



Maximum Drawdown

A New Approach
to Managing
Investment Risk



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Ever since Modern Portfolio Theory (MPT) was introduced in 1952, the answer to the question of how investment risk should be measured and managed has largely been codified as volatility or standard deviation. MPT is a framework that, in theory, allows an investor to maximize return for a given level of risk, defined in the MPT framework as standard deviation of returns.

But is volatility the correct metric to use when assessing investment risk for an individual? Certainly, volatility increases in strong down markets. But is volatility the culprit—or simply an innocent bystander? Consider, for example, that there can be long stretches of time during which investor outcomes are good, notwithstanding a high volatility environment, like the 3-year stretch from 1997-2000 shown in Table 1.

Table 1	Securities	Jan 1, 1997 - Jan 1, 2000		June 1, 2010 - June 1, 2014		Period Comparisons	
		Average 3 Month Volatility	% Price Change	Average 3 Month Volatility	% Price Change	Difference in Volatility	Difference in Price Changes
	Intel Corp	42.0%	152.6%	21.6%	48.6%	20.4%	104.0%
	Microsoft	35.6%	465.2%	21.8%	76.5%	13.8%	388.7%
	Cisco	43.0%	657.7%	27.7%	15.5%	15.3%	642.1%
	GE	27.6%	227.0%	21.1%	91.0%	6.5%	136.0%
	AT&T	31.7%	101.9%	15.1%	81.4%	16.6%	20.4%
	IBM	34.8%	190.7%	17.9%	59.6%	16.9%	131.1%
	Johnson & Johnson	26.6%	94.8%	12.6%	97.4%	14.0%	-2.6%
	Exxon Mobil	26.0%	77.0%	16.8%	88.0%	9.2%	-11.0%
	Walmart	33.2%	518.1%	14.0%	66.5%	19.2%	451.5%
	S&P 500 Index	18.4%	98.3%	14.6%	79.7%	3.9%	18.7%

Table 1 examines two lengthy time periods—one in which investors saw extraordinarily strong returns with low volatility, and another characterized by extraordinarily strong returns with high volatility. This raises an important question: If an investor can achieve outstanding returns in either a high- or low-volatility environment, why should we talk about risk in volatility terms? Was it riskier to hold Walmart stock from 1997-2000 when it appreciated 518% than it was to hold it from 2010-2014 when it rose just 66.5%? If we use volatility as our risk metric, the answer is a resounding “yes”—since the volatility during the 518% appreciation period was more than twice that of the 64% appreciation period.

Most individual investors, though, would strongly disagree with that answer.



Focus on the individual

Individual investors generally understand two important concepts at a gut level:

1. Investment gains are an extremely important tool in combating the risk of loss.
2. Most of us have only got “*one shot*”—that is, one chance to get it right. The critical issue for investors is that they arrive at their destination, and not the nature of the path that gets them there.

(This second point comes with a behavioral caveat, however: If the mental anguish investors suffer while trying to endure large investment losses becomes too great, they will just throw in the towel and sell their investments.)

These two gut-level concepts could be described more formally as 1) maximizing the exposure to the right side of a return distribution (gains) while trying to minimize exposure to the left side of the distribution (losses), with a behaviorally-informed maximum loss limit, and 2) an individual's investment life-span is highly path-dependent.

The first concept implies that—to an investor—gains and losses should be treated differently. In other words, *all volatility is not the same*.

The second concept underscores why this is so: A poor investment performance path can be unrecoverable for an *individual investor*. Of course, this is not necessarily so for the investment performance path of a pooled vehicle such as a pension plan, which is designed ostensibly to exist forever. A pension plan has to operate for the benefit of current and future plan members—the collection of all of their individual investment paths. Managing for any single path could lead to adverse outcomes for others in the plan. Therefore, the more traditional volatility-as-risk concept could be a valid approach.

People, however, don't exist forever. For those of us who must deal with mortality, defining and managing investment risk should take account of those aspects of our financial lives described above.

The answer: maximum drawdown

Fortunately, there is a simple, intuitive metric that can capture these aspects: Maximum Drawdown—the most an individual can lose in their account from their highest previous account value.

Unlike volatility, Maximum Drawdown distinguishes between “good” volatility (such as the late 1990s) and “bad” volatility (such as fall 2008). Unlike seeking to minimize volatility, attempting to minimize Maximum Drawdown would not have penalized an investor during some of the greatest bull markets of our lifetimes (including the mid- to late-1990s, 2013, and 2017). To the contrary, a

Maximum Drawdown focus would have allowed portfolios to take advantage of the loss-buffering gains those markets offered.

