



SWAN GLOBAL
INVESTMENTS

PORTFOLIO OPTIMIZATION:

Thinking Outside the Style Box

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REVISIONS

A.

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B.

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OBJECTIVES

Swan is focused on helping provide financial advisors with the thought leadership necessary to differentiate themselves and make their businesses stronger and more valuable. The purpose of this document is to highlight our theoretical view that a diversified hedged assets portfolio is a more effective and efficient way to optimize a portfolio than traditional portfolio optimization. The goal will be to present evidence to support the following portfolio management perspectives:

- Traditional portfolio optimization is flawed and potentially misleading and the efficient frontier is of limited use
- Traditional portfolio optimization leads to fairly indistinguishable asset allocations
- Traditional portfolio optimization fails to minimize losses, as they are built to minimize volatility
- An alternative approach to portfolio optimization (such as the Defined Risk Strategy), that directly addresses market risk, can lead to more effective and efficient portfolios
- Portfolio results can be improved through the use of hedged assets
- A defined risk portfolio, built upon the concept of maximizing return while minimizing an investors' possible level of "pain", could introduce a paradigm shift away from traditional portfolio optimization



PORTFOLIO OPTIMIZATION

Modern Portfolio Theory (MPT), originally introduced by Harry Markowitz, is based on the concept that an investor should only invest in optimal (or “efficient”) portfolios. According to Markowitz, a portfolio is optimal if “no other portfolio has higher expected return for a given level of risk or less risk for a given level of expected return (Markowitz, 1952).”

The efficient frontier, which was also introduced by Markowitz in 1952, illustrates a set of “optimal” portfolios that offer the highest expected return for a defined level of risk. Michael Kitces described how investment managers optimize portfolios using the efficient frontier in the Kitces Report:

“Mean Variance Optimization (MVO) is currently the most common methodology for creating portfolios based on MPT. In essence, the process mathematically determines the optimal weightings amongst a list of available asset classes to yield portfolios that have the highest expected return for a given level of risk. This is computed based on the inputs of the returns and standard deviations of each of the available assets, and the correlations amongst those assets.

While MVO is a popular tool for creating efficient portfolios, it can be a victim of its own inefficiencies.

MVO often results in impractical allocations, containing exaggerated exposures to a relatively small number of asset classes, which cannot reasonably be implemented for clients. The key problem with traditional MVO is its sensitivity to the underlying assumptions, where slight changes in the inputs can lead to dramatic differences in optimal portfolio allocations (The Kitces Report, July 2008, Michael Kitces).”

In essence, Kitces is saying that MVO is highly sensitive to estimation error. Portfolios created via MVO favor individual assets with high return-to-risk estimates. Therefore, using MVO tends to magnify errors in estimates. Portfolio optimization is built upon the assumption that asset classes will continue to exhibit past patterns of return, correlation, and variance. However, as experienced in 2008 and seen in Exhibit 1, past patterns do not always persist. This can lead to outcomes very different than the expectations. Note the long-term correlation of assets prior to the Financial Crisis (correlation measures how closely two different investments move in conjunction with one another; if one is seeking to diversify an investment portfolio, lower correlations or negative correlations are desired).



Long-Term Correlation Matrix: January 1988 - July 2007

	1	2	3	4	5	6
1) Russell 3000	1.00	0.62	0.61	0.52	0.41	-0.08
2) MSCI EAFE Index	0.62	1.00	0.58	0.35	0.25	0.01
3) MSCI Emerging Markets	0.61	0.58	1.00	0.43	0.30	0.04
4) Barclays U.S. Corp High Yield	0.52	0.35	0.43	1.00	0.44	-0.11
5) FTSE Nareit All REITs	0.41	0.25	0.30	0.44	1.00	-0.10
6) S&P GSCI	-0.08	0.01	0.04	-0.11	-0.10	1.00

Crisis Correlation Matrix: August 2007 - February 2009

	1	2	3	4	5	6
1) Russell 3000	1.00	0.92	0.83	0.75	0.86	0.59
2) MSCI EAFE Index	0.92	1.00	0.94	0.73	0.74	0.63
3) MSCI Emerging Markets	0.83	0.94	1.00	0.75	0.62	0.69
4) Barclays U.S. Corp High Yield	0.75	0.73	0.75	1.00	0.70	0.50
5) FTSE Nareit All REITs (Real Estate)	0.86	0.74	0.62	0.70	1.00	0.41
6) S&P GSCI (GS Commodity Index)	0.59	0.63	0.69	0.50	0.41	1.00

Less than 0.50
Between 0.50 and 0.70
Between 0.70 and 0.80
Between 0.80 and 0.90
Over 0.90

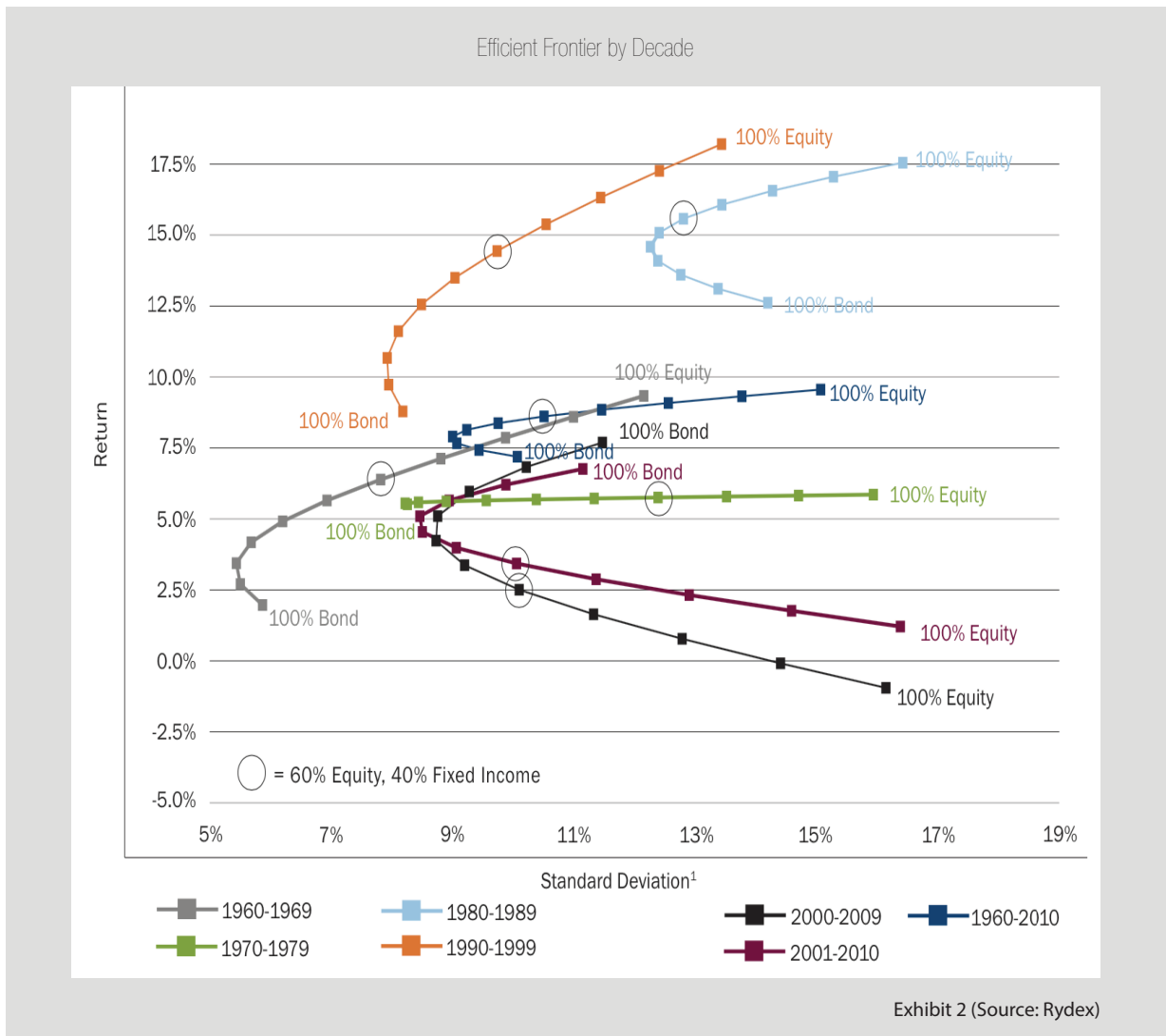
Exhibit 1 (Source: Zephyr StyleAdvisor)

