SWAN GLOBAL INVESTMENTS

Math Matters: Rethinking Investment Returns & How Math Impacts Results

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EXECUTIVE SUMMARY

Swan Global Investments has been managing the Defined Risk Strategy ("DRS") for over 18 years. With the DRS, Swan believes it has a superior solution to seeking investment returns that is transparent, repeatable, and scalable. This solution seeks to actively address the biggest threat investors of all types have in meeting their goals; namely, the devastating impact of bear market sell-offs on an investor's wealth. By directly addressing systematic risk via the intelligent and efficient use of option strategies, the DRS was designed to remedy the shortcomings of traditional asset allocation, market-timing, sector rotation, and stock-picking through the benefits of a hedged equity strategy.

However, there are a lot of misconceptions amongst investors as it relates to equity investment returns, hedged equity returns, and the math behind them. Many investors make their investment decisions based upon emotions like fear and greed. They do not understand the math that drives successful long-term results and why this is important. Understanding the core mathematical principles driving investment returns can help investors make better investment decisions. These core principles are often overlooked, ignored, or misunderstood by investors and will be explored in this paper for the purpose of strengthening the decision-making process.

The purpose is two-fold. First, Swan believes it is important that investors have a better understanding of how different equity investments ebb and flow and grow over time in order to properly assess them. Second, many investors familiar with passive or active equity investments sometimes have certain misperceptions regarding the DRS or other hedged equity strategies. This is mainly because a hedged equity approach generally underperforms during bull markets and tends to outperform in bear markets. The DRS, with its unique approach, requires a full market cycle and is better positioned as a core, long-term holding and not a short-term trading vehicle.

The goal of this paper is to establish that certain mathematical principles support the usage of a hedged equity approach over other traditional equity approaches for long-term investment growth. The paper will focus on four core, interconnected mathematical principles, all of which are instrumental to achieving better investment results over time. They are:

1. The importance and power of compounding
2. The value of avoiding large losses
3. The importance of variance drain
4. The importance of a non-normal distribution of returns

RETHINKING INVESTMENT RETURNS

Investors are constantly chasing one thing: return. Usually the second criteria investors look for is returns with low volatility. Every investor dreams of finding the holy grail of investing: a no-risk, high return investment. But as everyone should know, such an investment does not exist. The definition of risk is the possibility of suffering harm or loss. Obviously, all investments have some risk in some shape or form. So if one cannot invest in a riskless high return investment, what is the next best thing? What types of return end up leading to solid investment growth? Is it frequent large gains with only an occasional big loss? Is it smaller, flat, steady returns such as those sometimes found in fixed income? Is it frequent modest gains with relatively few, small losses?

Most investors do not stop to consider the importance of these questions and how the math behind these various types of return streams effect the final outcome. In addition, the final outcome is greatly impacted by the volatility of the experience along the way. Whether or not an investor can stay the course with an investment or survive withdrawing money from their account

depends a lot upon the volatility of the portfolio. High volatility portfolios tend to lead to poor, emotionally driven decisions.

A hedged equity approach such as the DRS must address these questions and the understanding investors have of investment returns in order to avoid uninformed decisions during short-term underperformance or whether hedged equity should even be considered in the first place. With hedged equity approaches, generally some upside potential during bull markets is sacrificed in exchange for some portfolio protection on the downside. Many investors hear the phrase "give up some of the upside" and think that mathematically the strategy will always underperform the equity markets. On the contrary, if investors have a proper understanding of the math behind investment returns and what impacts them the most, they will see why and how hedged equity returns can be a superior investment approach compared to traditional management.

THE FOUR MOST IMPORTANT MATHEMATICAL PRINCIPLES TO GROWING WEALTH

1. The Power of Compounding

Albert Einstein supposedly once said that the most powerful force in the universe is compound interest. The principle of compound growth can be defined as the power of exponential growth, that is, growth on growth. The concept of compound growth and its impact can be a difficult one to grasp. Why is compound growth so important and how does it impact the returns achievable with an investment?

The power of compounding is basically the snowball effect that happens when growth generates even more growth and continues to do so. You receive growth not only on your original investments, but also on any interest, dividends, and capital gains that have accumulated — thus, your money can grow faster and faster as time goes on. The late Dr. Albert Bartlett, a professor, author, and expert on arithmetic and exponential growth, painted an interesting picture as it relates to the power of compounding and exponential growth in one of his papers. An adaptation by economic analyst Chris Martensen explains Dr. Bartlett's analogy like this:

"Suppose I had a magic eye dropper and I placed a single drop of water in the middle of your left hand. The magic part is that this drop of water is going to double in size every minute. At first, nothing seems to be happening. But by the end of a minute, that tiny drop is now the size of two tiny drops. After another minute, you now have a little pool of water that is slightly smaller in diameter than a dime sitting in your hand. After six minutes, you have a blob of water that would fill a thimble.

Now suppose we take our magic eye dropper to Fenway Park and right at 12:00 p.m. in the afternoon, we place a magic drop way down there on the pitcher's mound. To make this really interesting, suppose that the park is watertight and that you are handcuffed to one of the very highest bleacher seats. My question to you is, "How long do you have to escape from the handcuffs?" When would it be completely filled? In days? Weeks? Months? Years? How long would that take?

Exhibit 1
Source: Wikipedia

The answer is this: You have until exactly 12:50 pm on that same day — just 50 minutes — to figure out how you're going to escape from your handcuffs. In only 50 minutes, our modest little drop of water has managed to completely fill the stadium. But wait, you say, how can I be sure which stadium you picked? Perhaps the one you picked is 100 percent larger than the one I used to calculate this example (Fenway Park). Wouldn't that completely change the answer? Yes, it would — by one minute. Every minute, our magic water doubles, so even if your selected stadium happens to be 100 percent larger or 50 percent smaller than the one I used to calculate these answers, the outcome only shifts by a single minute.

Now let me ask you a far more important question: At what time of the day would your stadium still be 97 percent empty space and how many of you would realize the severity of your predicament? The answer is that at 12:45 pm — only five minutes earlier — Fenway is only 3 percent full of water and 97 percent remains free of water. If at 12:45, you were still handcuffed to your bleacher seat patiently waiting for help to arrive, confident that plenty of time remained because the field was only covered with about 5 feet of water, you would actually have been in a very dire situation.

And that, right there, illustrates one of the key features of compound growth. With exponential growth in a fixed container, events progress much more rapidly toward the end than they do at the beginning. We sat in our seats for 45 minutes and nothing much seemed to be happening. But then, over the course of five minutes—whoosh!—the whole place was full of water. Forty-five minutes to fill 3 percent; only five more minutes to fill the remaining 97 percent." (Source: Martensen, Chris; "The Crash Course: The Unsustainable Future Of Our Economy, Energy, And Environment")

Although this visualization doesn't use money, it does show the incredible power of exponential growth and how growth on growth can have a slow and sneaky impact over time. In investing, the well-known "rule of 72" refers to a shortcut in estimating how long it would take to double your

money based on taking 72 and dividing it by the compound annual growth rate. For example, with a 10% compounded annual return, your money would double in 7.2 years.

How long it takes to double your money with an investment strategy matters, because the shorter the time period, the sooner the power of compounding kicks into high gear (see Exhibit 2 below). The sooner and steadier that growth occurs should lead to better long-term results. Conversely, lower rates of return and higher volatility will lead to lower long-term results.

The hypothetical graph on page 8 shows the power of compounding for an investment with no volatility. You can see how compound growth takes time to start to have an impact.

Doubling Times for Different Rates of Steady Growth

Percent Growth Per Year	Doubling Time In Years
Zero	Infinity
0.5	144.0
1.0	72.0
2.0	36.0
3.0	24.0
4.0	18.0
5.0	14.4
10.0	7.2
20.0	3.6

Exhibit 2
Source: Swan Global Investments; calculations using rule of 72

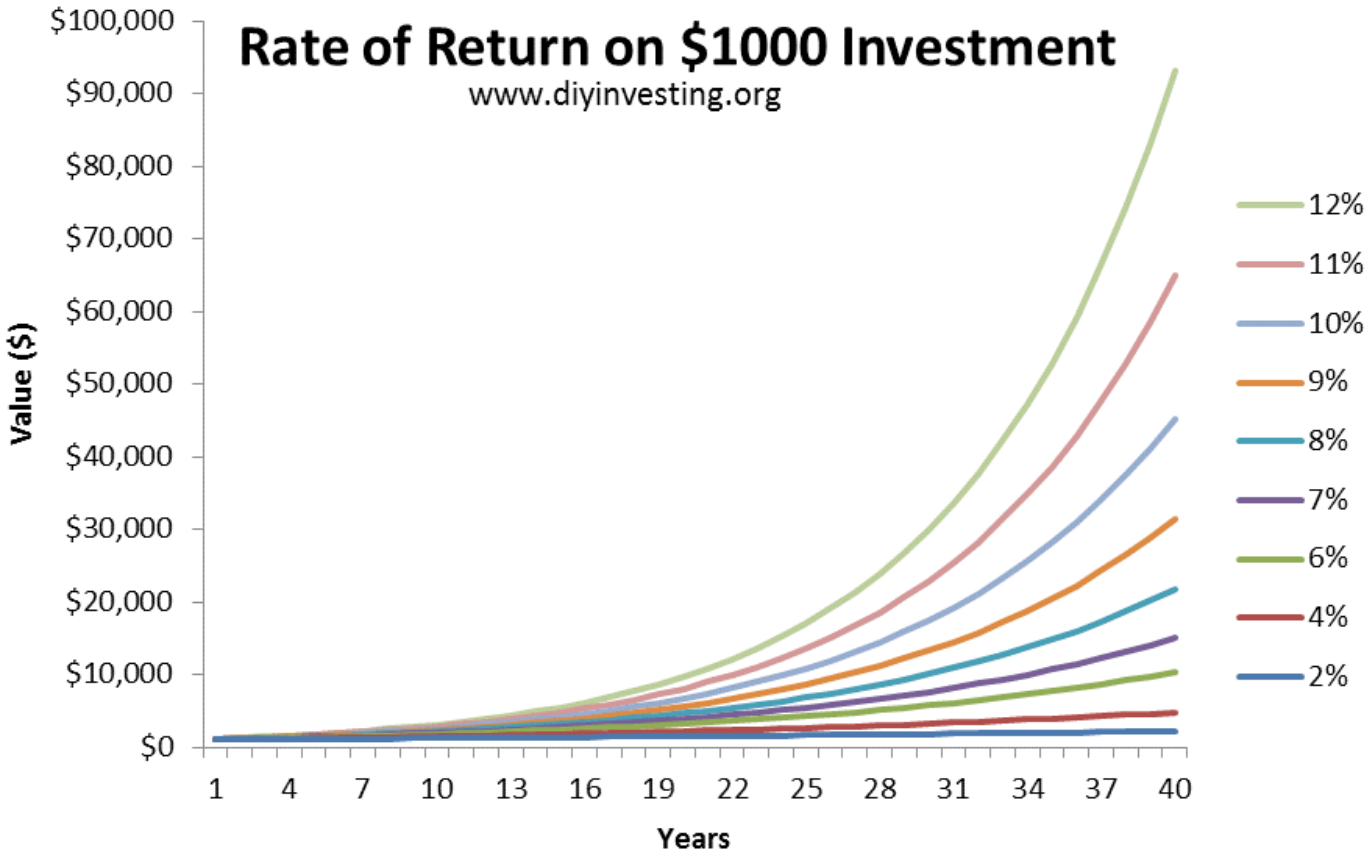


Exhibit 3
Source: diyinvesting.org

Now imagine a large drawdown due to a bear market instead of the smooth, no volatility growth seen in Exhibit 3. Anything that causes a "reset" to a lower level, such as a large downturn in the portfolio, will weaken the eventual compound returns. This principle is strongly interconnected with the second factor, the value of avoiding large losses. These two factors go hand in hand. The power of compounding, crucial to successful long-term returns, can be better utilized when avoiding large losses.

