RUTTER ASSOCIATES LLC

Evaluating Structured Products

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May 11, 2016

Abstract

Small institutional and retail investors are often faced with the daunting challenge of choosing among the myriad structured product offerings presented by security dealers as alternatives to long-only asset allocation. Most of these offer either enhanced upside return potential, reduced downside, or a combination of both *over certain ranges* of price evolution. All investors, of course, realize that these products are structured with an embedded mark-up to allow a dealer to lock in a profit via hedging, but very few have the means to calculate that mark-up and comparison shop unlike in the market for new autos, there are no published MSRPs or invoice prices attached to these vehicles. No less importantly, few investors have the wherewithal to analyze the potential performance profiles of these vehicles as either stand-alone investments or vis-à-vis possibly cheaper and simpler alternatives. In this note, we present approaches Rutter Associates uses in evaluating these vehicles for dealers and investors who are seeking to understand better that risk-return tradeoff they face in structured note transaction.

The take-away from this presentation is the approach we employ; this document is for didactic and illustrative purposes only and does not purport to show actual results. It is not, and should not be regarded as investment advice or as a recommendation regarding any particular note, security or course of action. Analyses and opinions expressed herein are current as of the date appearing in this material only and are subject to change without notice. The data to create our sample analyses were accurate at the time we used them but are certainly now stale. In the event any of the assumptions used herein to drive our simulations do not prove to be true, ex-post results are likely to vary, perhaps substantially.

Rutter Associates has on many occasions been asked to work with large institutional clients hoping to understand better the structured derivative trades entered into by their agents (or being considered) and the same technology we apply to these analyses are equally well suited to evaluating the relative attractiveness of structured products offered at the retail and small institutional level. A recent offering by a dealer firm described in a trade publication[1] caught our eye and allows us to present a sample set of analytics that are crucial to well-informed decision-making. This offering promises the opportunity to earn up to 20.1% over its 2-year life representing a 1.5x levered return on a basket of international stock indices (calculated up to a maximum basket return of 13.4%). The investor suffers no loss if the index basket loses up to 10% of its value over the two years, and beyond 10% decline in the basket the investor loses 1.11% for every 1% incremental decline. Thus, the two year return is capped at 20.1% and calculated as 1.5 X the basket return if positive, the two year return on the product is zero if the basket is unchanged or declines as much as 10%, and the two year return is 1.11 X (Index Basket Return + 10%) if the index basket return is less than -10% (for example the return would be negative 11.1% if the basket return is negative 20%). The five indices underlying the basket are the Euro Stoxx 50 (SX5E), FTSE 100 (UKX), Swiss Market Index (SMI), S&P/ASX 200 (AS51), and TOPIX (TPX). The weightings for each are 37%, 23%, 8%, 9%, and 23% respectively. The static return profiles of the index basket portfolio and the structured note are presented in Figure 1:

Note that dividends are not included in the return calculation of the structured product and not included in the "Long Stock Index Basket" profile above which is perhaps best thought of as a synthetic long basket position created by the combination of an at-the-money written put option and an at-the-money purchased call option. This type of "hockey-stick" diagram is familiar to option market participants and indeed, the structured product itself is perfectly replicated by a combination of two call options, a put option, and a zero coupon bond. Structured products are packages of derivative contracts that reference underlying indices and not investments in equity securities. It is clear from Figure 1 that for basket returns up to 20.1%, the structured product will always dominate, i.e., provide a higher return than the simple synthetic long position in the basket indices. However, for synthetic long basket returns beyond 20.1% the long basket position dominates because the structured product is capped. The important questions for investors are: 1) what is the price being paid for the product; 2) what are the probabilities that one investment will outperform the other; and 3) is the value of the upside foregone sufficiently compensated by the value of the reduced downside, i.e., would the investor prefer the simple long position or the structured product?

What is the Market Price of the Structured Product and a Long Index Basket?

For every $100 paid to the dealer by the investor, something less than $100 is going to work and that difference is dealer compensation for costs including the bid/offer costs of hedging, and normal profit. In order to put an approximate dollar value on a $100 investment, we use derivative valuation technology involving the simulation of thousands of potential basket values over a two-year horizon, where the parameters of the simulation (equity price trends involving dividend yield and risk-free rates, volatilities and correlations, and discounting rates) are extracted from market pricing of options and from historical equity return data. For each of the simulations we calculate a net present value of the structured product investment at the two-year horizon and then we average across each of the (thousands of) simulations. As of March 30, 2015 we calculate the approximate value of a new $100 position in the structured product to be in the range of $97.50 - $98.50, or in other words, the approximate cost of the two call options, put option, and zero coupon bond building blocks of the product is $98.00. The investor is paying the dealer about a 2% commission or "load" for assembling these building blocks into a single investment vehicle. The benchmark against which an investor should evaluate the structured product is a $100 investment in a hypothetical representative ETF (i.e., a long index position) that retains rights to dividends and the market value of which at inception is $100 less a small ETF commission.