Slight differences in return or standard deviation amongst any asset class can bring about drastically different allocation recommendations. The consistency and stability of the inputs are crucial to an efficient frontier providing any value. William Bernstein best described this shortcoming for someone using an efficient frontier to construct a portfolio:

“The technique works only in retrospect. It turns out that the outputted portfolio compositions are exquisitely sensitive to even very small changes in the input data. Change a few pieces of the input data slightly and the resultant portfolio compositions change drastically. Since the required input returns, SDs (standard deviations), and correlations are known with precision only in retrospect, mean variance optimization is worthless as a predictor of future optimal portfolios. This is because it is impossible to predict with anywhere near the required accuracy the returns, SDs, and correlations. In addition, the tendency for asset returns to mean revert introduces a perverse bias into optimizer results. If someone is using returns over the past 5, 10, or even 20 years, it is easily possible to overestimate the returns of the higher performing assets and vice versa. This will result in the optimizer overweighting precisely those assets which are likely to underperform in the future (Mean Variance Optimization, William Bernstein, 1997).”



This propensity for the efficient frontier to potentially allocate inefficiently can be seen in the great variation of the efficient frontier from decade to decade, as seen in Exhibit 2.



In spite of these weaknesses, MVO is by far and away the most widely used method of portfolio construction. Based on these limitations and shortcomings of mean variance optimization, the driving force behind strategic asset allocation portfolios, it would be very challenging to rely on asset allocation as a predictor of future returns or as a truly effective means of protection against market risk. Furthermore, one should expect to find most asset allocation models, comprised of the same asset classes, having similar results over a long-term market cycle due to the portfolio construction and optimizations being driven by the same risk and return characteristics.



1 (For more details on this study, please see Swan's whitepaper "Asset Allocation Strategies: Comparison and Analysis", January 2017).

In January of 2015, Swan Global Investments (managers of the Defined Risk Strategy or DRS) undertook a comprehensive study of 13 popular asset allocation strategies going back to our July 1997 inception. Since the inception of the DRS there have been approximately two and a half market cycles. Below in Exhibit 3 are the returns and a few portfolio statistics for these asset allocation strategies as well as the S&P 500, updated in early 2017 to go through the end of 2016.

Portfolio Statistics: July 1, 1997 through December 31, 2016	Annualized Returns	Cumulative Return	Population Standard Deviation	Sharpe Ratio	Worst Period Return	Maximum Drawdown	Alpha vs. Market	Beta vs. Market
S&P 500 Total Return	6.85%	264.27%	15.24%	0.31	-16.79%	-50.95%	0.00%	1
60% Equity/40% Bonds	7.61%	317.71%	8.99%	0.61	-11.11%	-28.70%	3.48%	0.55
60/20/20 (Alts)	7.30%	294.78%	9.99%	0.52	-11.56%	-33.69%	2.58%	0.64
Permanent Portfolio	6.12%	218.42%	6.15%	0.65	-8.63%	-12.78%	4.52%	0.22
Ivy Portfolio	6.39%	234.76%	11.29%	0.38	-19.87%	-46.28%	2.28%	0.59
Risk Parity	6.42%	236.72%	5.56%	0.77	-9.06%	-15.11%	5.09%	0.18
David Swensen	7.03%	275.98%	10.32%	0.48	-16.03%	-37.61%	2.51%	0.62
El Erian	6.61%	248.07%	11.41%	0.39	-16.30%	-40.84%	1.91%	0.66
Rob Arnott	7.23%	290.15%	8.47%	0.60	-16.31%	-29.40%	4.16%	0.42
Scott Burns/Andrew Tobias	6.26%	226.96%	10.91%	0.38	-15.67%	-38.54%	1.53%	0.66
Bernstein "Smart Money"	6.54%	244.15%	9.50%	0.47	-13.02%	-34.92%	2.28%	0.58
Core Four Portfolio	7.11%	281.47%	11.77%	0.42	-18.14%	-44.92%	2.31%	0.68
Ideal Index	6.26%	227.02%	10.85%	0.38	-14.42%	-39.07%	1.58%	0.65
All Seasons (Ray Dalio)	7.15%	284.78%	6.78%	0.74	-9.67%	-14.42%	5.58%	0.22
60/20/20 (Swan DRS at 20)	7.72%	326.20%	9.95%	0.56	-11.91%	-30.88%	3.07%	0.63
Swan Defined Risk Strategy (Net of Fees)	8.53%	393.44%	9.63%	0.67	-16.15%	-18.56%	6.55%	0.30

Exhibit 3 (Sources: Zephyr StyleAdvisor, Morningstar, Mebane Faber, and Swan Global Investments)

Worst period return equals worst one month return over the time period. No management fees are included except for the Swan DRS, based on the Swan DRS Select Composite, which is net of fees. One cannot invest directly in an index. Where indexes were used, expense ratios of acquired fund fees would be present if represented by actual investments seeking to track the indexes; thus investment returns would be lower for those portfolios.

It is important to note that expense ratios would likely have been higher in prior years.



What are the key takeaways from this study?

1. The asset allocation portfolio results are very similar (9 of the 13 fall within 91 basis points of each other from 6.39% to 7.30%, all fall within 149 bps, and most have similar volatility and beta)
2. Most portfolios still had significant losses during the 2008 Financial Crisis (10 out of 13 had worse than a -28% decline during the 2008-2009 market collapse)

Why? Most of them, if not all, are baked using the same recipe: MVO and the efficient frontier or modern portfolio theory. They were constructed to maximize return attribution from various asset classes while minimizing standard deviation (volatility/risk). All components and each asset allocation portfolio, for the most part, were highly correlated in the Financial Crisis and over the study time period.

As noted in Exhibit 1, during the Financial Crisis different asset allocations were ineffective, merely like reshuffling deck chairs on the Titanic.

Statistically, this was very apparent from the extremely high correlation of each of the asset allocation models to themselves and to the market. True diversification benefit only comes from consistently low correlation that can be quantified and measurable.