2. The Value of Avoiding Large Losses

"What do you call a market down 90%? It is a market that was down 80%, and then got cut in half from there." – Meb Faber

Large losses can be incredibly painful in the short-term, but even more dramatic is the impact on the long-term success of investment returns. There are many studies that show the value of avoiding large losses as well as studies that show how behavioral bias contributes to people continually and frequently participating in large losses.

Research has shown that most individuals are risk avoiders when handling gains and risk takers when dealing with losses (Tversky and Kahneman, Judgment under Uncertainty: Heuristics and Biases, 1982). Tversky and Kahneman had people receive $1,000 with the choice of a guaranteed gain of $500 or a 50% chance of a $1,000 gain. Over 80% chose the $500 guarantee, with few willing to take the risk of additional gain. On the other hand, in the second part of the experiment, people were given $2,000. They were then given the alternatives of a 50% chance of losing $1,000 or a 100% chance of losing $500. Around 70% chose the chance of losing $1,000, with few unwilling to avoid the risk of a larger loss. The results of the experiment indicated people tend to do the following when it comes to investing:

they don't let their profits run and they fail to cut their losses short. The reverse of this psychology is necessary to be a successful trader or investor. As Warren Buffett once famously said regarding the rules of investing: "Rule #1: Never lose money. Rule #2: Never forget rule #1."

It is of course challenging for investors to avoid large losses. It is hard-coded in our DNA. This behavioral bias is called the disposition effect. The disposition effect is a behavioral bias wherein an investor exhibits reluctance to realize losses, as seen in the aforementioend experiment. Investors tend to sell winners too early and ride losers too long, hoping that they might eventually turn into a gain. Studies by Shefrin and Statman (1985), Barberis and Xiong (2009), Odean (1998), and Weber and Camerer (1998), to name a few, have shown this disposition effect evident in investors' behavior. This is despite the fact that large losses can occur much more quickly than large gains. As the Oracle of Omaha once said: "It takes 20 years to build a reputation and five minutes to ruin it. If you think about that, you'll do things differently."

In the same vein as Buffett's quote, you could replace the word "reputation" with "portfolio", since large losses can quickly and disastrously wipe out years of investment growth. With that in mind, you SHOULD do things differently and always address and define risk in such a way that large losses do not occur, or at least occur less frequently. For example; a solid 8% a year means you can double your money in 9 years (rule of 72). But if you take a 50% loss in year 10, you would be right back to where you started and the annualized return over those years would be 0%.

Crestmont Research, in a thought provoking white paper entitled "Half & Half: Why Rowing Works", graphically displayed the dynamic of the gains necessary to offset losses. As the losses increase, the required gain to recover your losses exponentially increases. The exponential power of large losses really starts to take effect after -30% to -40%, as seen in Exhibit 5.

One Really Bad Year Can Erase Many Good Years of Gains

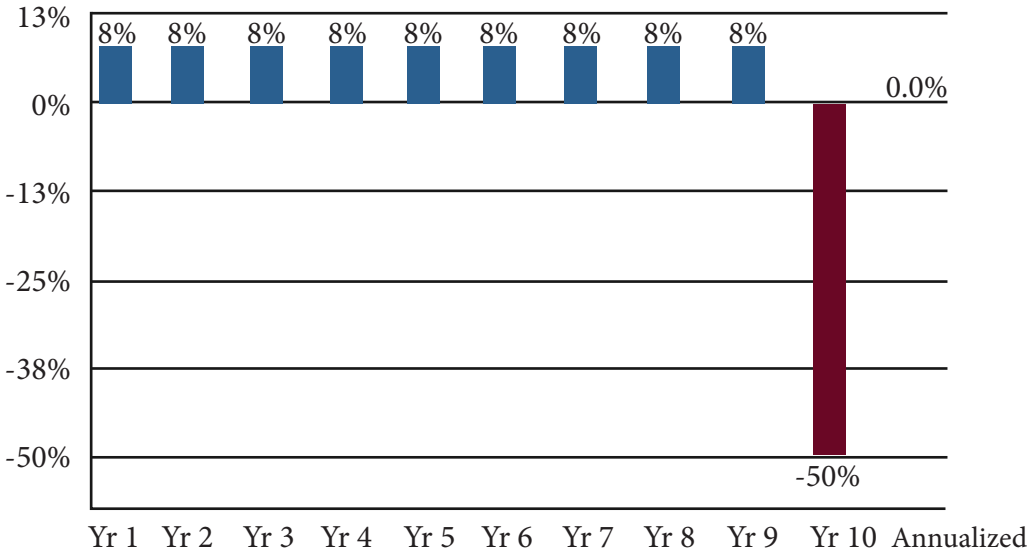


Exhibit 4
Source: PIMCO and Swan Global Investments

One key takeaway from this graph: avoiding a loss is the equivalent of capturing a gain of greater magnitude. This is why investors should consider the statistical measurements of upside and downside capture for a strategy.

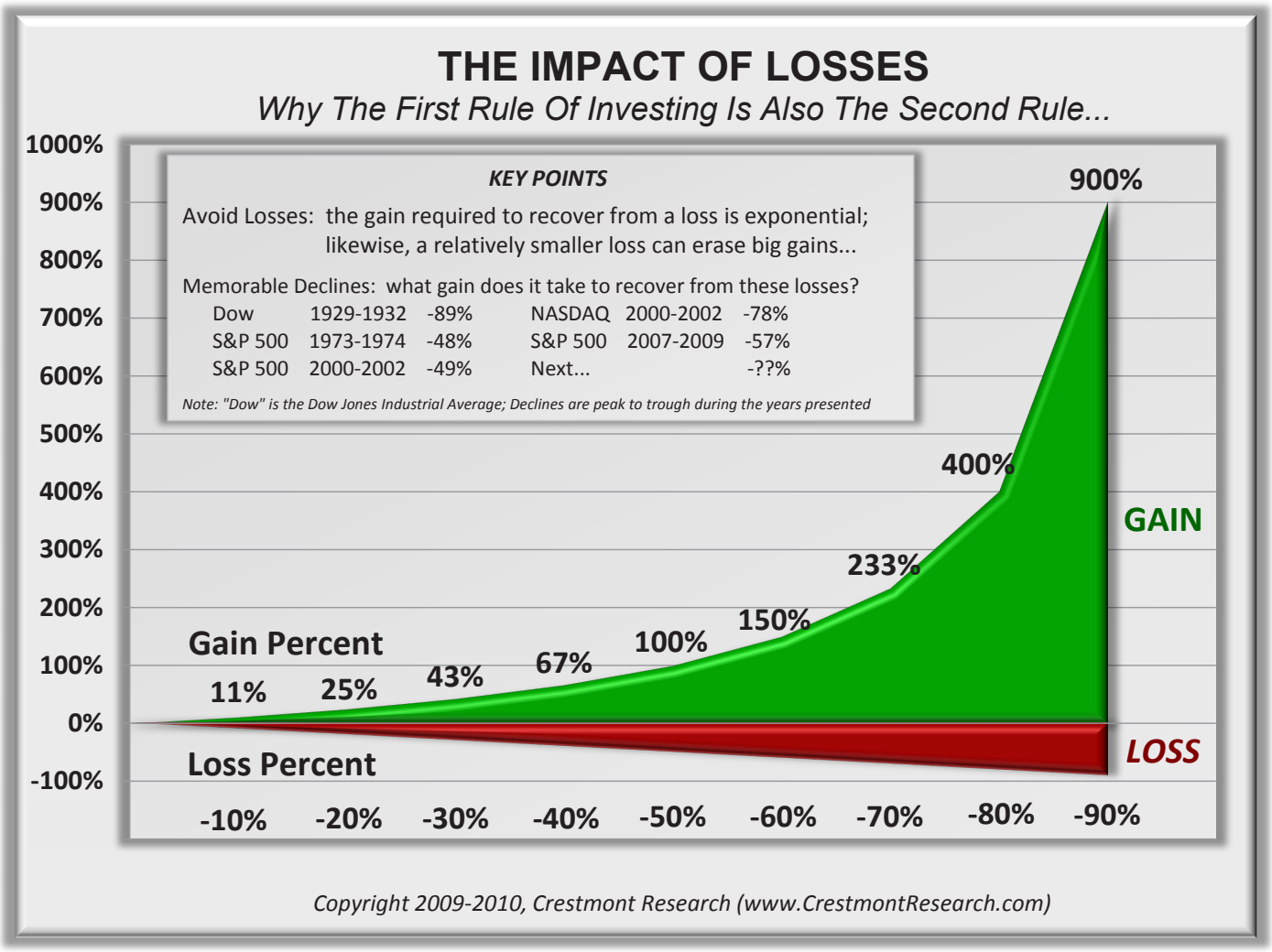


Exhibit 5
Source: Crestmont Research

In many cases, too much focus is mistakenly put on the upside capture statistic. Although upside capture is necessary, it is not nearly as important as the downside capture of an investment strategy. Crestmont provides another graphic that illustrates this key point incredibly well and ties together these first two factors of compounding returns and avoiding large losses:

"The stock market is much more volatile than most investors realize. Two volatility gremlins – the disproportionate impact of losses and the friction loss form the dispersion of returns – significantly reduce the compounding of returns.

Many absolute return-oriented investment strategies recognize this dynamic and seek to enhance investors' compounded returns by providing a more risk-managed and consistent return profile. "Capture" is one way to measure and illustrate the effectiveness and benefit of this approach. Whereas the 'relative return' investor (tracking stock market indexes) will generally experience 100% of the downside and 100% of the upside to achieve market returns, the 'absolute return' investor only needs a fraction of the upside when downside losses are limited. This graph illustrates just how little of the upside is needed

to match stock market returns over time and it demonstrates the way that many absolute return strategies exceed stock market returns without having to "beat-the-market" each year."