[1] Suzi Hampson, "Goldman Launches Leveraged Equity Basket Note", Structured Products, IncisiveMedia, July 2015

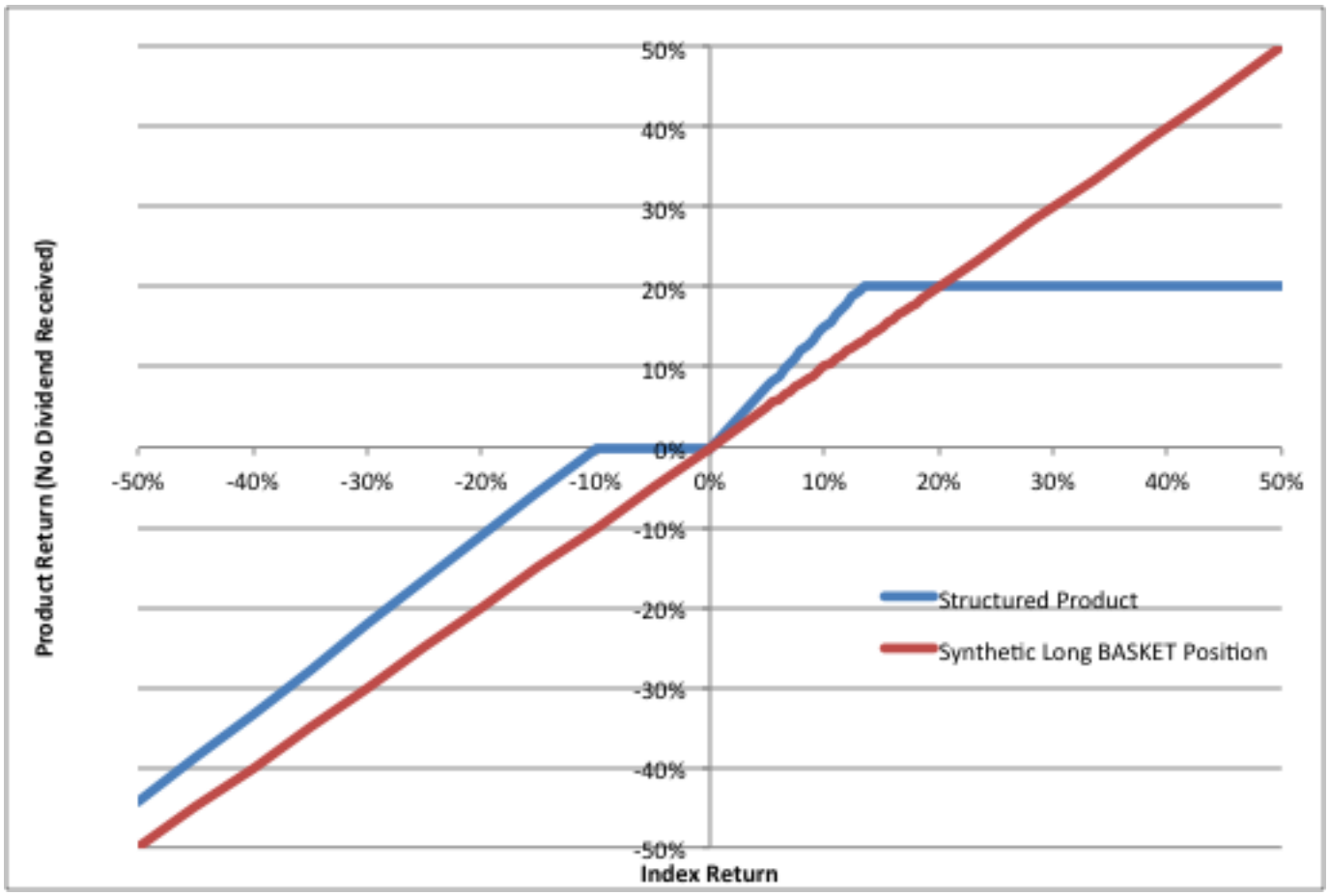

Figure 1: Two-Year Return Profiles of Long Stock Index Basket Position and Structured Product