Correlation Matrix: July 1, 1997 through December 31, 2016	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1) S&P 500 TR	1	0.94	0.98	0.56	0.79	0.51	0.91	0.88	0.76	0.93	0.93	0.89	0.92	0.47	0.45
2) 60%/40%	0.94	1	0.98	0.68	0.81	0.72	0.93	0.88	0.83	0.93	0.92	0.90	0.91	0.70	0.47
3) 60/20/20 (Alts)	0.98	0.98	1	0.65	0.83	0.62	0.94	0.92	0.83	0.95	0.96	0.91	0.94	0.58	0.49
4) Permanent Port.	0.56	0.68	0.65	1	0.66	0.79	0.69	0.67	0.71	0.69	0.64	0.65	0.65	0.76	0.32
5) Ivy Portfolio	0.79	0.81	0.83	0.66	1	0.77	0.94	0.93	0.95	0.90	0.89	0.92	0.9	0.64	0.46
6) Risk Parity	0.51	0.72	0.62	0.79	0.77	1	0.73	0.70	0.85	0.70	0.64	0.70	0.65	0.91	0.35
7) David Swensen	0.91	0.93	0.94	0.69	0.94	0.73	1	0.96	0.92	0.97	0.97	0.97	0.97	0.63	0.47
8) El Erian	0.88	0.88	0.92	0.67	0.93	0.70	0.96	1	0.92	0.96	0.95	0.93	0.95	0.61	0.47
9) Rob Arnott	0.76	0.83	0.83	0.71	0.95	0.85	0.92	0.92	1	0.90	0.88	0.91	0.88	0.72	0.47
10) Burns/Tobias	0.93	0.93	0.95	0.69	0.90	0.70	0.97	0.96	0.90	1	0.96	0.94	0.97	0.63	0.46
11) Bernstein	0.93	0.92	0.96	0.64	0.89	0.64	0.97	0.95	0.88	0.96	1	0.97	0.99	0.53	0.49
12) Core Four	0.89	0.90	0.91	0.65	0.92	0.70	0.97	0.93	0.91	0.94	0.97	1	0.98	0.58	0.46
13) Ideal Index	0.92	0.91	0.94	0.65	0.90	0.65	0.97	0.95	0.88	0.97	0.99	0.98	1	0.55	0.46
14) All Seasons	0.47	0.70	0.58	0.76	0.64	0.91	0.63	0.61	0.72	0.63	0.53	0.58	0.55	1	0.28
15) Swan DRS	0.45	0.47	0.49	0.32	0.46	0.35	0.47	0.47	0.47	0.46	0.49	0.46	0.46	0.28	1

Exhibit 4 (Source: Zephyr StyleAdvisor)

The Swan DRS is net of fees; no fees have been included for all other models.



In addition, it is important to note that these portfolios had an average allocation of 36% to fixed income and that fixed income was in a very strong bull market during the entire sixteen and a half year time period tested for these portfolios. Interest rates have been falling for the past 35 years from 20 percent down to near 2 percent. Due to the heavy allocation to bonds in all of these model portfolios, the possibility for a repeated attribution from fixed income in the next 15-20 years is likely very low, if not impossible. Portfolio optimization should not be dependent on one major asset class remaining in a bull market or providing the expected low volatility.

Swan believes that an alternative approach to portfolio optimization, focused on directly addressing market risk and MPT limitations, can lead to more effective and efficient portfolios. It is helpful to look at the two main shortcomings that drive this need for an alternative approach in order to best understand why.

AN ALTERNATIVE APPROACH TO PORTFOLIO OPTIMIZATION

There are two main reasons why an alternative approach to portfolio optimization is necessary:

1. MPT and MVO relies heavily on historical
2. MPT and MVO do not directly address market risk.

1. MPT and MVO's reliance on historical standard deviation

A traditional efficient frontier defines risk in terms of volatility, or standard deviation. However, using standard deviation as a way to measure risk is extremely limited. First, standard deviation does not differentiate between upward volatility and downward volatility. All volatility is considered the same; there is no differentiation between good, upside volatility, and bad, downside volatility. As a result an investment gets punished for growth within the efficient frontier framework.

Secondly, standard deviation does not account for the timing of negative returns. Mathematically standard deviation cannot distinguish whether the bad occurrences within a set of data are randomly scattered or if they tend to cluster in bunches. Anyone who lived through the Financial Crisis of 2008-2009 can attest to the fact that bad months followed bad months, compounding market losses. Yet standard deviation does not address this phenomenon.

Thirdly, standard deviation does not address market risk. An asset class could go through a very long time period of moving either steadily up or down and show a very low standard



Thirdly, standard deviation does not address market risk. An asset class could go through a very long time period of moving either steadily up or down and show a very low standard deviation, lulling one into a false sense of complacency. But that asset class can be just as sensitive to systematic risk and a market correction as an asset class with a high standard deviation. For example, consider how fixed income would likely be over-allocated in a current efficient frontier due to its high returns and low volatility over the past 20-30 years. Is it likely that bonds will have such high returns and such low risks going forward? Some would describe this as “driving a car by looking in the rear-view mirror.”

Despite its limitations, the usage of standard deviation within portfolio management will obviously continue due to its generally wide understanding and acceptance from the investment public. There is still some benefit in using standard deviation as a simple/quick measurement to understand how volatile an investment has been in the past and might continue to be going forward. But when it comes to portfolio construction, there are better options.

Two other alternatives to standard deviation that might be more effective in assisting with portfolio optimization are downside deviation and the pain index. Downside deviation is similar to standard deviation, but only includes “bad” volatility. Those observations that are considered to be “good” are excluded from the calculation of the risk metric.

The other alternative is to define risk in terms of capital preservation. Swan believes the pain index to be one of the most applicable measures of risk. The pain index measures the depth, duration, and frequency of losses for an investment. This gives an investor the ability to quantify the pain of market risk by measuring whether an investment minimizes periods of drawdown and loss. Exhibit 5 highlights some examples of the pain index for various asset classes over different time periods.

Pain Index	1980s	1990s	2000s	Common 1/88-12/10
Large Cap Stocks (US)	4.67%	1.80%	19.07%	10.11%
Small Cap Stocks (US)	7.83%	5.05%	13.58%	9.16%
Int'l Developed	4.04%	7.76%	19.33%	13.29%
Emerging Markets	N/A	14.03%	18.90%	16.06%
Invst Grade Bonds (US)	1.57%	0.84%	0.48%	0.63%
High Yield Bonds (US)	N/A	1.47%	3.48%	2.37%
REITs	2.71%	5.26%	11.32%	9.74%
Commodities	8.30%	16.60%	16.83%	17.39%
Hedge Funds	2.74%	0.51%	2.95%	2.06%

Exhibit 5 (Source: Zephyr StyleAdvisor)



Swan believes that these alternative measures of risk, downside deviation and the pain index, should provide additional value when seeking to construct a portfolio. These numbers can be compared to Swan's DRS study in Exhibit 9 on page 16.

2. MPT and MVO do not directly address market risk

The other main reason for an alternative approach to portfolio optimization is that MPT does not directly address market risk. Market risk, sometimes referred to as systematic risk, is by definition undiversifiable. Market risk needs to be addressed directly in order to truly optimize a portfolio to achieve an optimal risk-adjusted level of return.

Directly addressing market risk can be accomplished in one of two ways: market timing (stepping out of the market to remove market risk) or hedging. Swan believes that market timing is difficult, if not impossible, to implement on a long-term, consistent basis. Market timing has to rely on future prognostication or assumptions built on past outcomes in order to generate a market timing decision. Similar to how market timing signals are constructed after analyzing past reactions, asset allocation and MPT seek to indirectly address market risk through diversification built on past relationships as well.

Randy Swan, founder and CEO of Swan Global Investments, wrote this in 1997 when he developed the DRS:

“The great claim of asset allocation is that risk can be reduced by diversifying over several broad asset classes (i.e., stocks, bonds, cash and real estate) without a similar reduction in return. This risk reduction is, however, strictly theoretical (typically based upon relationships that existed over a particular period). There is no guarantee that these same relationships will continue in the future. This is the crux of where asset allocation or modern portfolio theory breaks down. Risk is not defined; instead it is merely expressed in historical standards.”

As described by Swan above, asset allocation and MPT merely distribute risk across asset classes but do not necessarily reduce the risk. If MVO fails to truly address market risk and market timing is not a dependable option, the only viable strategy remaining is hedging. Hedging is defined as owning an asset that should increase in value as another asset decreases in value (true non-correlation). The DRS is a hedged strategy and is built to address these major shortcomings of traditional portfolio optimization. Swan built several components of a diversified portfolio (equity and income) into one simple solution that solves both of these problems of volatility and market risk.

The strategy was designed to simplify and replace a total portfolio and over the past 18+ years, the strategy has proven its ability to do so by ably withstanding market downturns while still participating in the upside. The strategy's strong track record has been based on an underlying investment in U.S. large cap stocks (S&P 500), put options to hedge the underlying investment, and market-neutral options strategies built to allow upside market capture. As seen in Exhibit 3, the DRS has been able to not only outperform the S&P 500, but many popular asset allocation models as well. As a result, Swan believes that a superior and alternative approach to portfolio optimization is through the inclusion of hedged asset strategies, such as those managed using the DRS.



