National Activity Index (CFNAI), which is designed to gauge economic activity and related inflationary pressures, as an indicator of business cycle turning points.[2] We calculated the three-month average and change of the CFNAI and defined the business cycles as seen in Exhibit 7. In the period studied, 77 months were classified as recovery phases, representing 45% of the overall time. Expansion, slowdown, and contraction each had between 30 and 34 months.

Exhibit 7: U.S. Business Cycles Defined by CFNAI

		THREE-MONTH GROWTH OF CNFAI	
		>=0	**<0**
THREE-MONTH AVERAGE OF CNFAI	**>=0**	Expansion	Slowdown
	<0	Recovery	Contraction*

*If we are in a recovery phase and the signal moves to a contraction phase, we wait a month for confirmation of a contraction phase before switching to a contraction regime.



Source: S&P Dow Jones Indices LLC. Table and chart are provided for illustrative purposes.

The S&P Risk Parity Indices, regardless of the volatility targets, had significant outperformance against the hypothetical 60/40 portfolio in the slowdown and contraction phases.

Exhibit 8 shows how the S&P Risk Parity Indices performed on average during the business cycles. We can see that the S&P Risk Parity Indices, regardless of the volatility targets, had significant outperformance against the hypothetical 60/40 portfolio in the slowdown and contraction phases, while they underperformed in the expansion and recovery phases.

[2] The CFNAI is a weighted average of 85 indicators of national economic activity drawn from four broad data categories: production and income; personal consumption and housing; employment, unemployment, and hours; and sales, orders, and inventories. A zero value for the index indicates that the national economy is expanding at its historical trend rate of growth, negative values indicate below-average growth, and positive values indicate above-average growth. Current CFNAI data are available at the Federal Reserve Bank of Chicago's website at www.chicagofed.org/research/data/cfnai/current-data.

We can see that the contraction phase was the best for the S&P Risk Parity Indices, while the recovery phase was the toughest. During the contraction phase, the S&P Risk Parity Indices significantly outperformed the 60/40 portfolio by 1.85% to 2.85% a month, depending on the volatility target in the period studied. During the recovery phase, they underperformed by 5 to 46 bps a month. However, from a statistical point of view, the performance difference was not significant, even at a 0.1 level.

The return attribution of the three asset classes varied significantly from year to year, due to changes in the performance of individual asset classes, correlation between asset classes, and overall portfolio performance.

Exhibit 8: S&P Risk Parity Indices in Different U.S. Business Cycles

ECONOMIC REGIME	S&P RISK PARITY INDEX – 10% TV	S&P RISK PARITY INDEX – 12% TV	S&P RISK PARITY INDEX – 15% TV	60/40 EQUITY/BOND PORTFOLIO
AVERAGE MONTHLY RETURNS (%)				
Expansion	0.92	1.07	1.30	0.99
Slowdown	0.83	0.98	1.23	0.46
Contraction	0.77	0.91	1.13	0.35
Recovery	0.35	0.40	0.49	0.51
DIFFERENCE BETWEEN AVERAGE MONTHLY RETURNS OF S&P RISK PARITY INDICES AND 60/40 PORTFOLIO (TWO-SAMPLE T-STATS AND SIGNIFICANCE LEVEL)				
Expansion	-0.38	0.38	1.31	-
Slowdown	1.55	1.98**	2.50**	-
Contraction	1.85*	2.30**	2.85***	-
Recovery	-0.46	-0.28	-0.05	-