Index Basket Capital Gain/Loss	Long Index Capital Gain/Loss	Structured Product Capital Gain/Loss
-30.00%	-30.00%	-22.20%
-25.00%	-25.00%	-16.65%
-20.00%	-20.00%	-11.10%
-15.00%	-15.00%	-5.55%
-10.00%	-10.00%	0.00%
-5.00%	-5.00%	0.00%
0.00%	0.00%	0.00%
5.00%	5.00%	7.50%
10.00%	10.00%	15.00%
15.00%	15.00%	20.10%
20.00%	20.00%	20.10%
25.00%	25.00%	20.10%
30.00%	30.00%	20.10%

Table 1: Two-Year Capital Gain and Loss Profiles of a Long-Only Index Position and the Structured Product

Return Interval (% per annum)	Relative Frequency: Structured Product	Relative Frequency: Long Index Position
<-30	0.14%	0.48%
(30) to (25)	0.46%	0.92%
(25) to (20)	1.18%	3.02%
(20) to (15)	3.30%	7.50%
(15) to (10)	7.56%	12.00%
(10) to (5)	11.70%	15.32%
(5) to 0	14.64%	18.20%
0 to 5	30.36%	17.38%
5 to 10	30.66%	12.14%
10 to 15	0.00%	7.60%
15 to 20	0.00%	3.44%
20 to 25	0.00%	1.42%
25 to 30	0.00%	0.42%
>30	0.00%	0.16%

Table 2: Annualized Market-Implied Two-Year Return Density of the Structured Product and the Long-Only Index Position

As of March 30, 2015 we calculate the approximate value of a new $100 position in the structured product to be in the range of $97.50 - $98.50, or in other words, the approximate cost of the two call options, put option, and zero coupon bond building blocks of the product is $98.00. The investor is paying the dealer about a 2% commission or "load" for assembling these building blocks into a single investment vehicle. The benchmark against which an investor should evaluate the structured product is a $100 investment in a hypothetical representative ETF (i.e., a long index position) that retains rights to dividends and the market value of which at inception is $100 less a small ETF commission.

What are the Objective Return Profiles of the Structured Product and the Long Index Basket?

Table 1 displays a set of possible profit and loss scenarios over a two-year horizon for the long-only index strategy and the structured note it is essentially a subset of the data used to create Figure 1.

Figure 1 and Table 1 are, of course, useful in what-if analysis (e.g., "what if the index should rise 10.00% over the two-year life of the product?") and knowing that a $100 investment entails roughly a $2.00 "load" is important. However, to evaluate this structured product fully and come to an informed decision an investor needs to combine a set of expectations with these data to understand the probability distribution of returns it presents. In other words, the investor needs someone to overlay beliefs about the possible future trajectories (trend and volatility around that trend) of index basket prices (and dividend yields) on the schedule in Table 1.

If the investor can articulate expectations for trends and volatilities of the indices that underlie the index basket, Rutter Associates uses these to create a baseline probability distribution of annualized returns (i.e., a table or chart showing the probabilities of achieving returns below each relevant level). We will explore here the use of three standard alternative sources of these key return drivers: 1) market-implied trends from synthetic forward contracts and volatilities from traded option contracts; 2) returns and volatilities from historical return data; and 3) Equity Risk Premium (ERP)-based trends using published equity risk premium estimates and historical volatilities. For simplicity in these examples we assume that the correlation among the five indices underlying the basket is equal to its long-run average of 56%. Let's examine the outputs of each of these three alternatives, and express these outputs in terms of annualized return distributions.

Alternative 1: Market-Implied Simulation Using Synthetic Futures and Options

It is straightforward and commonplace to calculate an implied futures price for a stock index (that for our purposes can be used to extract a trend for simulation). The OneChicago exchange, for example, publishes the following equation:

$$F = [S - PV(Div)] \times e^{r \times (T-t)}$$

Where F is the futures price, S is the underlying stock or stock index price, $PV(Div)$ is the present value of any dividends expected to be entitled to the holder of the underlying between T and t, r is the "risk-free" interest rate and e is the base of the natural log.