PORTFOLIO IMPROVEMENT THROUGH HEDGED ASSETS

Having successfully implemented a hedging strategy in large cap U.S. stocks, the question then becomes whether or not the DRS can be extended to other assets. Numerous studies have been published that show the benefits of portfolio hedging using options, especially studies on collar strategies (which also directly address market risk by hedging various assets with puts), and their positive implications on return, volatility, and risk. Although Swan does not implement a collar strategy, these studies solidified the feasibility of hedging with options across multiple assets and established that options-based investing can improve traditional buy-and-hold and may be beneficial to any portfolio. For example, one of these studies examined a basic collar strategy on 17 various assets, such as foreign stocks, real estate stocks, currencies, and gold, from 2007-2011. The study showed 11 out of 17 assets with improved returns and less risk and 17 out of 17 with less risk when hedged (see Exhibit 6).

Exhibit 2: summary statistics 5% OTM 1-Month Call/6-Month Put Collars (study period 55 months except GLD*)

	ETF	ETF	5% OTM collar	ETF	5% OTM collar	ETF	5% OTM collar	ETF	5% OTM Collar	Months
	Symbol	Annualized	Annualized	Annualized Std	Annualized Std	Cumulative	Cumulative	Maximum	Maximum	in Cash
		Return	Return	Deviation	Deviation	Return	Return	drawdown	drawdown	
Emerging Market Index - iShares	EEM	-0.43%	5.87%	30.95%	14.05%	-1.97%	29.88%	-60.44%	-17.61%	1
EAFE Index - iShares MSCI	EFA	-7.32%	-3.66%	24.52%	12.24%	-29.43%	-15.73%	-57.38%	-31.84%	0
Australian Dlr Tr. - CurrencyShares	FXA	8.96%	5.24%	18.24%	10.92%	48.16%	26.36%	-31.75%	-18.82%	0
British Pound Tr. - CurrencyShares	FXB	-3.98%	-2.78%	10.78%	7.00%	-16.99%	-12.13%	-28.09%	-18.41%	0
Canadian Dlr Tr. - CurrencyShares	FXC	1.95%	2.84%	12.66%	8.19%	9.26%	13.67%	-23.74%	-9.13%	1
Euro Tr. - CurrencyShares	FXE	0.31%	0.73%	13.62%	9.27%	1.43%	3.40%	-21.19%	-13.20%	0
Swiss Franc Tr. - CurrencyShares	FXF	6.09%	6.63%	14.70%	9.51%	31.10%	34.20%	-17.65%	-10.37%	0
Japanese Yen Tr. - CurrencyShares	FXY	10.14%	8.77%	10.37%	8.13%	55.69%	47.00%	-9.36%	-7.79%	0
Gold Tr. - SPDR *	GLD	15.64%	8.80%	22.82%	13.65%	66.29%	34.35%	-21.95%	-11.30%	0
GSCI Commodity Tr. - S&P	GSG	-4.74%	2.62%	28.83%	11.37%	-19.95%	12.59%	-67.85%	-19.34%	5
Hi Yield Corp. Bond - iBoxx	HYG	5.29%	0.54%	17.01%	7.26%	26.63%	2.50%	-30.28%	-15.30%	9
Russell 2000 - iShares	IWM	-1.51%	-0.09%	25.13%	14.17%	-6.72%	-0.42%	-52.42%	-23.87%	0
DJ US Real Estate - iShares	IYR	-4.02%	-1.46%	33.27%	13.33%	-17.14%	-6.51%	-67.89%	-32.58%	0
NASDAQ 100 - PowerShares	QQQ	4.25%	1.75%	22.79%	13.16%	21.01%	8.28%	-49.74%	-28.80%	0
S&P 500 - SPDR	SPY	-2.14%	3.03%	19.46%	10.42%	-9.45%	14.64%	-50.80%	-19.81%	0
Barclays 20+ Treasury Bond - iShares	TLT	12.29%	5.85%	16.85%	10.97%	70.12%	29.76%	-21.80%	-17.02%	0
U.S. Oil Fund - U.S. Commodity Funds	USO	-5.32%	5.19%	37.79%	17.03%	-22.16%	26.11%	-76.20%	-33.76%	0

* The inception date for the GLD ETF was November 18, 2004, with option data available from June 20, 2008. Study period = 42 months

Exhibit 6 (Source: Szado and Schneeweis, Option-Based Risk Management In a Multi-Asset World, 2012)



This and other studies strengthen Swan's hypothesis that hedged assets can and should improve risk-adjusted returns across multiple assets. Furthermore, Swan has undertaken its own study of its DRS process applied to various assets to see if the outcomes would be similar.

Swan's multiple asset study involved applying the same process and rules of the 19+ year U.S. equity DRS SMA to various other equity assets. The necessary options data to perform this type of backtest only goes back to 2007 for some of these assets, thus, these hypothetical results only go back to that point in time. All hypothetical portfolios include a 1% management fee. Exhibit 7 shows the results of each DRS portfolio compared to the underlying asset ETF.

Notice the tremendous difference in the 4 risk metrics in Exhibit 7 of the underlying ETF representing the asset and the corresponding DRS product. Swan's focus on directly addressing market risk begins to make a big difference over a market cycle as an asset goes through a bull and bear market. The outcome is an improved risk/return profile whether these assets are used as a stand-alone investment or comprise a portfolio. Moreover, the DRS approach should improve any portfolio optimization, regardless if it's based on traditional standard deviation or alternative risk metrics. Most impressively, Swan's DRS assets tremendously limit the pain index as compared to the underlying asset. For example, the depth, duration and frequency of losses for the Swan U.S. equity DRS is about one-fourth that of the S&P 500 from 2007-2016 and around one-sixth since inception in mid-1997 as well (based on actual results and returns).

Underlying Asset	ETF Symbol	Return		Cumulative Return		St Dev (pop)		Sharpe Ratio		Max Drawdown		Pain Index	
		ETF	DRS	ETF	DRS	ETF	DRS	ETF	DRS	ETF	DRS	ETF	DRS
Small Cap	IWM	7.13%	8.49%	99.17%	125.79%	19.93%	10.91%	0.32	0.71%	-52.69%	-23.04%	10.33%	3.36%
Foreign Developed	EFA	0.58%	3.61%	6.00%	42.58%	19.01%	9.49%	-0.01	0.30%	-57.46%	-16.81%	18.99%	4.73%
Emerging Markets	WVO	1.79%	7.46%	19.40%	105.29%	23.79%	13.32%	0.04	0.50	-62.76%	-28.96%	20.44%	6.22%
Gold	GLD	5.67%	4.31%	73.54%	52.45%	19.27%	11.90%	0.26	0.30	-42.91%	-26.12%	15.57%	10.02%
US REITs	IYR	3.52%	4.54%	41.35%	55.82%	24.37%	11.69%	0.11	0.32	-69.66%	-24.85%	18.72%	5.35%
S&P 500	SPX TR	6.95%	6.50%	95.72%	87.73%	15.22%	8.19%	0.41	0.70%	-50.95%	-13.59%	9.72%	2.47%

Exhibit 7 (Source: Zephyr StyleAdvisor and SGI; results are hypothetical with a 1% fee, from 2007 through 2016, for all DRS returns except for S&P 500 DRS, which is represented by the Swan DRS Select Composite, net of all fees)