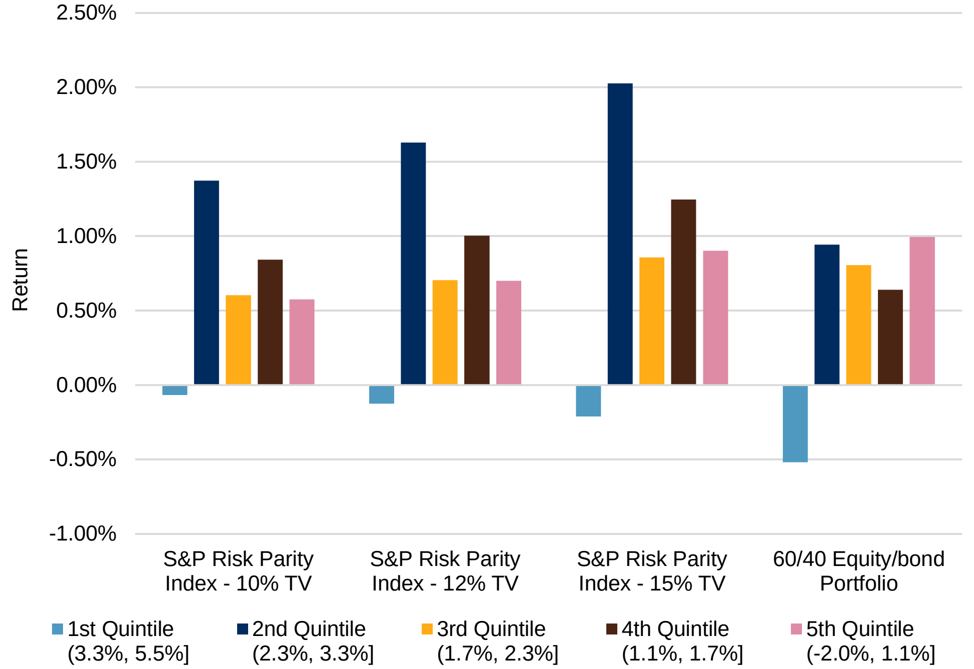
The 60/40 equity/bond portfolio is a hypothetical portfolio.
Source: S&P Dow Jones Indices LLC. Data as of May 31, 2018. Index performance based on monthly total return in USD. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.
*** Significant difference at 0.01 level
** Significant difference at 0.05 level
* Significant difference at 0.10 level

Inflation Hedge

One of the key potential benefits of the risk parity strategies is the historical inflation hedge that it has provided. To illustrate this, we studied the relationship between the indices' monthly returns and inflation rates[3] compared with the traditional 60/40 portolfio. Exhibit 9 shows that over the 14-year testing period, the S&P Risk Parity Indices with 10%, 12%, and 15% TV outperformed the 60/40 portfolio by a monthly average of 45 bps, 39 bps, and 31 bps, respectively, in the high-inflation months (1st quintile). They underperformed the 60/40 portfolio in the low-inflation months (5th quintile) by 42 bps, 29 bps, and 9 bps, respectively.

[3] Inflation was measured by year-over-year changes in the U.S. Consumer Price Index (Consumer Price Index for All Urban Consumers: All Items, Index 1982-1984=100, Monthly, Seasonally Adjusted, Source: U.S. Bureau of Labor Statistics). The monthly inflation rate was ranked from high to low for the period from January 2003 to May 2018, and divided into five quintiles. This analysis was performed from the hypothetical point of view of investors based in the U.S. or having exposure to U.S. inflation in their portfolios.

Exhibit 9: Average Monthly Return of the S&P Risk Parity Indices Versus the 60/40 Portfolio During Different Inflation Periods



Source: S&P Dow Jones Indices LLC and U.S. Bureau of Labor Statistics. Data from Dec. 31, 2003 to May 31, 2018. 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.

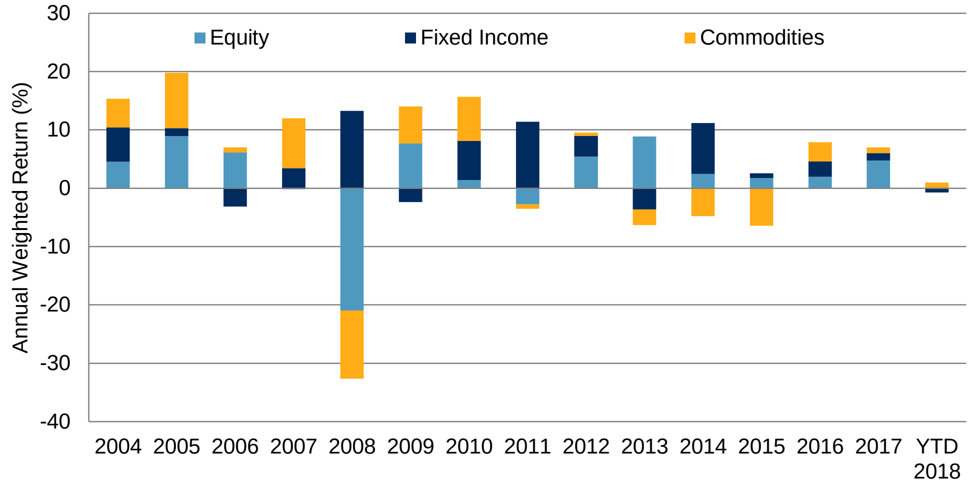
Return Attribution

Exhibit 10 illustrates the historical annual return attributed to the equity, fixed income, and commodities asset classes to the S&P Risk Parity Index – 10% TV. The return attribution of each futures contract is illustrated in Appendix B.