Given the implied two-year trend in equity prices (from "S" to "F") calculated using Bloomberg data and stock price volatility estimates based on implied volatilities from option prices reported in Bloomberg, we simulate 2,000 Monte Carlo paths of stock prices and therefore 2,000 random returns on both the long-only strategy (the index to which a dividend yield must be "added back") and the structured product. The following chart and tables show the results of our simulations on an annualized basis:

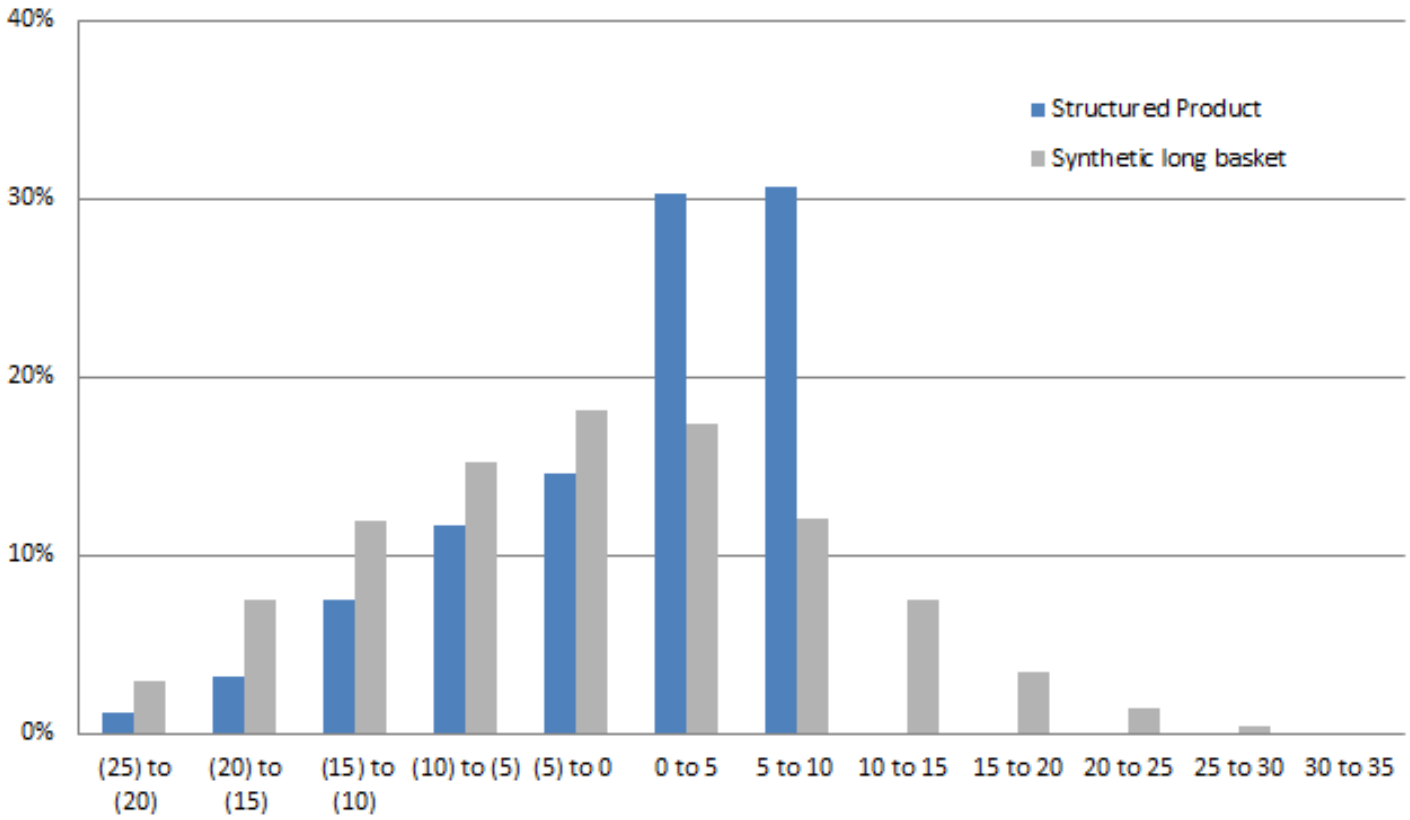

Figure 2: Estimated Annualized Return Histogram of Long Stock Index Basket Position and Structured Product: Market-Implied