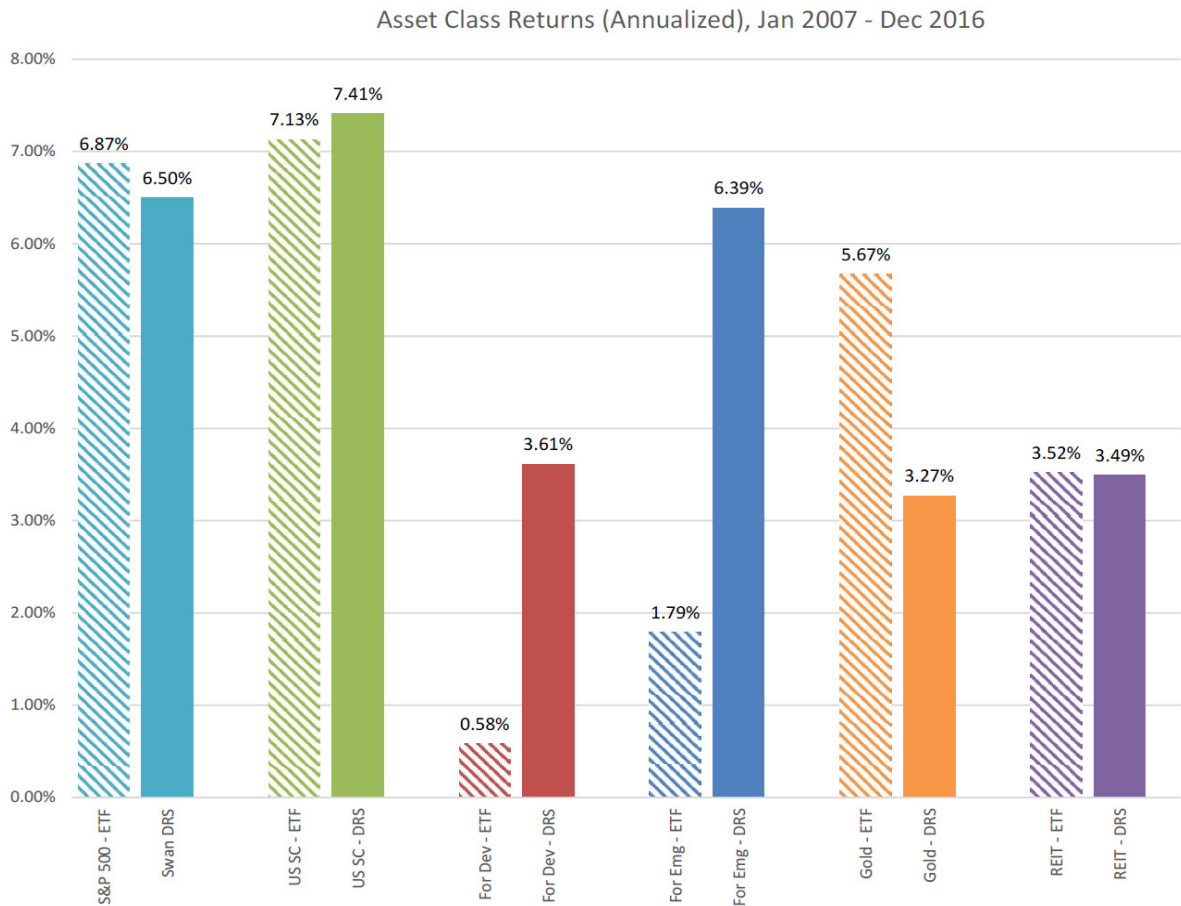


Exhibit 8 (Source: Zephyr StyleAdvisor and SGI; results are hypothetical, from 2007 through 2016, for all DRS returns except for S&P 500 DRS, which is represented by the Swan DRS Select Composite, net of all fees)

The pain index addresses some of the shortcomings of standard deviation mentioned previously. It does not “punish” a manager for upside volatility and it also addresses the timing issue of when the bad returns occur. Finally, the pain index approaches risk like most investors think of risk - in terms of money lost, amount of time necessary to recover, and “pain” felt.

Looking at each strategy individually, the gold DRS did not outperform its underlying benchmark, GLD (although it reduced volatility and risk and captured 76% of the underlying return). This is largely due to the roaring bull market that gold experienced over the past 8 years, with six straight up years before falling in 2013-2015. Comparatively, all the other assets first experienced a large bear and then strong bull market. Since the DRS has the ability to accumulate additional shares from re-hedging during and after market corrections, this allows the strategy to better participate in subsequent market rebounds.



Gold has not provided such an opportunity yet, except in a smaller manner after gold's decline in 2013. It is important to understand that the structure of the DRS will not capture all of the upside in order to be always protected on the downside, typically meaning the DRS will trail the S&P 500 during a bull market. This tradeoff over time, as shown, ends up smoothing out return and outperforming both individual assets and asset allocation portfolios.

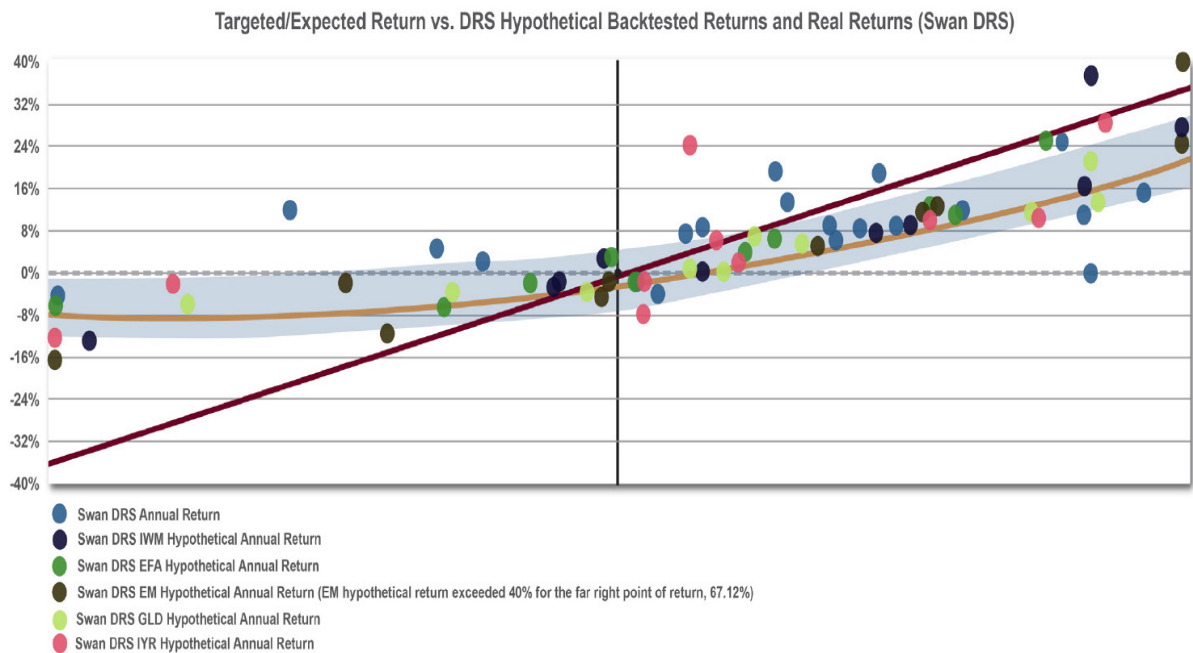


Exhibit 9 (Source: Morningstar, Blackrock, and Swan Global Investments; important disclosure, results indicated as hypothetical are backtested numbers and not from actual accounts, from 2007-2016. The Swan DRS Select Composite represents the Swan DRS results from inception through 2016.)



SPECIFIC ASSET COMPARISONS FOR USE IN ALTERNATIVE PORTFOLIO OPTIMIZATION

The benefits of a properly managed hedged asset can be achieved either at the portfolio level or the asset level. If at the asset level, any time there is a defined risk product such as the DRS, the portfolio should be more efficient and optimized with the DRS product replacing or supplementing the corresponding asset. This does not mean that at any given time in an investment cycle that a DRS product should outperform the underlying asset, but that over a long-term investment cycle or multiple bull and bear markets, the DRS products should provide a lower pain index, lower downside deviation, and higher return than if invested in the underlying assets (thus improving the efficiency of the portfolio).