There were two key observations. First, fixed income contributed the highest return to the overall portfolio over the full period studied. This was not a surprise. Since low volatility assets tend to be overweighted in risk parity strategies, we expected them to generate more return in the portfolio.

Second, the return attribution of the three asset classes varied significantly from year to year, due to changes in the performance of individual asset classes, correlation between asset classes, and overall portfolio performance. In 2008, equity and commodities experienced market drawdowns and only fixed income had a positive return. The overall portfolio posted a loss. The return attribution in 2008 clearly showed the diversification benefit from adding a fixed income instrument through its negative correlation with equity and commodity returns.

Exhibit 10: Annual Weighted Return by Asset Class for the S&P Risk Parity Index – 10% TV



ANNUAL RETURN (%)	EQUITY	FIXED INCOME	COMMODITIES
Mean	2.01	3.28	1.15
Median	2.47	2.62	0.93
Maximum	8.91	13.29	9.47
Minimum	-20.94	-3.64	-11.70
Full Period (January 2004 to May 2018)	1.97	3.39	1.10

Source: S&P Dow Jones Indices LLC. Data as of May 31, 2018. Past performance is no guarantee of future results. Table and chart 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.

The S&P Risk Parity Index Series uses a transparent, rules-based methodology to construct risk parity benchmarks that are easy to understand and replicate.

CONCLUSION

Risk parity, at its core, is an argument about the importance of diversification—across time and across asset classes. There are various ways risk parity strategies can be implemented, making it difficult to define a proper benchmark for risk parity funds and strategies. The S&P Risk Parity Index Series uses a transparent, rules-based methodology to construct risk parity benchmarks that are easy to understand and replicate. As shown by the historical performance of the S&P Risk Parity Indices, risk parity did not outperform a traditional 60/40 portfolio in all economic environments; however, it could provide a potentially smoother path of returns due to the inherent risk diversification. Benefiting from a material allocation to a broad basket of commodities, they could also offer a hedge to inflation that cannot be found in a 60/40 portfolio.

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APPENDIX A: FUTURES CONTRACTS AND ROLL SCHEDULES

Exhibit A1: Futures Contracts

CATEGORY	CONSTITUENT	EXCHANGE	SECTOR	CURRENCY
COMMODITIES				
Energy	Natural Gas	NYMEX	E	USD
	Heating Oil #2	NYMEX	E	USD
	Gas Oil	ICE	E	USD
	Crude Oil	NYMEX	E	USD
	Brent Crude	ICE	E	USD
	Gasoline	NYMEX	E	USD
Softs & Livestock	Sugar #11	NYBOT	C	USD
	Live Cattle	CME	C	USD
	Coffee "C"	NYBOT	C	USD
	Cotton #2	NYBOT	C	USD
Grains	Soybeans	CBOT	C	USD
	Corn	CBOT	C	USD
	Wheat	CBOT	C	USD
Metals	Copper	NYMEX	C	USD
	Gold (100 oz.)	COMEX	C	USD
	Silver	COMEX	C	USD
FIXED INCOME				
U.S.	T-Notes (10-year)	CBOT	FI	USD
	T-Notes (5-year)	CBOT	FI	USD
	T-Bonds (30-year)	CBOT	FI	USD
Europe	Long Gilt	ICE	FI	GBP
	Euro-Bund	EUREX	FI	EUR
	Euro-Bobl	EUREX	FI	EUR
Asia	JGB (10-year)	TSE	FI	JPY
EQUITY				
U.S.	S&P 500	CME	SI	USD
Europe	Euro Stoxx 50	EUREX	SI	EUR
Asia	Nikkei 225 Futures	OSE	SI	JPY

Source: S&P Dow Jones Indices LLC. Data as of July 2018. Table is provided for illustrative purposes.