What this graph indicates is that if you were somehow able to miraculously avoid participation during down months in the stock market, you would only have needed to get 26% of the gains during the up months in order to match the market over

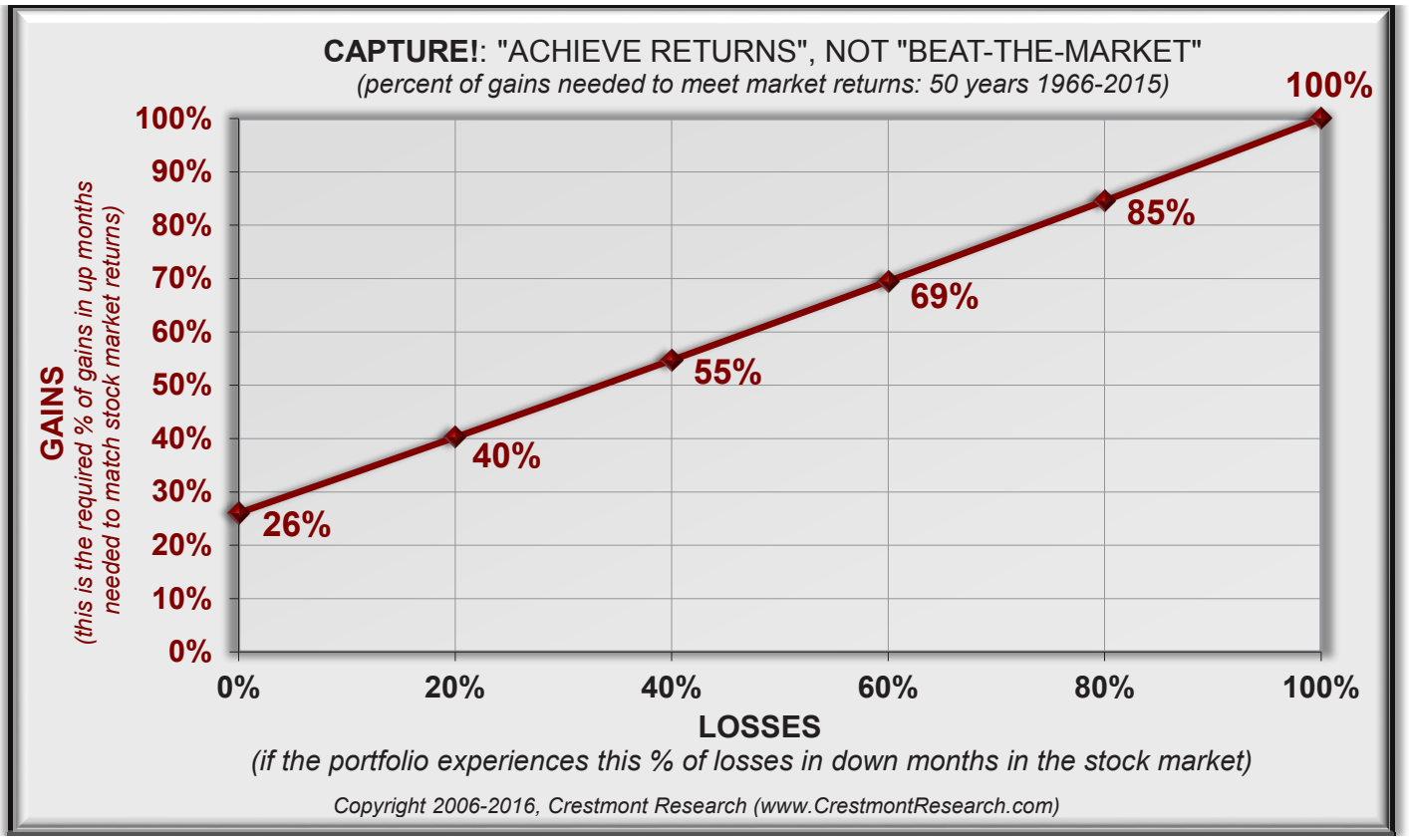


Exhibit 6
Source: Crestmont Research

that time (9.48% annualized return for the DJIA Total Return or 9.47% for the S&P 500 Total Return). If participation in the down months was 40%, then only capturing 55% in the up months would be needed to match the market. This comes as an astonishing realization to most investors; a definite reason to rethink the math behind investments. So many investors fall into the bad habit of hopping from one investment to another, chasing market performers trying to "beat the market". The key to successful long-term investing is not trying to find the hottest performer to get great up market participation, but minimizing or avoiding losses!

How big of a difference can avoiding large losses make over the long-term?

Exhibit 7 highlights the amazing impact avoiding large losses can have over time when compared to a buy and hold strategy. A $100,000 investment in the Dow Jones Index in 1950, if left alone, would

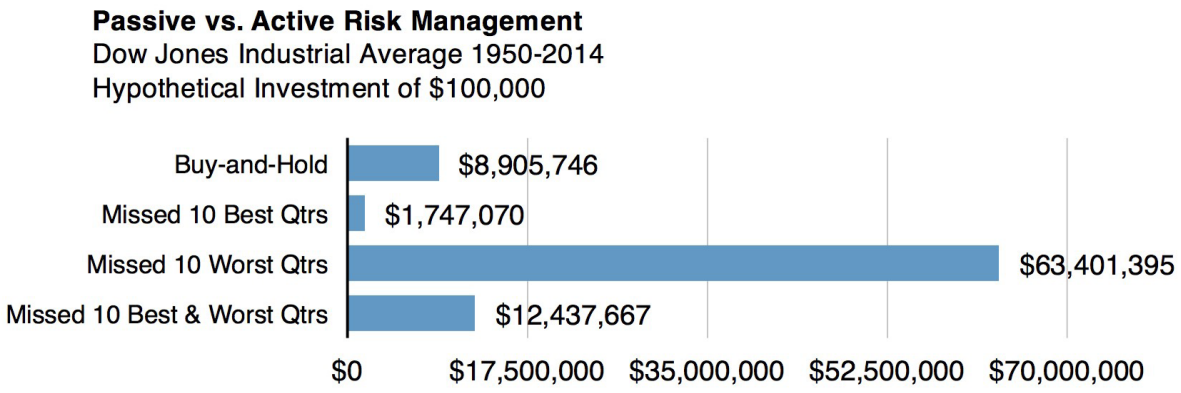


Exhibit 7
Source: WBI Investments

have grown to an astounding $8.9mm by the end of 2014 (8900%). However, if only the ten worst quarters in the Index were avoided across the 256 quarters over that time period, the final result would have been 612% more capital or $63.4mm (63,400% compared to 8900%)! Avoiding periods of large decline can have an enormous impact on returns (and peace of mind). Although it is impossible for any equity strategy to completely miss the ten worst quarters in the market over a long timeframe, it is possible through proper hedging or other various strategies to miss out on participating in some of the downside associated with the worst performing quarters in the market, and thus, in essence, "miss" some of those quarters. Even if this means missing out on full participation in some of the best quarters, missing the worst quarters has a much greater impact on an investor's bottom line. If all of the worst and best quarters were completely missed, an investor still ends up with an amount 40% higher than a buy and hold investor ($12.4mm). This is due to the power of compounding and avoiding the power of negative compounding.

By design, Swan's Defined Risk Strategy was meant to minimize losses. This is especially important for those investors in the retirement stage who are drawing down their accounts to fund living expenses. And the DRS has been able to minimize losses by always being hedged. Across 222 months of the DRS since its inception through the end of 2015, the S&P 500 has had 30 months of losses greater than -3.5%, or around 14% of the time. The DRS by comparison has had only 14 or 6% of months with losses greater than -3.5% in a month, cutting the occurrences in half. As it relates to the DRS's capture ratio of up/down quarters, the DRS has captured around 52% of positive quarters in the S&P 500 and 13% of negative quarters. As seen in Exhibit 6, this should and did lead to better results than the S&P 500 over the long-term and full market cycles.

Exhibit 8 shows how the market has performed since the DRS's inception in 1997 versus the DRS and a hypothetical investment that systematically captures 52% of up quarters and 13% of down quarters.

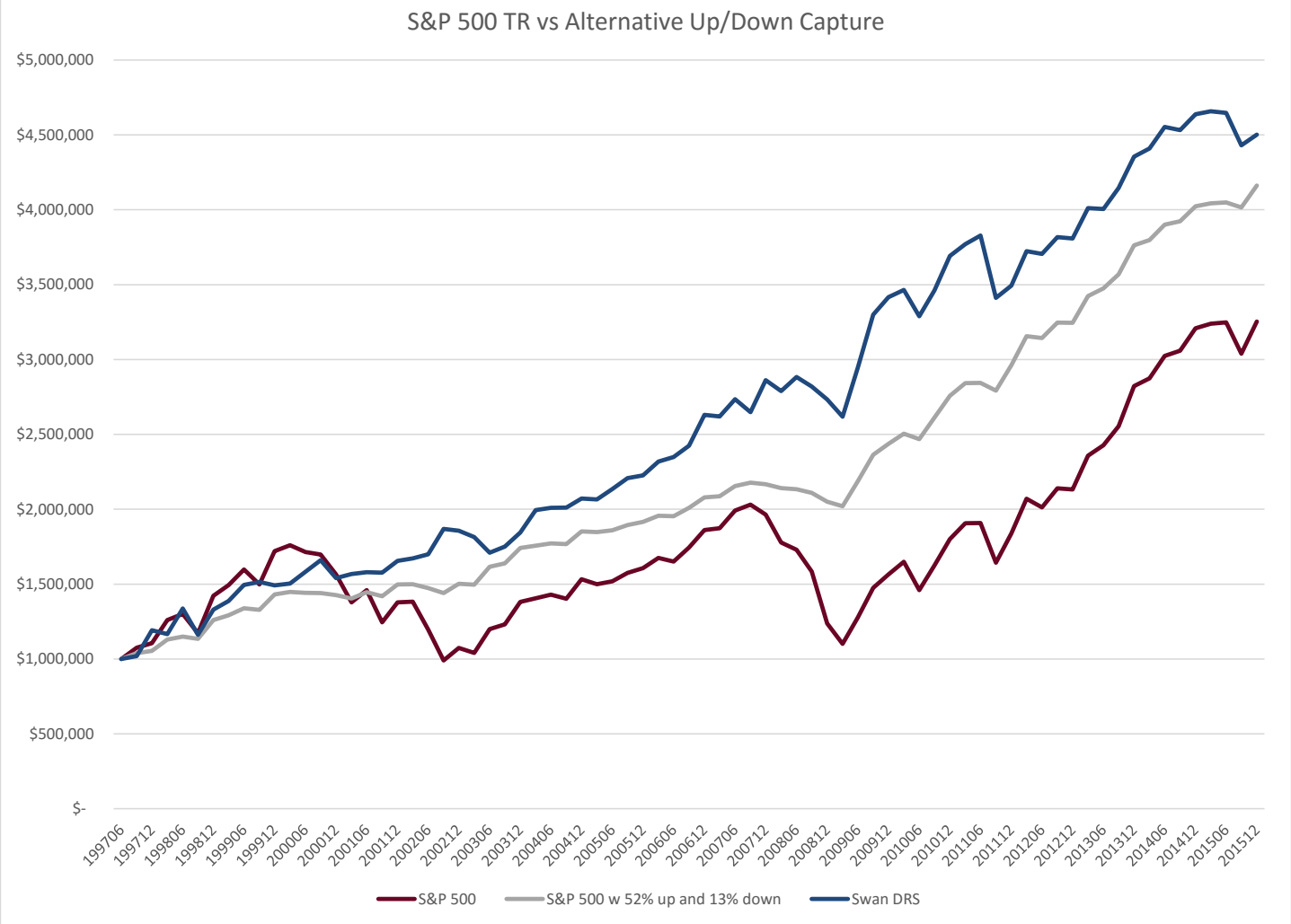


Exhibit 8
Source: Zephyr StyleAdvisor and Swan Global Investments

Notice this hypothetical shift in the mathematical returns nicely outperforms the S&P 500 most of the period after some underperformance during a bull market in the early years. The DRS itself has done even better than the hypothetical example. The hypothetical case was calculated by applying a 52% capture ratio to every up quarter and a 13% capture ratio to every down quarter, whereas in reality the DRS's capture ratios vary on a quarter to quarter basis - sometimes better, sometimes worse - and this of course varies its path.