So, from a traditional and non-traditional risk/reward standpoint, how do these underlying assets and their DRS counterparts compare to each other over the study time period?

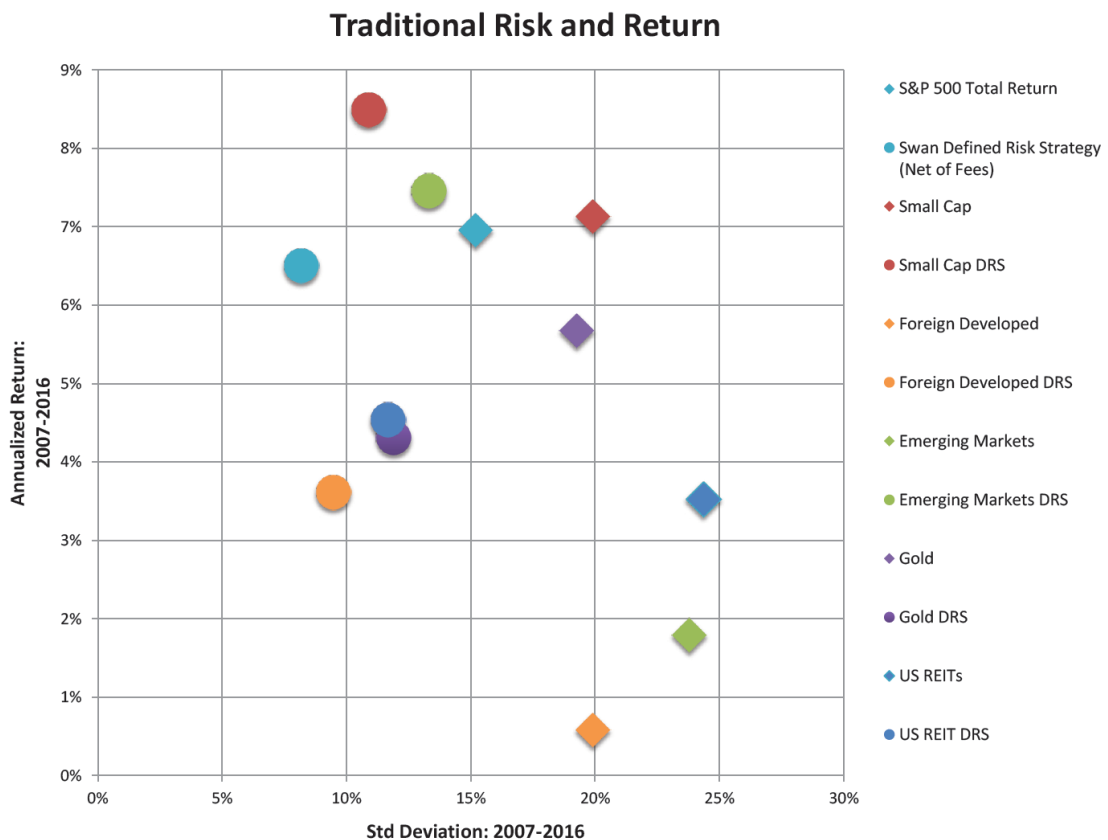


Exhibit 10 (Source: Zephyr StyleAdvisor and SGI; results are hypothetical with a 1% fee, from 2007 through 2016, for all DRS returns except for S&P 500 DRS, which is represented by the Swan DRS Select Composite, net of all fees)



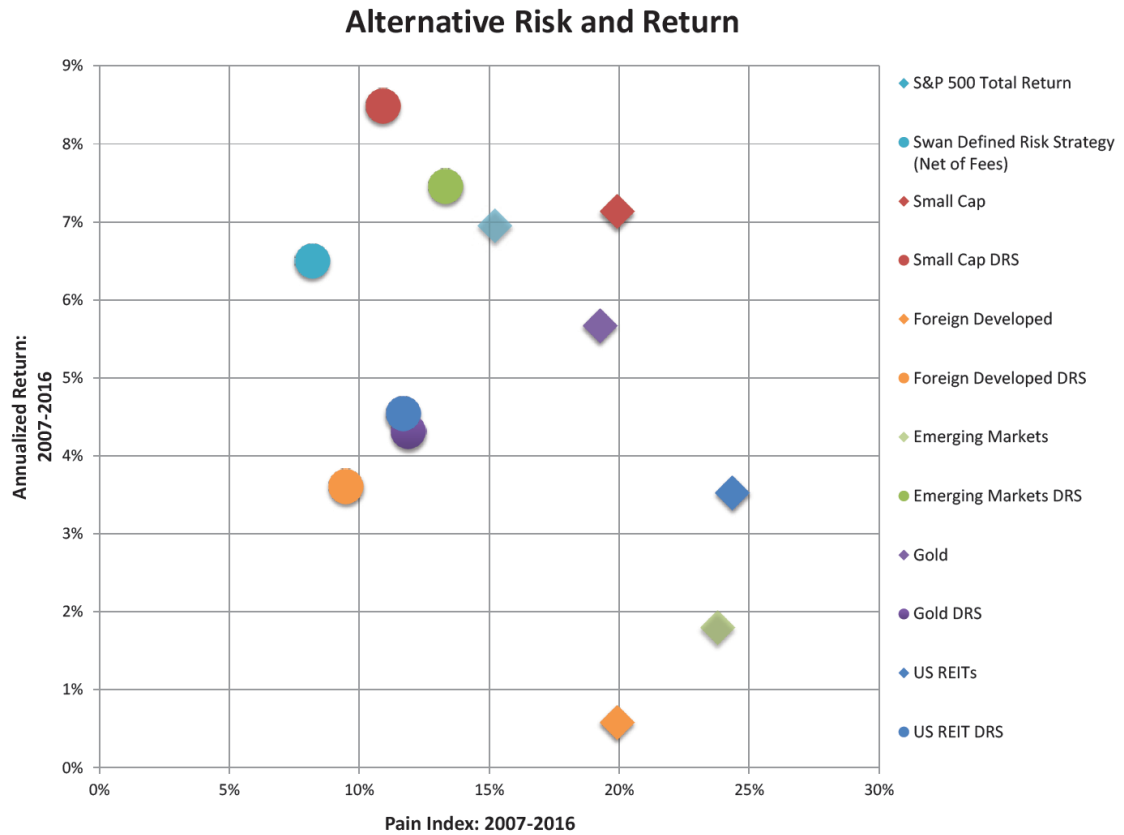


Exhibit 11 (Source: Zephyr StyleAdvisor and SGI; results are hypothetical with a 1% fee, from 2007 through 2016, for all DRS returns except for S&P 500 DRS, which is represented by the Swan DRS Select Composite, net of all fees)

Each of these risk/return graphs show a tight and efficient placement of all six DRS strategies in the desired upper left quadrant (circles represent DRS strategies and triangles represent index/underlying asset). The alternative risk/return method using the pain index in place of standard deviation separates the DRS strategies from the underlying assets even more noticeably. Although there are limitations to portfolio optimization based on hypothetical data and past data of returns and risk metrics as previously discussed, these graphs highlight the obvious difference the DRS could make across numerous assets throughout a bear/bull market cycle. Portfolio optimization should begin and end with a focus on market risk and protecting the portfolio from big losses; doing so should lead to lower volatility, less “pain”, and better returns.



THE DEFINED RISK PORTFOLIO

In addition to the DRS specifically improving risk/return (whichever way one chooses to look at it) across the various tested assets, an equal-weight combination of all of the DRS strategies provided interesting results. A defined risk portfolio of six assets resulted in a lower pain index number and a lower standard deviation than any other DRS strategy, with a higher sharpe ratio than the S&P 500. Obviously, this is a logical result from combining optimal assets (as a well-known restaurateur argues, better ingredients make a better pizza). By building a portfolio of DRS assets, an investor could create an efficient portfolio not dependent on past correlations and outcomes, while directly addressing market risk in all aspects of the portfolio.