Return Threshold (% per annum)	**Relative Frequency of Return Below Threshold: Structured Product**	**Relative Frequency of Return Below Threshold: Long Index Position**
< (30)	0.14%	0.48%
< (25)	0.60%	1.40%
< (20)	1.78%	4.42%
< (15)	5.08%	11.92%
< (10)	12.64%	23.92%
< (5)	24.34%	39.24%
< 0	38.98%	57.44%
< 5	69.34%	74.82%
< 10	100.00%	86.96%
< 15	100.00%	94.56%
< 20	100.00%	98.00%
< 25	100.00%	99.42%
< 30	100.00%	99.84%

Table 3: Annualized Market-Implied Two-Year Return Distribution of the Structured Product and the Long-Only Index Position

Return Interval (% per annum)	**Relative Frequency: Structured Product**	**Relative Frequency: Long Index Position**
<-30	0.00%	0.00%
(30) to (25)	0.00%	0.00%
(25) to (20)	0.15%	0.15%
(20) to (15)	0.45%	0.60%
(15) to (10)	1.20%	1.95%
(10) to (5)	4.25%	5.30%
(5) to 0	8.75%	11.65%
0 to 5	30.75%	19.25%
5 to 10	54.45%	20.05%
10 to 15	0.00%	18.80%
15 to 20	0.00%	12.90%
20 to 25	0.00%	6.10%
25 to 30	0.00%	2.35%
>30	0.00%	0.90%

Table 4: Annualized Two-Year Return Density of the Structured Product and the Long-Only Index Position (Estimate Based on Historical Data)

Our "market-implied" simulation suggests that the structured product offers a 61% probability of an annualized return between 0 and 10% and a 39% probability of a negative return. The simple long index strategy offers a 29.5% probability of a return between 0 and 10%, a 13% probability of a return greater than 10%, and a 57.4% probability of a negative return. In the simplest of terms, the "market implied" simulation suggests that the structured product reduces the probability of loss by trading away a larger probability of large gains (and some expected return see Table 8). Of course, given the reduction in downside risk, a reduction in expected return is to be expected.

Alternative 2: Simulation Using Historical Returns and Volatilities

Evaluating a structure by examining how it would have performed if the market moved as it had in the past is a mainstay amongst risk managers and is the basis of many Value-at-Risk analyses. In our second of three alternative analyses, we calculated the trend of the stochastic process from the 10-year historical trends of each underlying index, and the volatility of the process from the volatility of the composite index over the preceding two years. Given this historical trend and volatility, we simulate 2,000 Monte Carlo paths of stock prices and therefore 2,000 random returns on both the long-only strategy (the index) and the structured product. The following chart and tables show the results of our simulations based on historical data on an annualized basis:

Our simulation based on historical data suggests that the structured product offers a 85.2% probability of an annualized return between 0 and 10% and a 14.8% probability of a negative return. The simple long index strategy offers a 39.3% probability of a return between 0 and 10%, a 41.05% probability of a return greater than 10%, and a 19.65% probability of a negative return. This "historically-based" simulation suggests again that the structured product reduces the probability of loss by trading away a larger probability of large gains (and some expected return see Table 8). Of course, given the reduction in downside risk, a reduction in expected return is to be expected.

Alternative 3: Simulation Using ERP-Consistent Returns and Historical Volatilities

Treating each index as the "market portfolio" in its respective geography, we applied NYU professor Aswath Damodaran's Equity Risk Premium estimates (http://pages.stern.nyu.edu/ adamodar/) to the 10-year Treasury rate and subtracted the relevant dividend yield to obtain a trend input for the stochastic process of each index. Given this ERP-implied trend and historical volatility, we simulate 2,000 Monte Carlo paths of stock prices and therefore 2,000 random returns on both the long-only strategy (the index) and the structured product. The following chart and tables show the results of our simulations on an annualized basis:

Our simulation based on ERP and historical volatility data suggests that the structured product offers a 90.7% probability of an annualized return between 0 and 10% and a 9.3% probability of a negative return. The simple long index strategy offers a 36.2% probability of a return between 0 and 10%, a 50.9% probability of a return greater than 10%, and a 12.9% probability of a negative return. This "Equity Risk Premium-based" simulation suggests that the structured product reduces the probability of loss by trading away a larger probability of large gains (and some expected return see Table 8). Of course, given the reduction in downside risk, a reduction in expected return is to be expected.

Which is the Preferred Investment?

While the above tables and charts describe fully the return distributions of the structured product and the long index position and may provide sufficient information for decision-making, many investors favor the ex-ante Sharpe Ratio as a metric to evaluate the expected returns of alternative investments on a risk-adjusted basis. The Sharpe Ratio is the expected risk premium over the riskless rate of interest divided by the standard deviation of the return, and all else equal an investment promising a higher Sharpe Ratio is preferred to one offering a lower Sharpe Ratio.