Expanding the timeframe further out over its 18+ years, the largest one-year calendar loss for the DRS equaled -5.38% (all results represented by the DRS Select Composite). The S&P 500's largest calendar year loss over that same timeframe was -37%. In fact, the S&P 500 had four years with annual returns worse than the DRS's worst loss year over the same time period.

Many times, the challenge with investors is getting them to think of investments in relation to their time horizon and goals. The longer the time horizon, the more important these math principles become. By the same token, emotions like fear and greed become less important. Crestmont's Ed Easterling states it this way:

"Too often, investors are so focused on the task at hand that they can lose sight of taking the actions that are necessary to best

achieve their goals. With investments, the goal is to achieve successful returns over time. We should not be distracted by a focus on this week or month; we need successful returns over our investment horizons—which often extend for a decade or two or more."

How can an investor know whether an investment strategy will truly be able to avoid large losses? Managers can call themselves "risk-managed" or "tactical", but that does not mean their strategy will successfully avoid large losses. Managers can either actively structure a strategy to seek to avoid large losses by defining risk through a non-correlated asset such as options, or they can attempt to avoid large losses through market timing or passive diversification (undefined risk).

Based upon the examples discussed previously, it makes sense for the majority of an investor's portfolio to be constructed of investments that actively seek to avoid large losses. More aggressive strategies can be beneficial in the proper place, amount, and time, but the bulk of an investor's portfolio should not be in investments that can experience large losses. This is part of the shortcoming with today's popular portfolio management approaches based on Modern Portfolio Theory (the investment driving force behind fast-growing robo-advisors and target date funds). These approaches seek to put investors in a majority of passive index investments or active equity managers and another large percentage in fixed income investments, despite increasingly low or negative yields around the globe. Although some diversification is provided, both of these asset classes have experienced large losses in the past and likely will in the future. This approach doesn't take into consideration these various factors behind growing long-term wealth; traditional investment management needs to rethink the math and risk behind their investment strategies and think outside the (style) box.

3. Variance Drain (Volatility)

If someone were to tell you the market has averaged roughly 9.5% per year since 1928, you would want that investment, right? But how many years did the market actually have a return in the 9%-10% range? The answer might be surprising. Over the last 87 years, in only 2 years was the market return near its long-term average returning 9 or 10% and only 4 years within 2% (7.5-11.5). More often than not the market's return in any given year was much greater or less than 9.5% and sometimes dramatically so. And that is the problem with averages. Averages, by their very nature, mask volatility. And when it comes to compounding returns, volatility and the sequence of returns is very important to the final outcome. In reality, not everyone wants an investment that grows at an average 9.5% if it involves multiple -40% to -80% drawdowns and sometimes decades of negative return in order to get it.

This is another reason why defining downside risk is so important. Lowering volatility is key to achieving better compound growth as volatility diminishes the rate at which an investment grows over the long-term. Volatility has a measurable negative effect on returns because of its impact on compounding.

This impact is known as variance drain or volatility drag. When two investments with the same average return are compared, the one with the greater volatility, or variance, all other things being equal, will have a lower compound return. This is due to the effect of negative compounding on the more volatile investment.

The concept of variance drain or volatility drag comes from the term "arithmetic mean - geometric mean inequality" and was detailed in a 1995 paper titled "Variance Drain - Is Your Return Leaking Down the Variance Drain?" by Tom Messmore. Messmore observed that the more variable a given asset's return is, the greater the difference between the arithmetic and geometric returns. Arithmetic mean is the average of a set of numerical values, calculated by adding together and dividing by the number of terms in the set. Geometric mean is defined as the value of a set of numbers by using the product of their values, as opposed to the arithmetic mean which uses their sum.

A formula of variance drain looks like this:

$$r_g \approx r_a - \frac{1}{2}\sigma^2$$

rg = geometric return, ra = arithmetic return, σ^2 = its variance

This formula shows that the variance of returns "drains" the arithmetic average returns to produce the smaller, realized, compound returns (Source: Decker, Robert: The Variance Drain and Jensen's Inequality).

As an example, let's say an investment is purchased for $100. At the end of the first year, its value has doubled to $200, a 100% gain. In the second year however, the value undergoes a 50% loss and drops to $100.

The arithmetic return over 2 years is thus 25% or = (100% - 50%) / 2

The geometric return over 2 years is 0% or = $100 (final value) - $100 (starting value)

In this example, the variance drain is 25% = 25% (arithmetic average) - 0% (geometric average).

Why should this matter for investors? In order to optimally take advantage of the power of compounding, investors must avoid large losses and the exponential growth needed to recover from a loss. And in addition, investors must avoid the negative power of compounding by seeking to lower volatility drag as best as possible. Exhibit 9 shows this impact across various scenarios.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Arithmetic Annual Return	10%	10%	10%	10%	10%	10%
Standard Deviation (Volatility)	0%	10%	20%	30%	40%	50%
Geometric Annual Return	10%	9.60%	8.30%	6.03%	2.58%	-2.42%
Starting Funds	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000
Ending Funds	$259,375	$250,156	$221,935	$179,629	$129,073	$78,278
Total 10 Year Return	159%	150%	122%	80%	29%	-22%

Exhibit 9
Source: Tyton Capital Advisors, "Low Charges And High Volatility: How To Erase Your Returns"

Again, we can see how these factors all tie together in their mathematical application within an investor's portfolio: compounding, avoiding large losses, and now volatility. Compounding, whether negative or positive, is the common thread throughout all of them.

In addition, volatility can lead to detrimental investor behavior as seen from Dalbar's annual Quantitative Analysis of Investor Behavior report.

	Investor Returns[1]						
	Equity Funds	Asset Allocation Funds	Fixed Income Funds	Composite Fund Investor	Inflation	S&P 500	Barclays Aggregate Bond Index
30 Year	3.79	1.76	0.72	2.47	2.70	11.06	7.36
20 Year	5.19	2.47	0.80	3.34	2.28	9.85	6.20
10 Year	5.26	2.25	0.69	3.51	2.13	7.67	4.71
5 Year	10.19	5.09	1.21	6.84	1.69	15.45	4.45
3 Year	14.82	7.15	0.72	9.57	1.34	20.41	2.66
12 Months	5.50	2.24	1.16	3.98	0.75	13.69	5.97

1. **Returns are for the period ending December 31, 2014**. *Average equity investor, average bond investor and average asset allocation investor performance results are calculated using data supplied by the Investment Company Institute. Investor returns are represented by the change in total mutual fund assets after excluding sales, redemptions and exchanges. This method of calculation captures realized and unrealized capital gains, dividends, interest, trading costs, sales charges, fees, expenses and any other costs. After calculating investor returns in dollar terms, two percentages are calculated for the period examined: Total investor return rate and annualized investor return rate. Total return rate is determined by calculating the investor return dollars as a percentage of the net of the sales, redemptions and exchanges for each period.*

Exhibit 10
Source: "Quantitative Analysis of Investor Behavior, 2015," DALBAR, Inc. www.dalbar.com

The first columns under the aggregate heading "Investor Returns" detail the actual experiences of average investors. Too often fear and greed lead to poor decision-making and thus underperformance. As a result, we see that investors in equities have vastly underperformed the S&P 500. Not surprisingly, the periods of the most acute underperformance for investors occur during some of the most volatile times in the market (see Exhibit 11 on page 17). This is largely due to the tendency of investors to get in and out of the market at the wrong time. The market goes down to a point that many investors can't take the pain anymore and they sell their positions. And then the market goes back up but investors don't believe the rally for a while and then buy at a higher level. This habitual unintended practice of "sell low, buy high" drives this drastic underperformance.

Top 10 Months with the Most Acute Underperformance

Rank	Month	S&P 500 Return	Average Equity MF Investor Return	Underperformance
1	October, 2008	-16.80%	-24.21%	-7.41%
2	March, 2000	9.78%	3.72%	-6.06%
3	October, 1987	-21.54%	-26.87%	-5.33%
4	January, 1987	13.47%	9.35%	-4.12%
5	August, 1998	-14.46%	-18.47%	-4.01%
6	September, 2008	-8.91%	-12.75%	-3.84%
7	November, 2000	-7.88%	-11.33%	-3.45%
8	April, 1997	5.97%	2.75%	-3.22%
9	November, 1997	4.63%	1.48%	-3.15%
10	July, 1989	9.03%	5.91%	-3.12%

Exhibit 11
Source: "Quantitative Analysis of Investor Behavior, 2015," DALBAR, Inc. www.dalbar.com

Volatility, usually accompanied by fear, tends to lead to rash decisions. It is unlikely that the average investor will ever completely purge fear from their decision-making. Therefore, the next-best solution is to invest in a strategy that lowers volatility in the first place and helps to minimize some of the fear by establishing a defined amount of risk. If a strategy can lower volatility without sacrificing too much return over the long-term, it can likely lead to a better experience and outcome for the investor. If you can't stick with a portfolio, it doesn't matter what its compound annual growth rate is; you will never "experience" that return! This is why investors should consider the fourth and next factor when choosing an investment; its distribution of return.

4. Distribution of Returns

Utility theory posits this: (1) investors prefer more return to less and (2) investors dislike uncertainty (Source: Bollen, Measuring the Benefits of Options Strategies in Portfolio Management). Investors should naturally then prefer portfolios with asymmetric return distributions; in particular, distributions that have very low probability of extremely bad outcomes and consistency of returns. But what is a return distribution and why should an investor care what an investment's return distribution looks like?