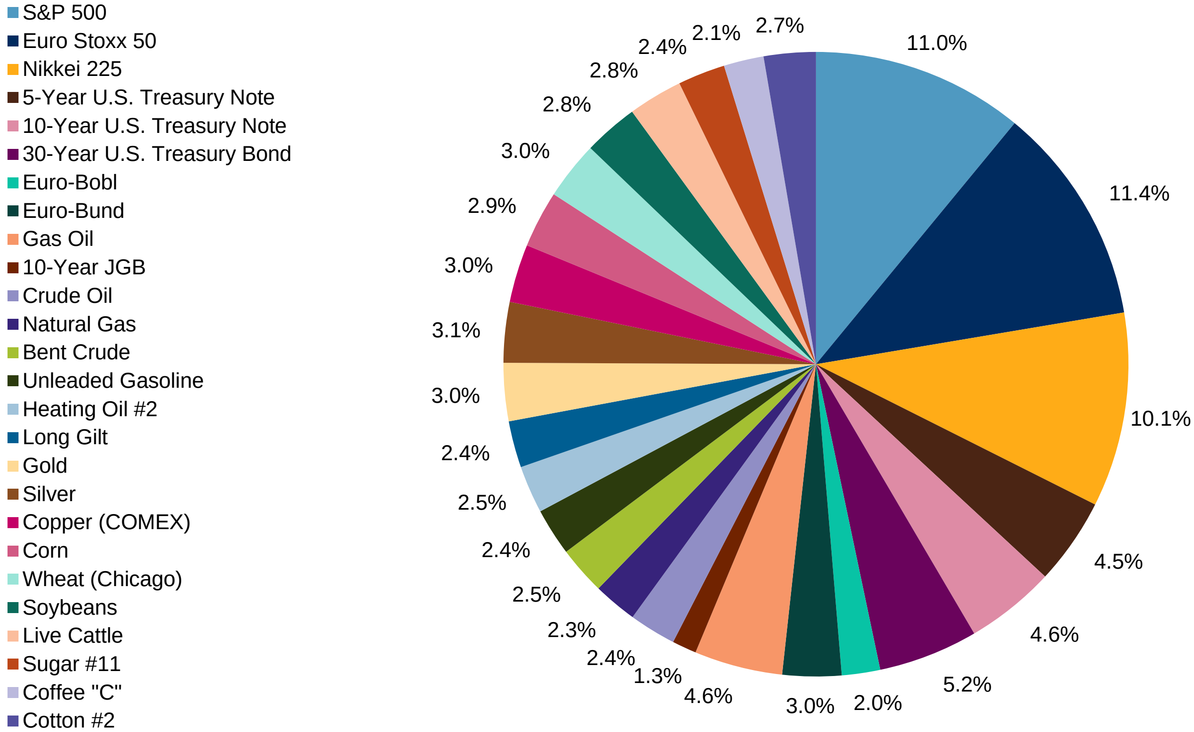
Exhibit A2: Schedule of Contract Months

FUTURES CONTRACT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Coffee "C"	H	K	K	N	N	U	U	Z	Z	Z	H	H
Sugar #11	H	K	K	N	N	V	V	V	H	H	H	H
Cotton #2	H	K	K	N	N	Z	Z	Z	Z	Z	H	H
Corn	H	K	K	N	N	U	U	Z	Z	Z	H	H
Soybeans	H	K	K	N	N	X	X	X	X	F	F	H
Live Cattle	J	J	M	M	Q	Q	V	V	Z	Z	G	G
Wheat	H	K	K	N	N	U	U	Z	Z	Z	H	H
Copper	H	K	K	N	N	U	U	Z	Z	Z	H	H
Gold (100 oz.)	J	J	M	M	Q	Q	Z	Z	Z	Z	G	G
Silver	H	K	K	N	N	U	U	Z	Z	Z	H	H
Crude Oil	H	J	K	M	N	Q	U	V	X	Z	F	G
Heating Oil #2	H	J	K	M	N	Q	U	V	X	Z	F	G
Gasoline	H	J	K	M	N	Q	U	V	X	Z	F	G
Natural Gas	H	J	K	M	N	Q	U	V	X	Z	F	G
Gas Oil	H	J	K	M	N	Q	U	V	X	Z	F	G
Brent Crude	J	K	M	N	Q	U	V	X	Z	F	G	H
U.S. T-Notes (10-year)	H	M	M	M	U	U	U	Z	Z	Z	H	H
U.S. T-Bonds (30-year)	H	M	M	M	U	U	U	Z	Z	Z	H	H
U.S. T-Notes (5-year)	H	M	M	M	U	U	U	Z	Z	Z	H	H
Long Gilt	H	M	M	M	U	U	U	Z	Z	Z	H	H
Euro-Bund	H	M	M	M	U	U	U	Z	Z	Z	H	H
Euro-Bobl	H	M	M	M	U	U	U	Z	Z	Z	H	H
JGB (10-year)	H	M	M	M	U	U	U	Z	Z	Z	H	H
S&P 500	H	H	M	M	M	U	U	U	Z	Z	Z	H
Euro Stoxx 50	H	H	M	M	M	U	U	U	Z	Z	Z	H
Nikkei 225 Futures	H	M	M	M	U	U	U	Z	Z	Z	H	H

Source: S&P Dow Jones Indices LLC. Data as of July 2018. Table is provided for illustrative purposes.