Table 8 presents the Sharpe Ratio for both the Structured Product and the Long Index position for each of the three sample simulation methodologies. In each case these methodologies lead to higher Sharpe Ratios for the simple Long Index strategy than for the Structured Product.

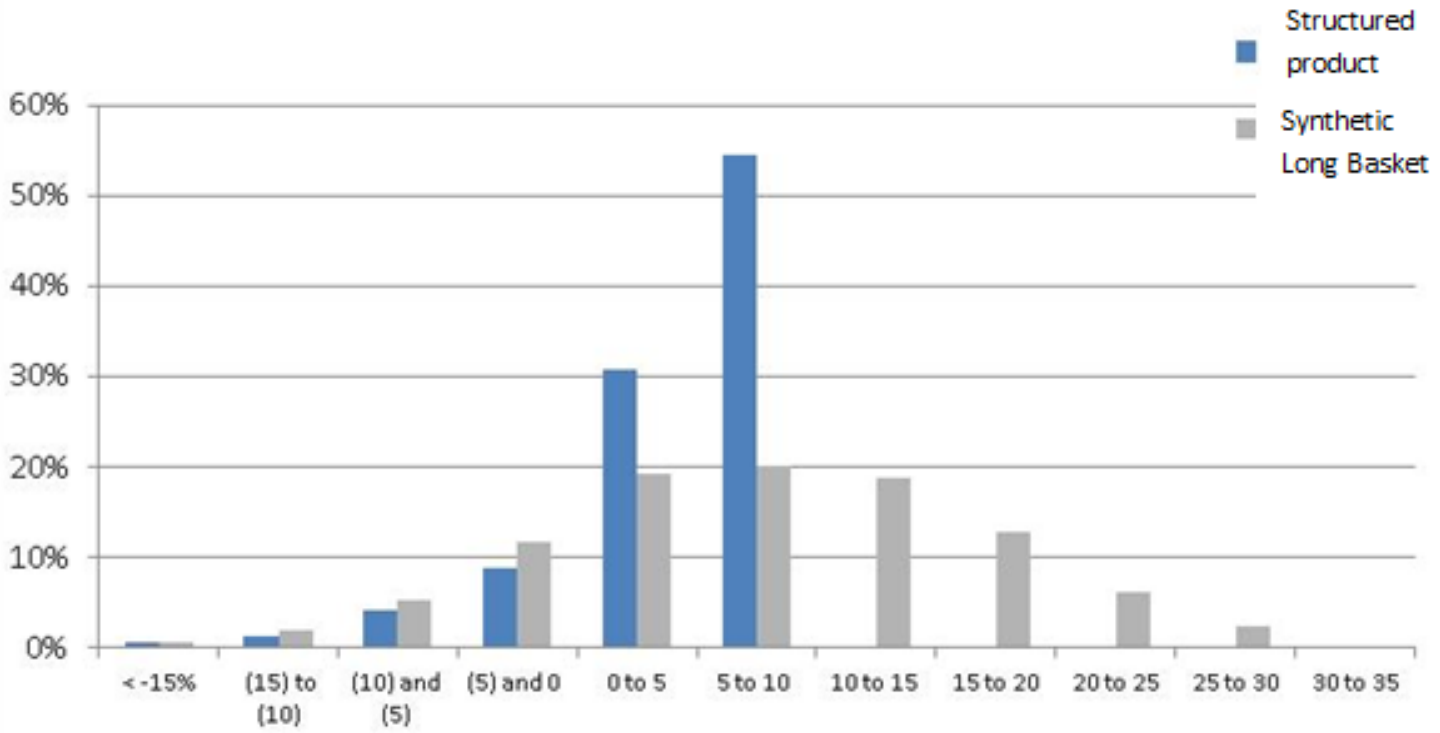

Figure 3: Estimated Annualized Return Histogram of Long Stock Index Basket Position and Structured Product: Historical Data

Return Threshold(% per annum)	**Relative Frequency of Return Below Threshold: Structured Product**	**Relative Frequency of Return Below Threshold: Long Index Position**
< (30)	0.00%	0.00%
< (25)	0.00%	0.00%
< (20)	0.15%	0.15%
< (15)	0.60%	0.75%
< (10)	1.80%	2.70%
< (5)	6.05%	8.00%
< 0	14.80%	19.65%
< 5	45.55%	38.90%
< 10	100.00%	58.95%
< 15	100.00%	77.75%
< 20	100.00%	90.65%
< 25	100.00%	96.75%
< 30	100.00%	99.10%