A return distribution is a probability distribution or a statistical function that shows all the possible values and likelihoods that a random variable can take within a given range. The area under a normal distribution, or the familiar looking bell-shaped curve, denotes the probability of the returns. The probability decreases to the left or right of the mean. There are four moments to a return distribution: return, standard deviation or volatility, skewness, and kurtosis. When analyzing historical returns of an investment, a return distribution helps assess the likelihood of where returns might fall and to assess the asset's level of risk and return potential.

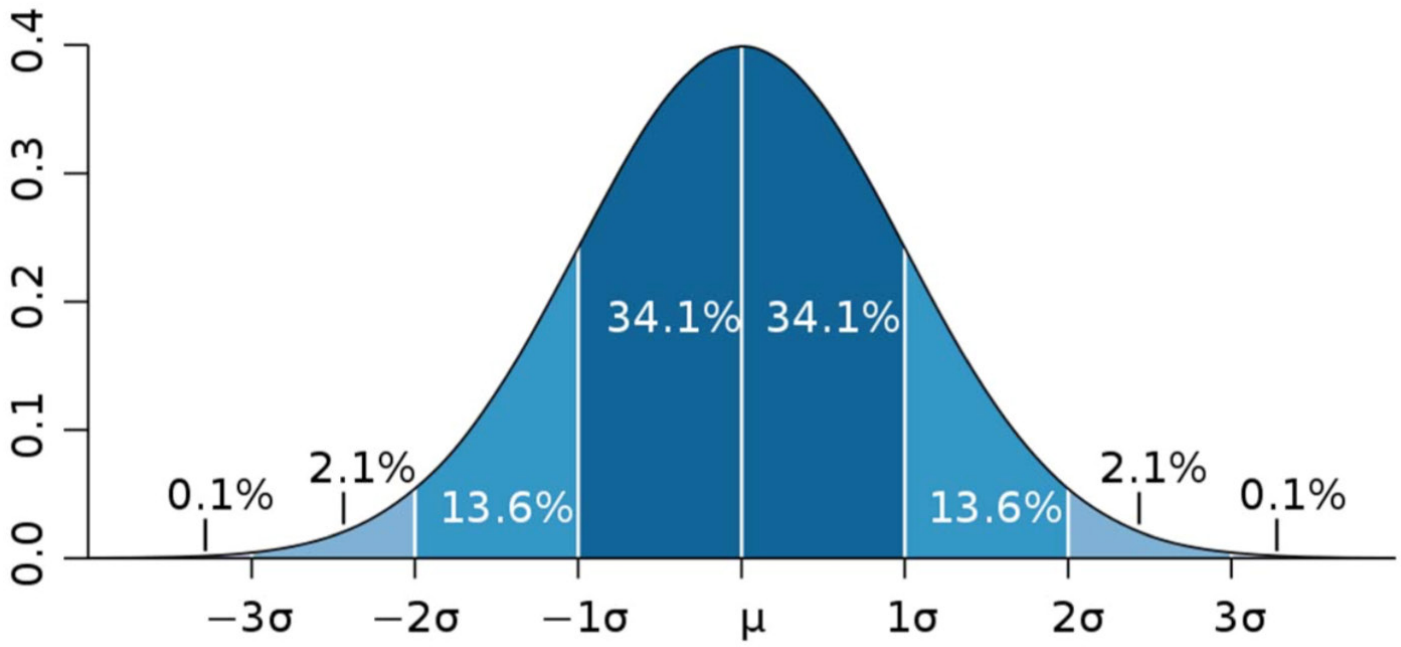


Exhibit 12
Source: Wikipedia

The distribution above is an idealized, "normal" distribution where outcomes fall into a very predictable pattern. The above shows, for example, that 68.2% of occurrences should fall within one standard deviation. A normal distribution is also symmetrical, meaning both the count and scale of observations above and below the mean occur with an equal probability. However, stock market returns do not often fit into this idealized pattern. Empirical observations for equities have shown that the distribution of returns is often characterized by left-skewed distributions and either pointy or flat distributions. A left-skewed distribution denotes that outlier events tend to occur on the downside. The tallness or flatness of the distribution is derived from the kurtosis of a distribution; this refers to how tightly packed around the mean the deviations will be. This table highlights each moment within a distribution of returns and their characteristics:

Table 1: Return Distribution Characteristics

NAME	MOMENT	COMMON NAME	CHARACTERISTIC	PREFERENCE
Mean	First	Expected Return	Balance point of the area under the distribution	Higher values with higher moments constant
Standard Deviation (variance)	Second	Volatility	Measure of the width (dispersion)	Lowest value to meet requirement
Skewness	Third	Fat tail	Measure of symmetry	Positive
Kurtosis	Fourth	Fat tail	Measure of shape, tall or flat	Negative downside, positive upside (Note: Kurtosis for a normal distribution is 3)

Exhibit 13
Source: Evestment

As noted, empirical observation shows that the S&P 500 is not a normal distribution:

Figure 5: Distribution of Monthly Returns for the S&P 500

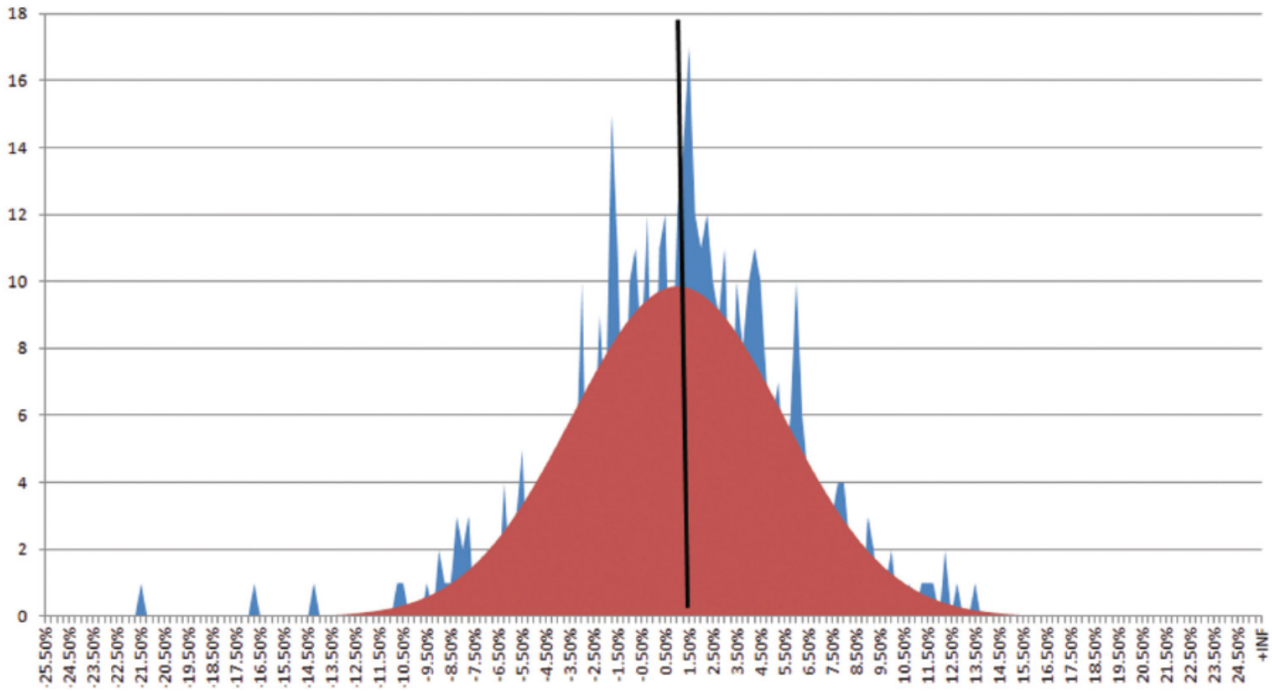


Exhibit 14
Source: Evestment

Instead, equity markets generally follow a fairly normal distribution pattern but with negative skewness, high kurtosis, and large fluctuations within the fat tails (tail risk events). What does that mean, in plain English? It means that most of the time individual months will fall fairly close to their long-term average, but when things go bad in the markets, they go really bad. The worst of the bad months are more extreme than the best of the good months. Volatility, when it does happen, tends to be driven by the extreme tail events.

So if that is what the market gives us as a distribution of return, what can we do as investors? We should try to tilt the odds in our favor by pursuing a distribution of returns that has a healthy number of upside observations and structurally limits the downside, especially the far left tail occurrences, as much as possible. Ideally then, investors should consider all four moments in an investment's return distribution and find investments that have these optimal distribution patterns.

One possibility is hedged equity or options-based equity strategies. This is exactly what the DRS has been able to do; shift the return distribution into a more optimal pattern compared to traditional equities. Let's take a look at the difference between the DRS and the S&P 500:

Smoothed Monthly Return Distribution Since July 1997 Inception of DRS Select Composite

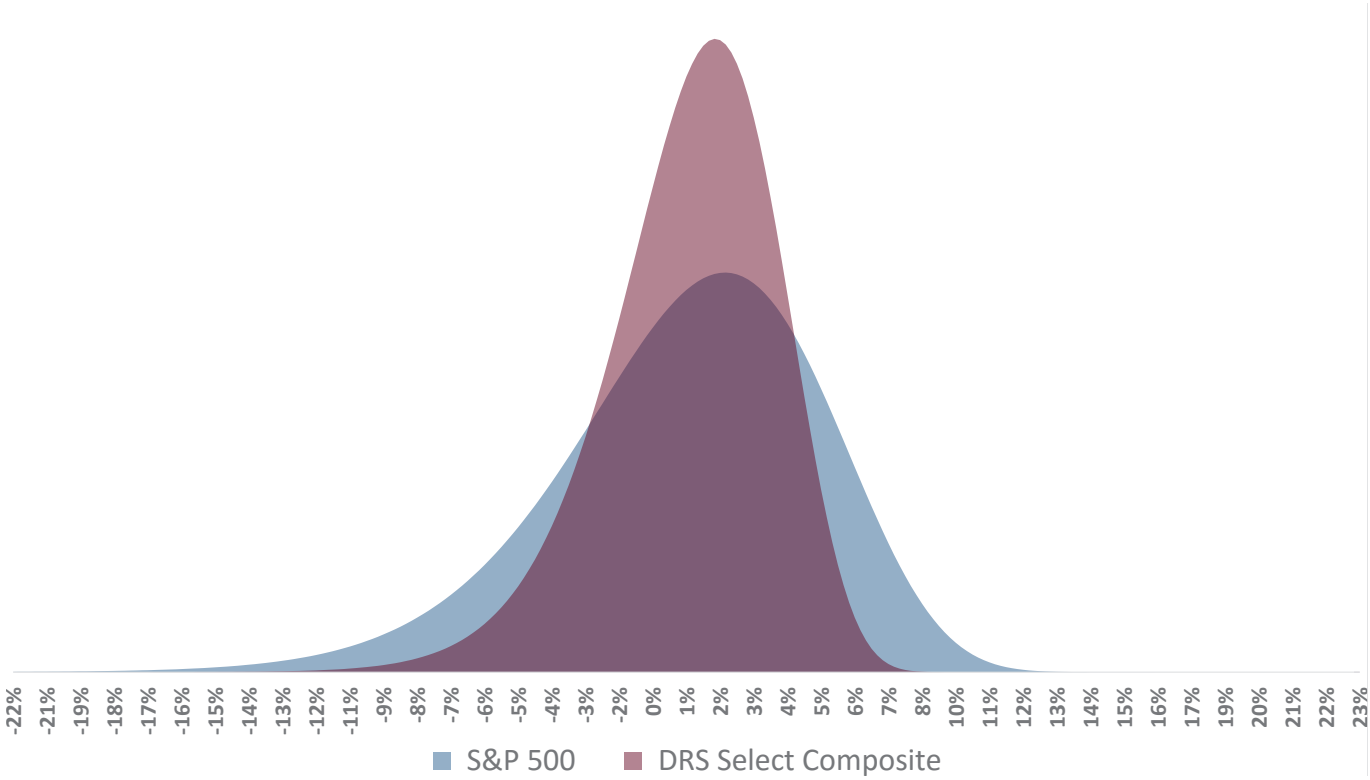


Exhibit 15
Source: Swan Global Investments; S&P 500 Total Return monthly data from Morningstar