A shift in thinking about an individual's investment risk from volatility to Maximum Drawdown yields powerful insights on how to manage investment risk appropriately for individual investors. Risk management products and programs that are able to specifically target this clarifying idea of Maximum Drawdown can be better tailored to suit the needs of individual investors in ways that traditional risk management products and programs are simply unable to achieve. Maximum Drawdown-focused risk management techniques also behave in intuitive ways—doing what the investor “wants” to do, but in a controlled and methodological manner.

The upshot: Risk management techniques that approach the question of “risk” from the same standpoint taken by the clients they serve can be a great leap forward in terms of how the professional investment community manages investment risk for their individual clients.

Traditional Approaches To Managing Investment Risk

Managing the investment risk associated with a pool of assets (like a mutual fund) poses a unique set of challenges to a money manager. What is the best way to manage against catastrophic investment loss? What are the investment restrictions inside the pool? What experience does the client inside of the pool expect? How should sequence of return risk be dealt with in a product that has an infinite life, but contains the investments of participants whose time in the pool will be finite (and thereby subject to that particular risk)?

Investment pioneers over the decades have attempted to answer some (but never all) of these questions. Here are many of the various methods they have developed to address investment risk.

Modern Portfolio Theory (MPT) / Mean Variance Optimization (Diversification)

A well-diversified portfolio, based on the tenets of Modern Portfolio Theory (MPT), is the classic method of minimizing portfolio risk. The logic behind diversification is sound: If you hold assets that behave differently in diverse market environments, then some investments should become more valuable when others become less valuable — thus helping to insulate the portfolio from major drawdowns.

While a well-diversified portfolio can be a good first step toward managing some investment risks, it's ultimately insufficient for protect-stage investors nearing a goal. Diversification's most notable flaw for protect-stage investors is that it requires future relationships (such as correlation, covariance, distribution of returns) between different investment categories to be both known and stable.

Unfortunately, those future relationships are simply unknowable. Worse, they tend to become quite unstable during market declines—right when investors seeking refuge from big losses look to diversification for shelter. So while diversification can help in terms of relative performance, it can still experience excessive drawdowns in bad markets.

Target Date

Target Date funds allocate their assets in some systematic way that varies as the target date approaches. Typically, this involves allocating away from equities and toward bonds. The precise portfolio is generally governed by a so-called “glide path” that is the result of a Mean-Variance Optimization (MVO) run at different points during the fund's life.

One potentially devastating error in the underlying intellectual foundation for Target Date methodologies is the blind eye these funds typically turn toward sequence of return or path-dependent risk. Example: A 2040 Target Date fund launched in 2008 might have suffered devastating – and potentially irrecoverable – returns for an investment that participants typically use for their retirement assets.

The reason behind the fatal flaw in the methodology is simple: The faulty assumption underlying both the MVO and the glide path approaches is that an investor has an infinite number of chances or “lives”—therefore that investor should follow an approach that (on average) provides for the “best” chance of success. But, of course, people only live one life. They are exposed to one sequence of returns for their investments, fully determined by when they invest and when they plan on retiring.

And, generally, investors are not indifferent between “winning” by a lot and “losing” by a lot when it comes to their retirement assets. After all, the penalty for “losing” by a lot is that they are unable to retire with their desired lifestyles—or worse, unable to retire at all.

Target Date methodologies ignore all of these problems.

A risk management approach that is meant primarily for retirement assets should be constructed in recognition of the fact that individual investors typically have a continuous, *but nonetheless single*, opportunity to build wealth. In order to accomplish this, every possible sequence of returns must be accounted for—not just the “average” ones.



Volatility Targeting (Minimum Volatility, Managed Volatility)

Volatility targeting is a risk-management strategy that seeks to keep a portfolio's realized volatility within some pre-defined range. To that end, volatility targeting strategies typically allocate a portfolio among assets with different historical volatility characteristics, including cash (which has zero nominal realized volatility). In the simplest realizations, a portfolio will allocate some portion of its assets to a particular equity index (which may be a broad-based index like the S&P 500) or to a particular sector like utilities or financial stocks, with the remainder of the portfolio being allocated to cash.

The relative weights of the equity and cash positions are typically based on some measure of past realized volatility for the equity component. The allocation to the equity component is determined in a manner such that, when it is combined with the zero-volatility cash component, the (past) realized volatility of the overall portfolio is within the desired range. Some volatility targeting methodologies also allow for the use of leverage in the equity component (occasionally as high as 150%!) in cases where realized volatility is deemed to be too low.

There are clearly some issues that must be considered when examining a volatility targeting risk-management strategy.