Table 5: Annualized Two-Year Return Distribution of the Structured Product and the Long-Only Index Position (Estimate Based on Historical Data)

Return Interval (% per annum)	**Relative Frequency: Structured Product**	**Relative Frequency: Long Index Position**
<(30)	0.00%	0.00%
(30) to (25)	0.00%	0.00%
(25) to (20)	0.00%	0.00%
(20) to (15)	0.15%	0.35%
(15) to (10)	0.90%	1.00%
(10) to (5)	2.45%	4.00%
(5) to 0	5.80%	7.55%
0 to 5	26.80%	15.70%
5 to 10	63.90%	20.50%
10 to 15	0.00%	21.30%
15 to 20	0.00%	14.80%
20 to 25	0.00%	9.35%
25 to 30	0.00%	3.85%
>30	0.00%	1.60%

Table 6: Annualized Two-Year Return Density of the Structured Product and the Long-Only Index Position (ERP and Historical Volatility)

Figures 2, 3 and 4 show highly skewed return densities so we also show in the table a "Modified" Sharpe Ratio that divides the return to risk taking (expected return minus risk-free rate of interest) by an alternative measure of risk:

$$MSR = 1.96 \times \frac{\mathbb{E}[R] - \bar{r}}{\mathbb{E}[R] - R_{2.5\%ile}}$$

Where MSR is Modified Sharpe Ratio, $\mathbb{E}[R]$ is Expected Return, $\bar{r}$ is Risk-Free Rate, $R_{2.5\%ile}$ is 2.5%-tile Return.

The measure of "risk" in the denominator in this case is not standard deviation which does not differentiate between upside and downside variation (and "risk" the possibility of a downside shock), but is rather the shortfall from expected return that occurs one time out of forty in our simulations. This measure is somewhat analogous to the Sortino Ratio which proxies risk as downside "semideviation", popular in hedge fund analysis. Table 8 presents the Modified Sharpe Ratio for both the Structured Product and the Long Index position for each of the three sample simulation methodologies. In each case these methodologies lead to higher Modified Sharpe Ratios for the simple Long Index strategy than for the Structured Product. Based on the three simple analyses we have run, the Sharpe Ratio and Modified Sharpe Ratio approaches would lead to a choice of the Long Index position over the Structured product. Note that in the "market implied" scenario, we cite a Sharpe Ratio and Modified Sharpe Ratio of zero for the long index position, despite an expected return slightly below the risk-free rate (of 95bps). The theoretical risk premium in a market-implied (a/k/a "risk neutral") scenario must be zero, but our analysis contains some residual estimation error from the Monte Carlo process of 2,000 iterations, there are slight differences from the US risk-free rate that drive the dynamics of the indices underlying the basket and there are other adjustments required in a more formal analysis for payouts determined in one currency but made in another. We do not account for these small adjustments in this note.

These examples of the analytics that Rutter Associates performs for dealers and investors in evaluating Structured Notes and other derivative-embedded vehicles are by no means meant to be "last words" on the topic. For example, not all investors have the same risk tolerance, and those with extremely high levels of risk aversion (i.e., those willing to forgo much expected return to avoid downside risk) will no doubt prefer the Structured Product to the Long Index if the three sample approaches we detail accurately describe the state of nature. That said, this approach provides critical information to our clients as they make decisions about transacting these types of structured products. Much as new car buyers look to MSRP, dealer cost, Consumer Reports and a test drive, dealers and investors in structured notes need to look to probability distributions of returns of the type produced by Rutter Associates in order to make informed decisions.

Rutter Associates
January 2016

Acknowledgments

We would like to thank our college interns Anna Grosul and Kyle Lojek for valuable research assistance in the preparation of this presentation.