APPENDIX B: RISK/RETURN ATTRIBUTION PER SECURITY

Exhibit B1a: Individual Instrument Risk Attribution



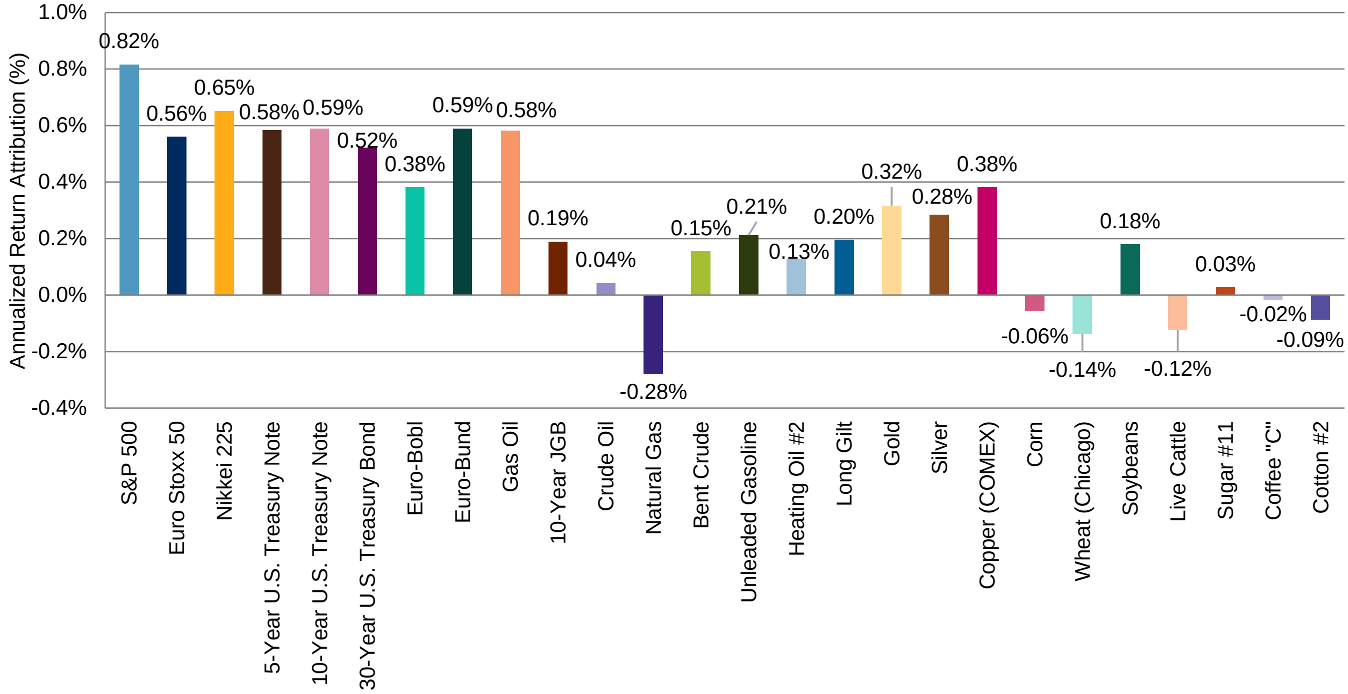
Source: S&P Dow Jones Indices LLC. Data from January 2004 to May 2018. Chart is provided for illustrative purposes.