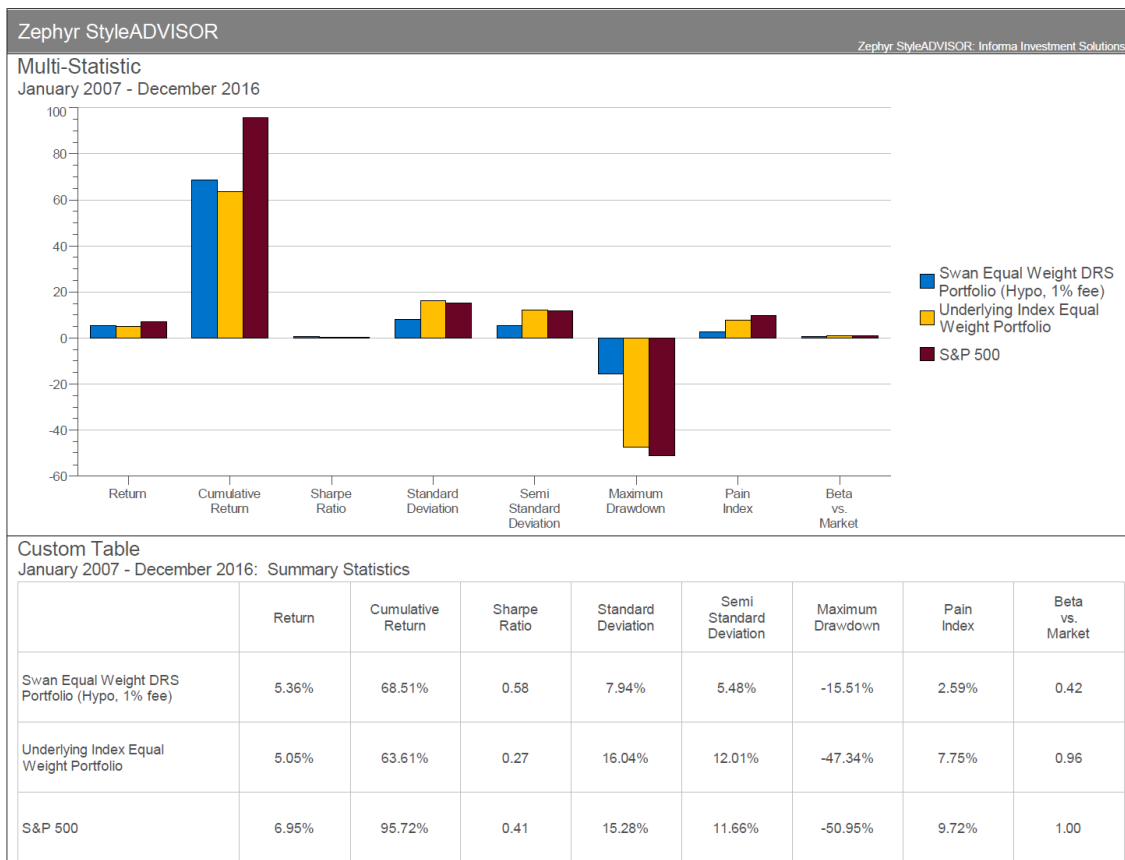


Exhibit 12 (Source: Zephyr StyleAdvisor and SGI; Swan Equal-Weight Portfolio net of fees, both portfolios rebalanced annually. Results are hypothetical, from 2007 through 2016)



Exhibit 12 compares an equal-weight six-asset DRS portfolio to those six assets (each rebalanced annually). Besides the improvement in return, notice the stark improvement to Sharpe ratio, semi standard deviation, maximum drawdown, and the pain index from the DRS portfolio. This combination would also provide true diversification (recall that diversification benefit increases the lower the correlation) and still be hedged and fully invested at all times.

DRS Correlation Matrix: Returns vs. S&P 500: January 2007 - December 2016

1) Swan Defined Risk Strategy (Net)	1.00	0.79	0.61	0.66	0.00	0.64	0.76
2) IWM DRS	0.79	1.00	0.64	0.66	-0.05	0.69	0.84
3) EFA DRS	0.61	0.64	1.00	0.68	0.08	0.51	0.63
4) VWO DRS	0.66	0.66	0.68	1.00	0.22	0.55	0.69
5) GLD DRS	0.00	-0.05	0.08	0.22	1.00	0.05	0.08
6) IYR DRS	0.64	0.69	0.51	0.55	0.05	1.00	0.70
7) S&P 500	0.76	0.84	0.63	0.69	0.08	0.70	1.00

Less than 0.50
Between 0.50 and 0.70
Between 0.70 and 0.80
Between 0.80 and 0.90
Over 0.90

Exhibit 13 (Source: Zephyr StyleAdvisor and SGI; results are hypothetical with a 1% fee, from 2007 through 2016, for all DRS returns except for S&P 500 DRS, which is represented by the Swan DRS Select Composite, net of all fees)

Swan believes that more and more investors going forward will be looking toward alternative ways of measuring risk and optimizing portfolios, having been bitten one too many times by the limitations and shortcomings of MPT and MVO. For advisors seeking to help their clients, it is imperative that they consider implementing tools that directly address market risk and the shortcomings of MPT. True portfolio optimization will only be achieved by allocating portfolios to risk-managed strategies constructed to consistently provide return, low standard deviation, and low pain index across multiple timeframes, market cycles, and assets through the use of instruments that directly hedge against market risk (such as put options).

The rise of robo-advisors and target-date funds (most, if not all, built on MPT and MVO-based portfolios) as well as financial “advice” through social media avenues, internet newsletters, and TV media, has made it increasingly difficult for professional investment advisors to distinguish themselves. The sea of financial “help” seeking to capture investors’ attention has made it increasingly important for advisors to display true thought leadership and go beyond the normal Wall Street narrative. By offering innovative and potentially superior solutions, advisors can differentiate themselves in a monotonous landscape. Robo-advisors and traditional asset allocators lack defined risk products that address market risk with a proven track record of protecting against market downturns.



Swan is focused on helping provide financial advisors with the thought leadership necessary to differentiate themselves and make their businesses stronger and more valuable. As fee-based advisory models have replaced commission-based business, the goals of advisors and clients are aligned like never before. Both advisors and investors seek to preserve capital, grow wealth, and stay committed to a long-term plan through up and down markets. For advisors, the benefit of a DRS approach and portfolio goes beyond offering a unique approach that has outperformed the market with lower risk by 1.68% annually since July 1997. Advisors can reap benefits from a DRS-based portfolio by helping clients stay invested through market corrections (lessening the emotional reactions investors display in 2008 type markets), potentially increasing fee-based compensation from higher potential returns and less client turnover. In conclusion, a stronger, well-defined risk approach to portfolio optimization should lead to optimal results for not only portfolios and clients, but for advisors as well as they seek to grow and protect their business.



DEFINITION OF INDICES

S&P 500- The S&P 500 Index is a market cap weighted index of 500 widely held stocks often used as a proxy for the overall U.S. equity market.

Russell 3000- The Russell 3000 is a market cap weighted index of the 3,000 largest companies in the U.S. equity markets. It is one of the broadest measures of U.S. equity market performance, representing approximately 98% of the market capitalization of the U.S. equity market. The Russell 3000 is subdivided in to the Russell 200 (large caps), Russell Mid Cap (mid caps), and Russell 2000 (small caps). The Russell Microcap are those stocks too small to be incorporated in to the Russell 3000. Each of the Russell indices is further subdivided in to “value” and “growth” halves.

Russell 2000- The Russell 2000 is a market cap weighted index of 2,000 companies representing the small cap segment of the U.S. equity market. The index is composed of the 1,001st to 3,000th largest stocks in the U.S. market.