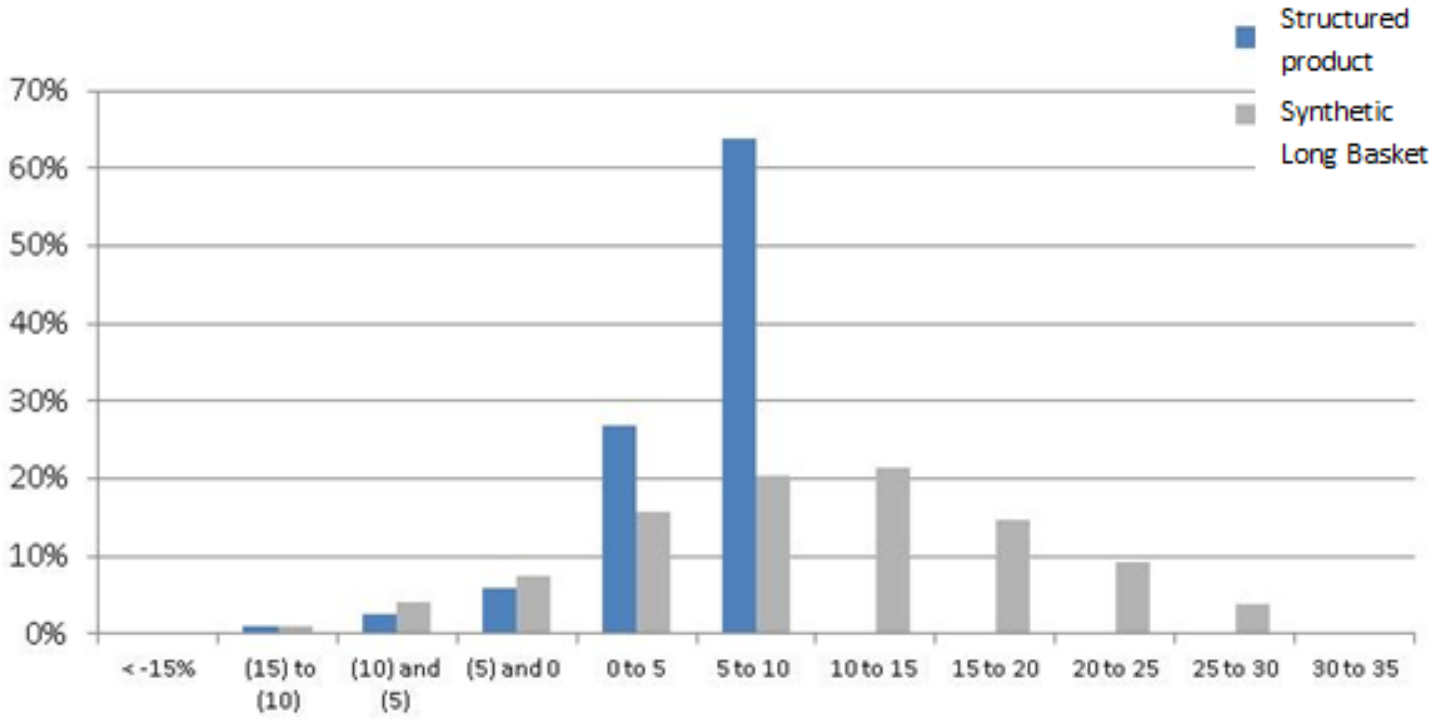

Figure 4: Estimated Annualized Return Histogram of Long Stock Index Basket Position and Structured Product: ERP-Consistent

Return Threshold(% per annum)	**Relative Frequency of Return Below Threshold: Structured Product**	**Relative requency of Return Below Threshold: Long Index Position**
<(30)	0.00%	0.00%
<(25)	0.00%	0.00%
<(20)	0.00%	0.00%
<(15)	0.15%	0.35%
<(10)	1.05%	1.35%
<(5)	3.50%	5.35%
<0	9.30%	12.90%
<5	36.10%	28.60%
<10	100.00%	49.10%
<15	100.00%	70.40%
<20	100.00%	85.20%
<25	100.00%	94.55%
<30	100.00%	98.40%

Table 7: Annualized Two-Year Return Density of the Structured Product and the Long-Only Index Position (ERP and Historical Volatility)

		Expected (Annualized) Return	2.5%-ile Return	Standard Deviation of Return	Sharpe Ratio	Modified Sharpe Ratio
ERP	Structured Product	5.74%	-6.30%	5.09%	0.94	0.78
	Long Index Position	10.22%	-7.72%	9.22%	1.01	1.01
10 Years of Historical Data	Structured Product	4.47%	-8.84%	5.71%	0.62	0.52
	Long Index Position	7.82%	-10.13%	9.23%	0.74	0.75
Market-Implied	Structured Product	-0.12%	-18.50%	8.00%	Negative	Negative
	Long Index Position	0.50%	-20.10%	10.70%	0	0

Table 8: Key Statistics and Ex-Ante Simulated Performance Measures