First, let's take a look at the return distribution of the S&P 500 Total Return since July 1997 when the DRS began, represented by the blue curve. Notice how the blue curve looks fairly similar to a normal distribution, but is skewed to the left a little bit and has a fatter left tail (more big down moves). The blue curve is showing that it has a lot more occurrences where the returns were less than -5% or greater than +5% compared to the red curve of the DRS over this time period. Contrast this with the return distribution for the DRS. With this visual you can see how the DRS has historically cut off the far left and right tails and squeezed more occurrences into the middle of the distribution, giving it the higher kurtosis or pointedness in the curve but with a much smaller left tail (less large losses).

If we show a histogram from 2004 when the DRS formalized its philosophy to not make market-timing calls, the following graph shows all the occurrences that drive these curves:

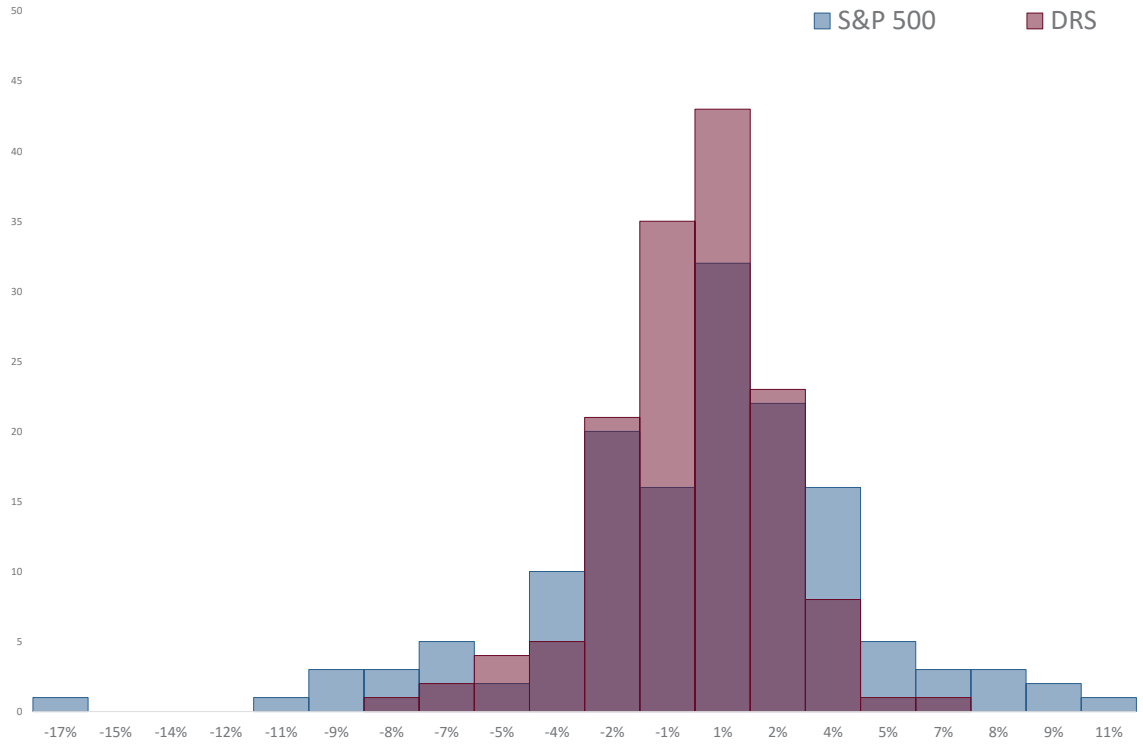


Exhibit 16
Source: Swan Global Investments; S&P 500 Total Return monthly data from Morningstar

Again, notice the lack of DRS occurrences in the far left and far right columns, while the lighter shaded red shows the additional occurrences that take place in the center in the -1% and 1% buckets. Why should an investor consider the return distribution of a strategy? An investor should want greater frequency of return in the median and a removal of occurrences in tail events. It is in the left tail where fear takes over, and it is in the right tail where greed infects an investor's thinking. If return distribution is consistent across periods of time and the reasons for return are established as driven by process and not decisional-driven timing luck/skill, an investor can get a good idea whether a strategy might provide an optimal means of return over time. It should paint a clear picture of whether a strategy actually avoids large losses to lessen the negative compounding effect and take advantage of lower volatility and steadier, compounding growth.

COMPARING THE FOUR BASIC WAYS TO INVEST IN EQUITIES

Reliance by long-term investors on equity as one of the main engines of growth in a portfolio has been empirically verified through numerous studies. Equities tend to grow over time, albeit with considerable risk. The table below shows how real returns in equities over long periods of time have generally led to tremendous growth in most developed nations around the world. However, the table also shows that across various timeframes, if you happen to have bad luck and invest during a worst-case scenario, returns can be devastatingly bad. No country listed had positive real returns between the 1, 3, and 10-year worst-case returns and only three countries had positive returns for the 20-year worst-case scenario.

		Worst Case Scenario						
	Annualized Return (1900-2012)	1-Year	3-Year	10-Year	20-Year	30-Year	40-Year	50-Year
Australia Real USD	7.42	-52.71	-50.09	-31.01	48.61	198.55	324.98	827.40
Equal Weighted USD	**6.73**	**-48.14**	**-56.99**	**-53.44**	**-13.22**	**119.11**	**197.32**	**592.04**
South Africa Real USD	6.51	-43.30	-53.57	-51.78	-32.71	117.35	162.32	394.99
US Real	**6.26**	**-37.59**	**-59.52**	**-33.27**	**19.14**	**132.49**	**350.62**	**855.57**
Canada Real USD	5.77	-46.48	-59.29	-33.86	15.00	105.67	317.40	733.95
New Zealand Real in US$	5.75	-49.73	-45.71	-28.77	-12.56	65.62	79.93	298.86
Sweden Real USD	5.64	-49.60	-77.23	-72.46	-72.79	-39.56	4.60	71.85
Denmark Real USD	5.58	-50.48	-64.35	-50.32	-11.10	-17.94	86.75	233.64
Finland Real in US$	5.35	-75.29	-87.17	-85.55	-62.25	-37.32	-16.00	84.96
UK Real USD	5.23	-53.94	-66.55	-45.32	-30.89	39.81	73.16	111.40
Netherlands Real USD	5.20	-69.00	-79.62	-71.02	-52.54	-52.31	-25.95	78.57
Switzerland Real USD	5.17	-42.94	-73.03	-72.63	-57.14	54.36	103.47	218.62
World Real USD	**5.01**	**-40.98**	**-53.03**	**-58.12**	**-30.01**	**47.65**	**127.31**	**284.95**
Norway Real USD	4.53	-63.27	-81.93	-70.01	-44.74	-40.40	-14.37	-3.69
Japan Real USD	4.20	-91.84	-98.65	-98.52	-97.09	-97.21	-93.86	-71.07
Ireland Real USD	4.14	-66.78	-65.14	-63.84	-59.23	25.05	34.23	45.67
Spain Real USD	3.53	-50.69	-71.15	-85.94	-79.67	-57.36	-61.99	-55.90
Germany Real USD	3.35	-79.68	-93.41	-96.54	-97.99	-99.16	-99.13	-88.50
Belgium Real USD	3.02	-50.19	-71.60	-76.12	-64.93	-53.60	-62.66	-35.16
France Real USD	2.91	-77.54	-83.65	-75.21	-74.39	-66.93	-74.88	-61.52
Italy Real USD	1.94	-62.43	-79.93	-85.63	-77.57	-54.65	-60.28	-29.10
Austria Real USD	-0.17	-73.26	-92.34	-96.83	-96.63	-98.57	-99.42	-99.10
Average	4.68	-57.99	-71.09	-65.28	-44.76	8.67	56.98	199.47
Percentage Negative	5%	100%	100%	100%	86%	55%	45%	36%

based on annual data from Dimson, Marsh & Staunton

Exhibit 17
Source: Patrick O'Shaughnessy, The Investor's Field Guide: Dangers of Portfolio Patriotism; worst case scenarios are cumulative returns

The main takeaway from this information should be that equities over the long-term tend to be a great source of growth, but at tremendous risk of large losses along the way. If equities can be harnessed for its growth potential while avoiding the large losses and worst-case scenarios, it could become an even better source of return and one that deserves to be a core holding for those that don't have 40 or 50 years to stay invested.

There are four basic approaches to investing in liquid equities:

1. Passive investing: You can buy the market through an index ETF or fund and get its unknown returns and its unknown pattern of returns. Historically, someone can get an idea of what a passive approach is probably going to look like as seen in the prior image of the distribution of the U. S. equity market, which looks fairly similar across longer time periods. It can vary greatly, but an investor is likely to get double-digit gains or losses in most years, an occasional but fairly rare flat year, and over time, mid to high

single digit returns. It is important to note though that on a sufficiently long enough timeline, the probability of being a completely passive investor goes to zero. If you are planning to invest for an objective other than buying and holding forever, you have to make decisions eventually about when and how much to invest and when and how much to withdraw, as well as your start period and end period; all active decisions (Credit: Druce Vertes, StreetEye.com).

2. Active investing: You can buy an investment that is actively managed and get its unknown returns and its unknown pattern of returns. It's very possible to pick a great manager based on its track record and then the investment doesn't perform well going forward. Studies have shown that over 80% of active managers underperform their benchmarks on a 5-year and 10-year basis, both domestic and international equity, as seen below. It is extremely difficult, if not impossible, to consistently pick good active managers. Logically, it is easy to deduce that if a manager does beat its benchmark in one period it is highly unlikely to beat it the next period based upon these statistics.