MSCI EAFE- The MSCI EAFE Index measures international equity performance. It comprises the MSCI country indexes that represent developed markets outside of North America: Europe, Australasia and the Far East. With 909 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country.

MSCI Emerging Markets- The MSCI Emerging Markets Index captures large and mid cap representation across 21 Emerging Markets (EM) countries. With 822 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country.

Barclays U.S. Aggregate- The Barclays U.S. Aggregate Bond Index covers the USD-denominated, investment-grade (rated Baa3 or above by Moody’s), fixed-rate, and taxable areas of the bond market. This is the broadest measure of the taxable U.S. bond market, including most Treasury, agency, corporate, mortgage-backed, asset-backed, and international dollar-denominated issues, all with maturities of 1 year or more.

Barclays U.S. Corporate High Yield- The Barclays U.S. Corporate High Yield index measures the market of USD-denominated, non-investment grade, fixed-rate, taxable corporate bonds. Securities are classified as high yield if the middle rating of Moody’s, Fitch, and S&P is Ba1/BB+/BB+ or below.

FTSE NAREIT All REIT- The FTSE NAREIT All REITs Index is a market capitalization-weighted index that includes all tax-qualified real estate investment trusts (REITs) that are listed on the New York Stock Exchange, the American Stock Exchange or the NASDAQ National Market List. The Index is not free float adjusted and constituents are not required to meet minimum size and liquidity criteria.

S&P GSCI- The S&P GSCI is a composite index of commodity sector returns which represents a broadly diversified, unleveraged, long-only position in commodity futures.



DEFINITION OF STATISTICS

S&P 500- The S&P 500 Index is a market cap weighted index of 500 widely held stocks often used as a proxy for the overall U.S. equity market.

Beta- Beta measures the sensitivity of the manager to movements in an underlying benchmark. Conservative investors prefer a beta less than 1.0, suggesting the investment moves less than the market. Aggressive investors prefer a beta greater than 1.0, which are more sensitive to market movements.

Correlation- Correlation measures how closely two different investments move in conjunction with one another. It contains a directional aspect. If one is seeking to diversify an investment portfolio, lower correlations or negative correlations are desired. A zero correlation suggests an investment's movement is independent of the other. A negative correlation suggests an investment's movement is the opposite direction of the other.

Pain Index- The pain index quantifies the capital preservation tendencies of a manager or index. It measures the depth, duration, and frequency of periods of losses. The lower the pain index the better. A pain index of 0% indicates the investment has never lost value. A pain index should be compared against a benchmark or peer group in order to understand context.

Sharpe Ratio- The most famous return-versus-risk measurement, the Sharpe ratio represents the added value over the risk-free rate per unit of volatility risk. Generally, the higher the better. A manager's Sharpe ratio should be higher than index or higher than a universe average.

Standard Deviation- Standard deviation measures how closely returns track their long term average. Standard deviation measures volatility risk. Generally, the lower the better. A manager's standard deviation should be lower than index or lower than a universe average.



IMPORTANT DISCLOSURES

This communication is informational only and is not a solicitation or investment advice. Nothing in this presentation constitutes financial, legal, or tax advice. All information is subject to change or correction without notice. The charts and graphs contained herein should not serve as the sole determining factor for making investment decisions. To the extent that you have any questions regarding the applicability of any specific issue discussed to your individual situation, you are encouraged to consult with Swan. All information, including that used to compile charts, is obtained from sources believed to be reliable, but Swan does not guarantee its reliability. Swan's investments may consist of securities which vary significantly from those in the benchmark indexes listed above and performance calculation methods may not be entirely comparable. Accordingly, comparing results shown to those of such indexes may be of limited use. All Swan performance results have been compiled solely by Swan Global Investments and are unaudited. Other performance return figures indicated in this material are derived from what Swan believes to be reliable sources, but Swan does not guarantee its reliability. The resulting hypothetical performance analysis is not actual performance history. Actual results may materially vary and differ significantly from the suggested hypothetical analysis performance data. There is no guarantee the DRS structured portfolio investment will meet its objectives. This is not a guarantee or indication of future performance. References to the S&P 500 and other indices herein are for informational and general comparative purposes only. Indexes are unmanaged and have no fees or expenses. An investment cannot be made directly in an index. Investment strategies with other securities may vary significantly from those in the benchmark indexes listed. All investments involve the risk of potential investment losses as well as the potential for investment gains. Prior performance is no guarantee of future results and there can be no assurance that future performance will be comparable to past performance. Swan Global Investments, LLC ("Swan") is an independent Investment Advisory headquartered in Durango, Colo. registered with the U.S. Securities and Exchange Commission under the Investment Advisers Act or 1940. Being an SEC-registered advisor implies no special qualification or training. Swan offers and manages its Defined Risk Strategy to individuals, institutions and other advisory firms. All Swan products utilize the Defined Risk Strategy ("DRS"), but may vary by asset class, regulatory offering type, etc. Accordingly, all Swan DRS product offerings will have different performance results due to offering differences and comparing results among the Swan products and composites may be of limited use.

There are eight DRS Composites offered: 1) The DRS Select Composite which includes non-qualified accounts; 2) The DRS IRA Composite which includes qualified accounts; 3) The DRS Composite which combines the DRS Select and DRS IRA Composites; 4) The DRS Institutional Composite which includes high net-worth, non-qualified accounts that utilize cash-settled, index-based options held at custodians that allow participation in Clearing Member Trade Agreement (CMTA) trades; 5) The Defined Risk Fund Composite which includes mutual fund accounts invested in the S&P 500; 6) The DRS Emerging Markets Composite which includes mutual fund accounts invested in emerging markets; 7) The DRS Foreign Developed Composite which includes all research and development account(s), and mutual fund accounts invested in foreign developed markets; 8) The DRS U.S. Small Cap Composite which includes all research and development account(s), and mutual fund accounts invested in U.S. small cap issues. Additional information regarding Swan's policies and procedures for calculating and reporting performance returns is available upon request.

Swan claims compliance with the Global Investment Performance Standards (GIPS) and has prepared and presented this report in compliance with GIPS standard. Swan's compliance with GIPS has been independently verified from its inception on July 1, 1997 through December 31, 2015. A copy of the verification report is available upon request. To receive copies of the report please call 970.382.8901 or email operations@swanglobalinvestments.com. Verification assesses whether (1) the firm has complied with all the composite construction requirements of the GIPS standards on a firm-wide basis and (2) the firm's policies and procedures are designed to calculate and performance in compliance with the GIPS standards. Verification does not ensure the accuracy of any specific composite presentation. The Defined Risk Strategy Select Composite demonstrates the performance of all non-qualified assets managed by Swan Global Investments, LLC since inception. It includes discretionary individual accounts whose account holders seek the upside potential of owning stock, and the desire to eliminate most of the risk associated with owning stock. The composite relies on LEAPS and other options to manage this risk. Individual accounts own S&P 500 exchange-traded funds, LEAPS associated with the ETFs, as well as option strategies based on other widely traded indices. The Defined Risk Strategy Select Composite includes all non-qualified discretionary accounts which are solely invested in the Defined Risk Strategy. The Defined Risk Strategy was designed to protect investors from substantial market declines, provide income in flat or choppy markets, and to benefit from market appreciation. Stock and options are the primary components of the strategy. The performance benchmark used for the Defined Risk Strategy is the S&P 500 Index comprised of 500 large-capitalization stocks, and which does not charge fees. 073-SGI-032117



ABOUT SWAN GLOBAL INVESTMENTS

Investing Redefined

Randy Swan started Swan Global Investments in 1997 looking to supply investment management services that were not available to most investors. Early in his financial career, Randy saw that options provided an opportunity to minimize investment risk.

His innovative solution was the proprietary Swan Defined Risk Strategy, which has provided market leading, risk-adjusted return opportunities through a combination of techniques that seek to hedge the market and generate market-neutral income.



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