Exhibit B1b: Individual Instrument Risk Attribution

EQUITY	RISK ATTRIBUTION (%)	FIXED INCOME	RISK ATTRIBUTION (%)	COMMODITIES	RISK ATTRIBUTION (%)
S&P 500	3.1	U.S. T-Notes (5-year)	1.3	Natural Gas	0.6
Euro Stoxx 50	3.2	U.S. T-Notes (10-year)	1.3	Heating Oil #2	0.7
Nikkei 225 Futures	2.0	U.S. T-Bonds (30-year)	1.5	Gas Oil	0.7
Total	**7.1**	Long Gilt	1.3	Crude Oil	0.7
		Euro-Bund	0.6	Brent Crude	0.7
		Euro-Bobl	0.9	Gasoline	0.7
		JGB (10-year)	0.4	Sugar #11	0.7
		Total	**5.9**	Live Cattle	0.8
				Coffee “C”	0.6
				Cotton #2	0.8
				Soybeans	0.8
				Corn	0.8
				Wheat	0.8
				Copper	0.9
				Gold (100 oz.)	0.8
				Silver	0.9
				Total	**6.6**

Source: S&P Dow Jones Indices LLC. Data from January 2004 to May 2018. Table is provided for illustrative purposes.

Exhibit B2a: Individual Instrument Annualized Return Attribution



Source: S&P Dow Jones Indices LLC. Data from January 2004 to May 2018. Chart is provided for illustrative purposes.

Exhibit B2b: Individual Instrument Annualized Return Attribution

EQUITY	RETURN ATTRIBUTION (%)	FIXED INCOME	RETURN ATTRIBUTION (%)	COMMODITIES	RETURN ATTRIBUTION (%)
S&P 500	1.0	U.S. T-Notes (5-year)	0.7	Natural Gas	-0.3
Euro Stoxx 50	0.7	U.S. T-Notes (10-year)	0.7	Heating Oil #2	0.2
Nikkei 225 Futures	0.8	U.S. T-Bonds (30-year)	0.6	Gas Oil	0.3
Total	**2.4**	Long Gilt	0.7	Crude Oil	0.0
		Euro-Bund	0.5	Brent Crude	0.2
		Euro-Bobl	0.7	Gasoline	0.2
		JGB (10-year)	0.2	Sugar #11	0.0
		Total	**4.0**	Live Cattle	-0.2
				Coffee “C”	0.0
				Cotton #2	-0.1
				Soybeans	0.2
				Corn	-0.1
				Wheat	-0.2
				Copper	0.5
				Gold (100 oz.)	0.4
				Silver	0.3
				Total	**1.2**

Source: S&P Dow Jones Indices LLC. Data from January 2004 to May 2018. Table is provided for illustrative purposes.

S&P DJI RESEARCH CONTRIBUTORS		
Charles Mounts	Global Head	charles.mounts@spglobal.com
Jake Vukelic	Business Manager	jake.vukelic@spglobal.com
GLOBAL RESEARCH & DESIGN		
AMERICAS		
Aye M. Soe, CFA	Americas Head	aye.soe@spglobal.com
Phillip Brzenk, CFA	Director	phillip.brzenk@spglobal.com
Smita Chirputkar	Director	smita.chirputkar@spglobal.com
Rachel Du	Senior Analyst	rachel.du@spglobal.com
Bill Hao	Director	wenli.hao@spglobal.com
Qing Li	Director	qing.li@spglobal.com
Berlinda Liu, CFA	Director	berlinda.liu@spglobal.com
Maria Sanchez	Associate Director	maria.sanchez@spglobal.com
Kelly Tang, CFA	Director	kelly.tang@spglobal.com
Hong Xie, CFA	Director	hong.xie@spglobal.com
APAC		
Priscilla Luk	APAC Head	priscilla.luk@spglobal.com
Utkarsh Agrawal, CFA	Associate Director	utkarsh.agrawal@spglobal.com
Akash Jain	Associate Director	akash.jain@spglobal.com
Liyu Zeng, CFA	Director	liyu.zeng@spglobal.com
EMEA		
Sunjiv Mainie, CFA, CQF	EMEA Head	sunjiv.mainie@spglobal.com
Leonardo Cabrer, PhD	Senior Analyst	leonardo.cabrer@spglobal.com
Andrew Cairns	Senior Analyst	andrew.cairns@spglobal.com
Andrew Innes	Associate Director	andrew.innes@spglobal.com
INDEX INVESTMENT STRATEGY		
Craig J. Lazzara, CFA	Global Head	craig.lazzara@spglobal.com
Fei Mei Chan	Director	feimei.chan@spglobal.com
Tim Edwards, PhD	Managing Director	tim.edwards@spglobal.com
Anu R. Ganti, CFA	Director	anu.ganti@spglobal.com
Hamish Preston	Senior Associate	hamish.preston@spglobal.com
Howard Silverblatt	Senior Index Analyst	howard.silverblatt@spglobal.com

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