1. A volatility targeting strategy makes an explicit connection between high volatility and falling equity prices. But as noted earlier, high volatility markets can also mean rapidly rising stock prices (e.g., March 2009-December 2009, or the late 1990s)—a scenario that volatility targeting doesn't appreciate. Therefore, a volatility targeting methodology would likely have reduced investors' exposure to equities during some of the great bull runs in history.
2. Volatility targeting is an entirely backward-looking risk-management strategy: Past realized volatility is the exclusive determinant of portfolio allocation. Fast changes in market volatility (and possibly direction) may not be captured quickly enough to reallocate the portfolio, depending on how the volatility calculation is specified.
3. The implementation of volatility targeting strategies can lead to excessive trading (and the associated costs) due to portfolio rebalancing when volatility is high. This can lead to adverse portfolio performance and non-intuitive portfolio allocation decisions, particularly at inflection points in the market.

Portfolio Insurance (Put Option Replication)

Portfolio insurance (or any type of put replication technique) *seems* like a good idea: hedge the risk in a stock portfolio with a short position in stock futures (the size of which is calculated using a formula for valuing stock options). Just manage the short futures position to replicate the payoff from a put option. Investors buy futures when the market rises and sell when the market falls—a strategy meant to mimic owning a put option on the index.



This approach works fine in most markets. But like MPT, portfolio insurance tends to fail exactly when protect-stage investors need it most—such as when prices nosedive rapidly.

This is due to three key design flaws, which can be seen most clearly by examining how portfolio insurance behaved during the infamous October, 1987 market crash:

- Portfolio insurance incorrectly assumes that investors can trade instantaneously (to a close approximation) and that there will always be a relatively continuous market in which to trade—that is, no large gaps between a security’s trading price from moment to moment. But this simply isn’t the case. Large and sudden price gaps do occur—and they are usually wildly exacerbated during market panics such as the 1987 crash (and, more recently, the “flash crashes” of 2010 and 2015).
- Portfolio insurance’s hedging instrument is a form of the very thing it tries to protect. In 1987, for example, portfolio insurance used stock index futures to hedge a portfolio of stocks. When the stock portfolio’s value fell, the portfolio insurance algorithm signaled investors to sell the stock index futures—thus creating a negative feedback loop that greatly worsened the crisis. As portfolio values dropped, portfolio managers were forced to sell more futures (which led to further drops in portfolio values, requiring selling of futures, and so on).
- Portfolio insurance requires a very liquid market for its hedging instrument (such as S&P 500 futures). But when markets take a big and sudden hit, liquidity is typically very thin—drastically impairing the ability to hedge at the exact time when hedging is crucial.

Although these flaws—gap risk, negative feedback loops, and hedging instrument liquidity—weren’t apparent to investors using portfolio insurance back in 1987, they certainly are today. Despite that, there are numerous “portfolio insurance 2.0” risk management strategies in the current marketplace. They often use inverse ETFs to accomplish the task that was originally performed by index futures. But the fundamentals are identical—and, unfortunately, so are the negative conclusions about the results of this hedging technique.

Listed Options

This risk management technique typically calls for purchasing put options on a broad-based index (like the S&P 500) that are meant to hedge the systematic risk or beta associated with a portfolio.

Listed options have important and attractive risk mitigation characteristics. They offer protection against gap risk—large differences in a stock’s or index’s closing price one day and its opening price the next. Listed options also are liquid, transparent and trade on exchanges. Because they allow investors to mitigate risk at a known cost for a window of up to approximately two years, they can help avoid major drawdowns over relatively short risk management time frames.



But listed options can come with opportunity costs that may make them sub-optimal for some protect-stage investors.

Here's why. Puts are generally more expensive than calls with similar characteristics. A typical option hedging strategy is to partially offset the cost of purchasing put options by simultaneously selling call options. Managers continually using this “collar” strategy in a naïve fashion are unable to participate fully in strong up markets—denying investors the capital appreciation they likely need to achieve their goals. Therefore, this strategy may not be best for some investors who are nearing a goal but still need portfolio growth to get them into the end zone.

Some other issues to be aware of:

- Options are expensive. It's not uncommon for a put option program to cost 15% to 20% of a portfolio's value *per year*.
- Options may experience basis risk, which occurs when there is a difference (or slippage) between an investor's portfolio and the option strategy designed to protect that portfolio.
- There is no way to determine the likely long-term cost (beyond a year or two) of an options-based hedging strategy.

Constant Proportion Portfolio Insurance (CPPI)

CPPI strategies seek to protect a portfolio by allocating some portion of it on day 1 to a bond and then changing the allocation between the investment portfolio and the bond periodically.