Percentage of U.S. Equity Funds Outperformed by Benchmarks					
Fund Category	**Comparison Index**	**One-Year (%)**	**Three-Year (%)**	**Five-Year (%)**	**Ten-Year (%)**
All Large-Cap Funds	S&P 500	86.44	76.25	88.65	82.07
All Mid-Cap Funds	S&P MidCap 400	66.23	70.48	85.37	89.71
All Small-Cap Funds	S&P SmallCap 600	72.92	80.40	86.55	87.75
Real Estate Funds	S&P US Real Estate Investment Trust	80.14	86.23	91.49	78.08
Percentage of International Equity Funds Outperformed by Benchmarks					
Fund Category	**Comparison Index**	**One-Year (%)**	**Three-Year (%)**	**Five-Year (%)**	**Ten-Year (%)**
International Funds	S&P 700	68.90	58.50	62.54	84.09
Emerging Markets Funds	S&P/IFCI Composite	68.70	65.97	72.19	89.71
Percentage of Fixed Income Funds Outperformed by Benchmarks					
Fund Category	**Comparison Index**	**One-Year (%)**	**Three-Year (%)**	**Five-Year (%)**	**Ten-Year (%)**
Investment-Grade Long Funds	Barclays Long Government/Credit	98.31	75.94	95.59	97.06
Investment-Grade Intermediate Funds	Barclays Intermediate Government/Credit	30.29	31.01	41.09	49.12
Investment-Grade Short Funds	Barclays 1-3 Year Government/Credit	53.93	23.17	33.75	58.06
High-Yield Funds	Barclays High Yield	73.09	77.03	88.83	92.98

Source: S&P Dow Jones Indices LLC, CRSP. Data as of Dec. 31, 2014. Outperformance is based upon equal weighted fund counts. All index returns used are total returns. Charts and tables are provided for illustrative purposes. Past performance is no guarantee of future results.

Exhibit 18
Source: S&P Dow Jones Indices

3. Tactical equity investing: Tactical investing is another form of active investing, whether tactical active or tactical passive. You will still get unknown returns and an unknown distribution of returns as well. Like some active managers, a tactical manager can have years of great timing and outperformance and yet this means nothing for its future return. With tactical managers, there is this risk of the unknown or unpredictability of outcome. As some active managers are just closet indexers or perform similar to their benchmark indices, this risk tends to be greater for tactical managers. Timing, stock selection, or tactical decisions could have led to excellent performance for many years and then the investment doesn't perform well going forward.

In addition, tactical managers don't re-structure the return distribution of equities, but create an entirely new distribution of returns; one in which the return can be completely the opposite of the concurrent market return based on the manager's tactical decisions and timing. Uncertainty, active selection, and timing risk can play a big role in whether an investor achieves successful long-term returns with this approach.

So, if it is extremely hard to beat or achieve market return through picking an active or tactical manager and passively tracking the market means participating in all its volatility and potential for large drawdowns, how can investors think outside the box and participate in equity growth with more certainty and less volatility? There is a fourth approach: hedged equity.

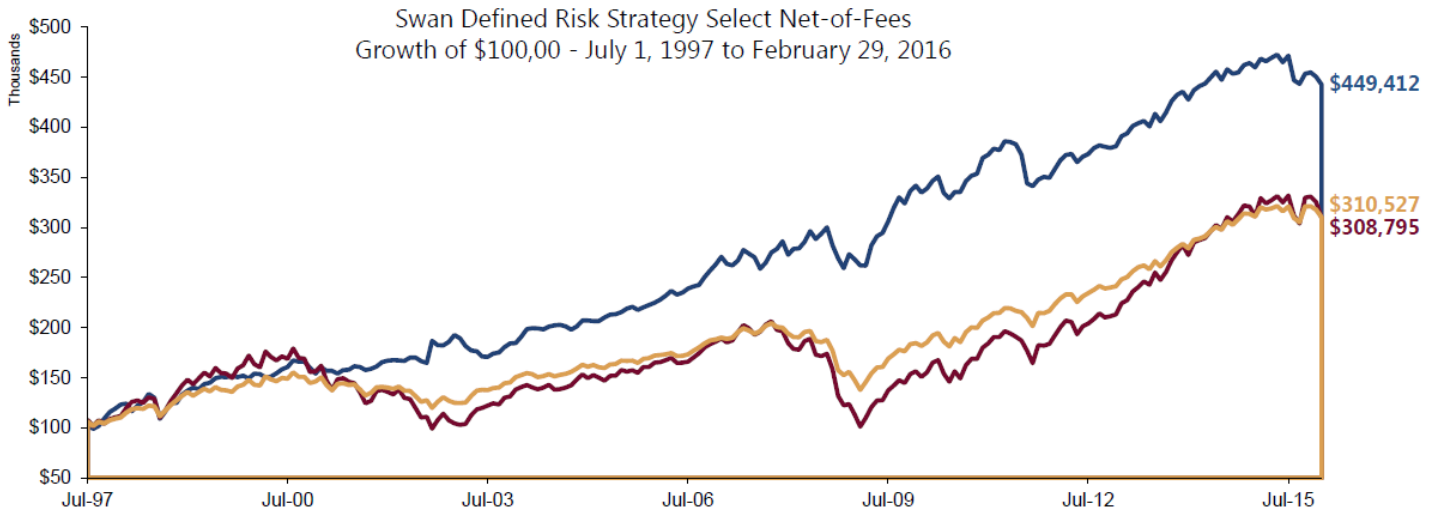
4. Hedged equity: Hedged equity involves investing in equities while also hedging that exposure with non-correlated assets such as put options. Investing in a proven hedged equity strategy such as the DRS gets exposure to the long-term growth of equities, while always remaining hedged to protect against large downside losses. By using options to re-structure the return distribution, an investor can minimize the uncertainty and unknown that normally comes with equity returns. It is important to note, however, that not all hedged equity strategies are created equal. Some choose to hedge with different instruments that might not truly be non-correlated, while some choose when and if to hedge the underlying portfolio. These approaches are more of a mixture of tactical investing and hedged equity.

So what have the results been for the DRS? How has the DRS done at avoiding some of the large losses in the S&P 500 over its 18-year track record? Does the math behind an approach that tends to trail in bull markets actually support this approach versus traditional equity returns? Here is a summary comparison:

DRS Select Composite:

	Swan DRS	S&P 500	60% S&P 500 40% Barclays U.S.
Annualized Return since Inception	8.38%	6.23%	6.26%
Standard Deviation since Inception	9.81%	15.46%	9.29%
Beta since Inception	0.3%	1.0%	0.59%
Sharpe Ratio	0.63%	0.26%	0.44%

The benefits of compounding growth and avoiding large losses become more and more apparent over time and over full market cycles, as seen in Exhibit 19. Notice how in bull markets like the current one over the last several years that the strategy can underperform the S&P 500 and yet still mathematically provide better returns over a longer time period and full market cycle.



Net Annualized Performance (February 29, 2016)

	Swan DRS	S&P 500 Index	60% S&P 500 Index / 40% Barclays US Agg
YTD (not annualized)	-0.19%	-5.09%	-2.23%
3 Year	4.51%	10.75%	7.43%
5 Year	3.50%	10.13%	7.68%
10 Year	7.03%	6.44%	6.04%
Inception (7/97)	8.38%	6.23%	6.26%

Source: Swan Global Investments and Morningstar; the S&P 500 Index is an unmanaged index, and cannot be invested into directly.
Past performance is no guarantee of future results. DRS results are from the Select Composite, net of fees, as of 2/29/2016.

Exhibit 19
Source: Swan Global Investments

How does the DRS do this? The process is a fairly simple four-step process:

1. Establish equities; passive and invested at all times

2. Create hedge to define risk; buy long-term put options (LEAPS)

3. Seek to generate return through market-neutral option strategies

4. Monitor and adjust; rebalance and re-hedge the portfolio regularly to take advantage of large sell-offs (this re-hedge has the ability to add additional equity shares to further compound future market growth)

This process establishes a predictable expected return band on a one-year timeframe when compared to passive equities.

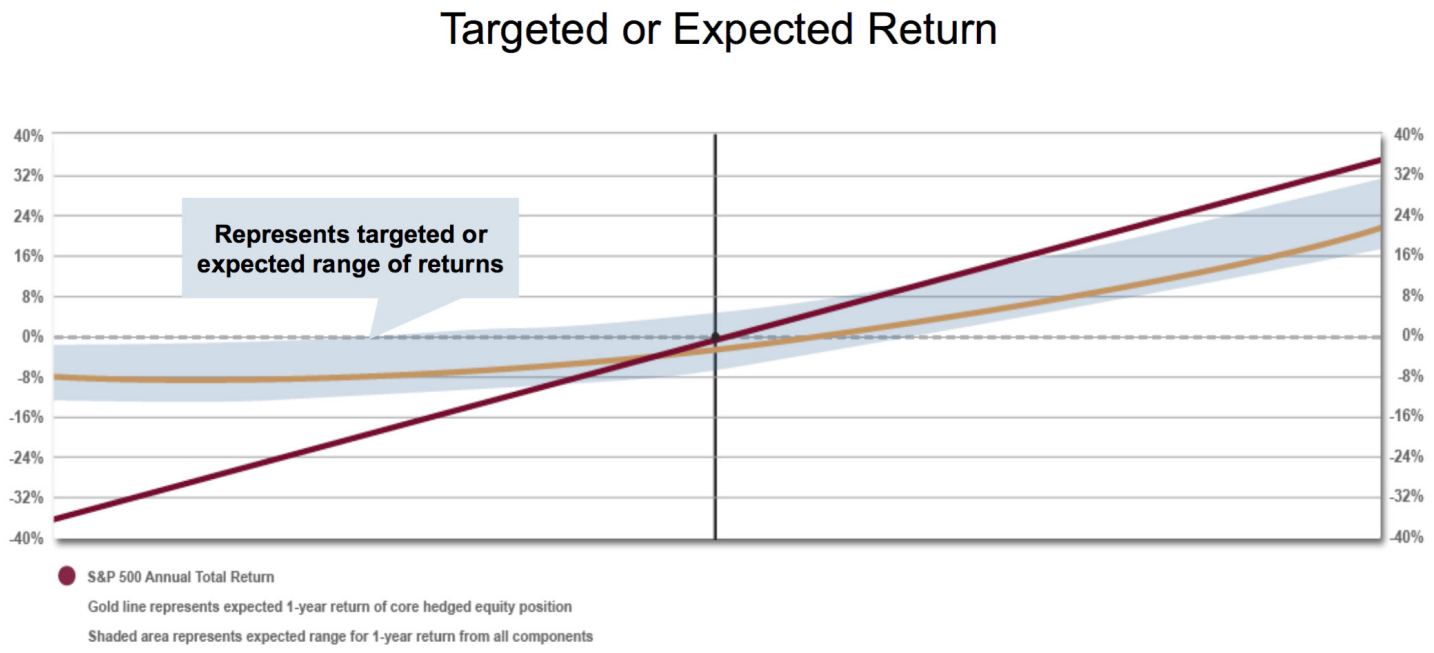


Exhibit 20
Source: Swan Global Investments

And the DRS has been remarkably consistent with its expected return since its inception:

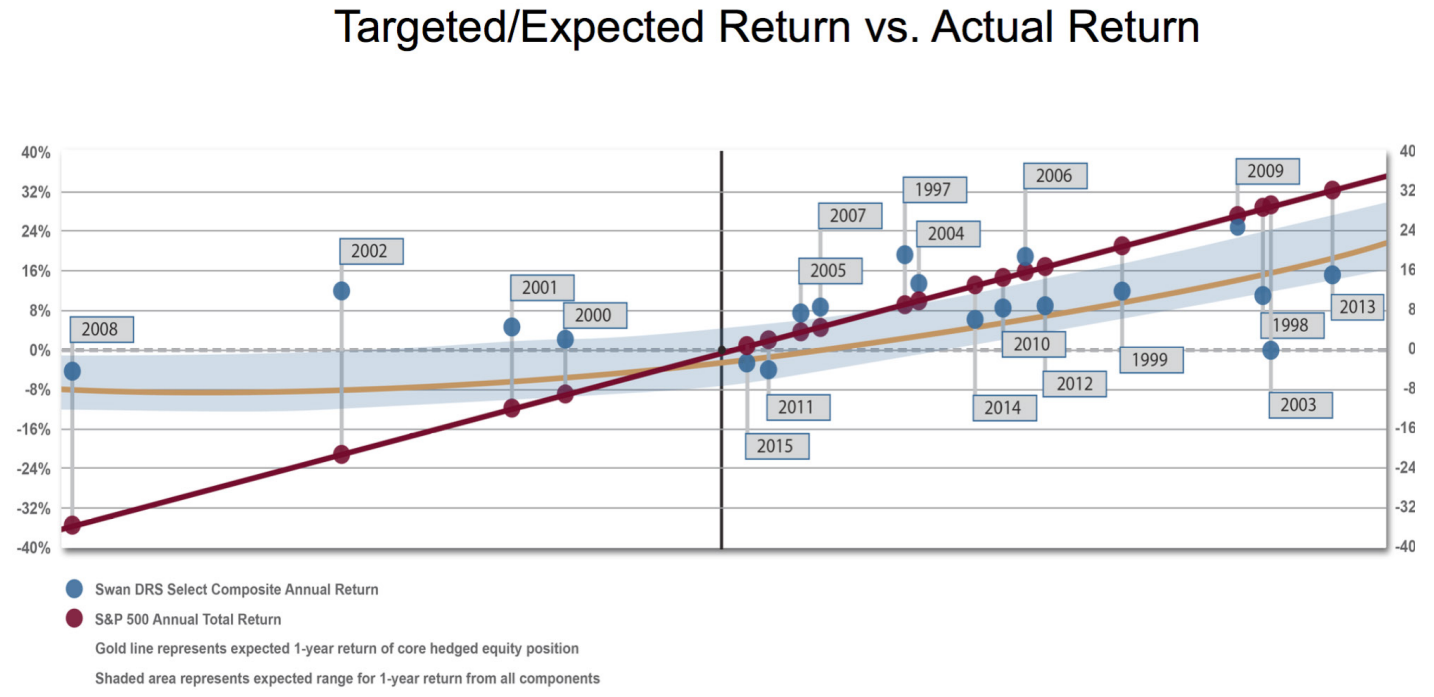


Exhibit 21
Source: Swan Global Investments

For some comparison to Exhibit 17's worst-case scenarios, here are the worst and best case scenarios on a rolling return monthly close basis since DRS inception for the DRS, S&P 500 Total Return, and a 60/40 portfolio (60% S&P 500, 40% Barclays U.S. Agg Bond Index):

Rolling Return Period	S&P 500: July 97-Dec 2015				Swan DRS: July 97-Dec 2015			
	Current Rolling Return	Average Rolling Return	Worst Rolling Return	Best Rolling Return	Current Rolling Return	Average Rolling Return	Worst Rolling Return	Best Rolling Return
Rolling 1 Year	1.38%	7.82%	-43.32%	53.62%	-2.93%	8.57%	-6.87%	38.25%
Rolling 2 Year	7.36%	6.65%	-26.08%	37.22%	1.69%	8.38%	-0.80%	23.95%
Rolling 3 Year	15.13%	5.53%	-16.09%	25.56%	5.74%	8.11%	1.31%	19.18%
Rolling 4 Year	15.35%	4.77%	-9.76%	22.42%	6.55%	8.00%	3.18%	12.90%
Rolling 5 Year	12.57%	4.50%	-6.63%	23.00%	4.05%	8.11%	4.05%	12.89%
Rolling 6 Year	12.98%	4.48%	-1.13%	21.72%	4.71%	8.19%	4.71%	11.14%
Rolling 7 Year	14.81%	4.09%	-3.85%	15.25%	7.39%	8.24%	5.85%	10.81%
Rolling 10 Year	7.31%	4.18%	-3.43%	8.53%	7.30%	8.33%	6.46%	10.67%

Rolling Return Period	60-40 Portfolio: July 97-Dec 2015				Swan DRS: July 97-Dec 2015			
	Current Rolling Return	Average Rolling Return	Worst Rolling Return	Best Rolling Return	Current Rolling Return	Average Rolling Return	Worst Rolling Return	Best Rolling Return
Rolling 1 Year	1.28%	6.76%	-27.65%	34.50%	-2.93%	8.57%	-6.87%	38.25%
Rolling 2 Year	5.85%	6.22%	-14.59%	24.76%	1.69%	8.38%	-0.80%	23.95%
Rolling 3 Year	9.62%	5.71%	-7.24%	18.45%	5.74%	8.11%	1.31%	19.18%
Rolling 4 Year	10.04%	5.36%	-4.05%	16.11%	6.55%	8.00%	3.18%	12.90%
Rolling 5 Year	8.95%	5.23%	-2.26%	15.85%	4.05%	8.11%	4.05%	12.89%
Rolling 6 Year	9.47%	5.23%	1.69%	15.08%	4.71%	8.19%	4.71%	11.14%
Rolling 7 Year	10.70%	4.99%	-0.12%	11.21%	7.39%	8.24%	5.85%	10.81%
Rolling 10 Year	6.48%	5.00%	0.42%	7.42%	7.30%	8.33%	6.46%	10.67%

Exhibit 22
Source: Swan Global Investments and Zephyr StyleAdvisor

This information shows how the DRS, by seeking to avoid large losses and lower volatility, is able to have a more predictable, stable rolling return with much better worst case scenarios than the S&P 500 or a 60/40 portfolio. In fact, since inception the DRS has had a positive two-year rolling return 98% of all rolling months, compared to 72% of the time for the S&P 500 over the same time period. All other rolling returns above have been positive returns on a 3, 4, 5, 6, 7, and 10-year basis for the DRS. Not the case for the S&P 500, with substantially negative returns on all of the same timeframes. This consistency and the benefits of it for those seeking to grow their assets or those seeking to withdraw income from their portfolio is further described on our website in Marc Odo's white paper "The Retirement Conundrum: Untying the Gordian Knot". Of course, past returns are no guarantee of future results but they do give a picture into how these mathematical principles apply over full market cycles. Exhibit 23 below gives the specific details of how the math adds up over time, starting with the DRS's first full year through the end of 2015. Even though the arithmetic average return has been the same for the DRS and the S&P 500, the lower volatility drag and ability to limit participation in down markets has led to a higher geometric return for the DRS. The table shows the four mathematical principles in action over time.

Year		Swan Defined Risk Strategy (Net)		60SP/40Agg		S&P 500
Initial Value		$1,000,000		$1,000,000		$1,000,000
1998	11.6%	$1,115,500	21.0%	$1,209,800	28.6%	$1,285,800
1999	12.3%	$1,252,149	12.0%	$1,354,976	21.0%	$1,556,332
2000	3.2%	$1,291,842	-1.0%	$1,341,562	-9.1%	$1,414,550
2001	7.5%	$1,388,342	-3.7%	$1,291,790	-11.9%	$1,246,502
2002	12.2%	$1,557,998	-9.8%	$1,164,936	-22.1%	$971,025
2003	-0.7%	$1,547,871	18.5%	$1,380,216	28.7%	$1,249,515
2004	12.3%	$1,737,949	8.3%	$1,494,774	10.9%	$1,385,462
2005	7.5%	$1,867,774	4.0%	$1,554,565	4.9%	$1,453,488
2006	18.1%	$2,206,589	11.1%	$1,727,433	15.8%	$1,682,994
2007	8.8%	$2,400,989	6.2%	$1,834,879	5.5%	$1,775,390
2008	-4.5%	$2,292,944	-22.1%	$1,430,105	-37.0%	$1,118,496
2009	25.0%	$2,866,181	18.4%	$1,693,244	26.5%	$1,414,450
2010	8.1%	$3,098,341	12.1%	$1,898,635	15.1%	$1,627,466
2011	-5.4%	$2,931,650	4.7%	$1,987,681	2.1%	$1,661,806
2012	9.0%	$3,195,792	11.3%	$2,212,487	16.0%	$1,927,695
2013	14.3%	$3,654,069	17.6%	$2,601,000	32.4%	$2,552,075
2014	6.5%	$3,892,314	10.6%	$2,877,226	13.7%	$2,901,454
2015	-2.9%	$3,778,269	1.3%	$2,914,055	1.4%	$2,941,494

Geo Compound Return:		7.66%		6.12%		6.18%
Arith Average Return:		7.94%		6.70%		7.91%
Standard Deviation:		7.88%		10.91%		18.61%
Cumulative Return:		277.83%		191.41%		194.15%

Exhibit 23
Source: Zephyr StyleAdvisor, Swan Global Investments; begins first full year, 1998

CONCLUSION

It is time for investors to rethink how they view investment returns and what truly matters when investing in equities.

1. Compound growth matters
2. Avoiding large losses matters
3. Volatility matters
4. Distribution of return matters

In summary, there are four basic approaches to investing in equities. Passive investing is exposed to left-tail risk and high volatility. Active and tactical investing attempts to try to change the distribution of returns by making market calls, either from the bottom-up (active) or top-down (tactical). The DRS is structured to change the distribution of returns. Mathematics is rational; investing in equities can be irrational at times. By rethinking the math behind investment returns, investors should come to the rational conclusion that there is a viable alternative to buy-and-hold equity investing or irrationally jumping from one active manager to another in search of the hottest stock picker or market-timer. Anyone invested in equities for the long-term should consider hedged equity and the DRS. The math behind changing a return pattern, as hedged equity and the DRS seeks to do, supports this alternative approach to equity investing as a better way to achieve long-term returns. It is of vital importance that today's investors study and understand the mathematical principles behind investment returns in order to avoid behaviorial biases and to help them find the best possible solutions for reaching their financial goals.

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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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