The exact dynamics of how the initial allocation and changes to that allocation occur through time are a function of the particular specification of the CPPI dynamics. But in general, when the investment portfolio appreciates relative to the bond, more money is allocated to the investment portfolio and away from the bond. Likewise, when the investment portfolio loses value relative to the bond, more money is taken out of the investment portfolio and put into the bond.

Importantly, however, note that the fund or manager using a CPPI program is never fully invested in the market at any point—thus ensuring that investors cannot maximize their return potential in up markets.

Timing Strategies

Timing strategies use pre-determined rules—which can be rooted in anything from technical patterns to behavioral psychology—to try to shift assets in and out of an investment, asset class or entire market at just the right moments. Certainly, a rules-based approach can help investors avoid making emotional decisions about their assets. A strategy that says, essentially, “when event



'A happens, take action 'B'" can potentially shut down reactionary money moves based on the headlines (if it's followed diligently, of course).

However, timing strategies don't measure up nearly as well at mitigating the risk of suffering drawdowns or the risk of missing upside gains. The reason: The flawed assumption underlying all timing strategies is that the past is prologue—what happened with asset prices previously gives reliable information about what they'll do next.

But unlike the natural world, where a law like Newton's Law is constant, financial markets don't come with consistent, stable rules. Markets evolve and (as noted above) relationships between assets change. A timing strategy without the flexibility to adapt to changing market dynamics and assumptions cannot help investors get out of the way of losses—or shift them back in time to capture gains—consistently over long periods.

Market timers' uninspiring results have proven that fact time and time again.

In addition, the backtesting done on timing strategies is problematic. Timing strategies look especially appealing when a strategy's provider shows the results that investors would have achieved if they had used the strategy during some previous time period. However, it is not always possible to stress the assumptions embedded in the backtesting—or verify that the signal was not fitted to the data.

Ultimately, market timing demands that investors get two notoriously difficult decisions right: when to exit and when to re-enter. The probability of that happening consistently over time is low, while cost of getting one or both of those decisions wrong can be extremely high. Not a desirable combination for protect-stage investors.

Today's Solution

Horizon Investments offers a new way to think about risk mitigation: Risk Assist. Risk Assist's primary design is to limit losses to a pre-defined level (which varies by portfolio). However, Risk Assist seeks to mitigate risk while also staying out of the way and letting the portfolio generate gains as often as possible.

How is that approach important or unique? Think about how much you wanted to “manage risk” during 2013, a year that saw the S&P 500 soar 32%. A risk management program that gets in the way of that kind of return can end up being very expensive, so we designed Risk Assist to have the ability to remain fully invested during strongly trending markets like 2013 and 2017.

At its core, our Risk Assist solution is a switching algorithm between the primary investment portfolio and a portfolio with exposure to U.S. Treasury bonds. The algorithm utilizes modern volatility forecasting techniques and Horizon's proprietary optimization procedures with respect to Maximum Drawdown to calibrate to each portfolio's "catastrophic" risk. We use our volatility forecasts to help optimize the speed and magnitude of the de-risking and re-risking decisions rather than as some sort of "timing signal."

It is important to understand that Risk Assist is NOT a market timing program. There is no forecast of asset returns in the algorithm. While there can be relatively long stretches of time over which there is no de-risking activity, there will be times that Risk Assist does begin to de-risk. At that point, Risk Assist must balance two opposing forces:

- On the one hand, Risk Assist wants to re-enter the market as quickly as possible as it recovers.
- On the other hand, Risk Assist wants to avoid getting whipsawed if the market turns south again (having to once again de-risk shortly after re-entry).

The way Risk Assist seeks to solve this problem—getting back into the market quickly but without being whipsawed—is largely through the lens of its volatility forecast:

- When the volatility forecast is high, the chance of being whipsawed is high. At those times, we "raise the bar" for re-entry into the market—meaning we have to wait a bit longer than we otherwise would to re-risk.
- However, when our volatility forecast is low, the chance of being whipsawed is similarly low. This means that we can (and will) re-enter the market more aggressively.

We believe our unique approach to risk mitigation, Risk Assist, combines the underappreciated concept of "staying out of the way" when it can with the advanced volatility forecasting and risk mitigation techniques that help avoid catastrophic losses that can derail individual investors. We believe this combination provides the potential to deliver strong returns in up markets, but help limit losses during times of severe market stress.

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Mr. Ladner serves as Head of Investment Management and is the Chair of the Investment Committee for Horizon. In these capacities, he oversees all aspects of the Investment Management division for the firm. He also provides the Investment Management division with Macro analysis and interpretation of global derivatives, credit, foreign exchange, equity, and funding markets. His previous roles at Horizon included Head of Risk and Director of Quantitative & Alternative Strategies.

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