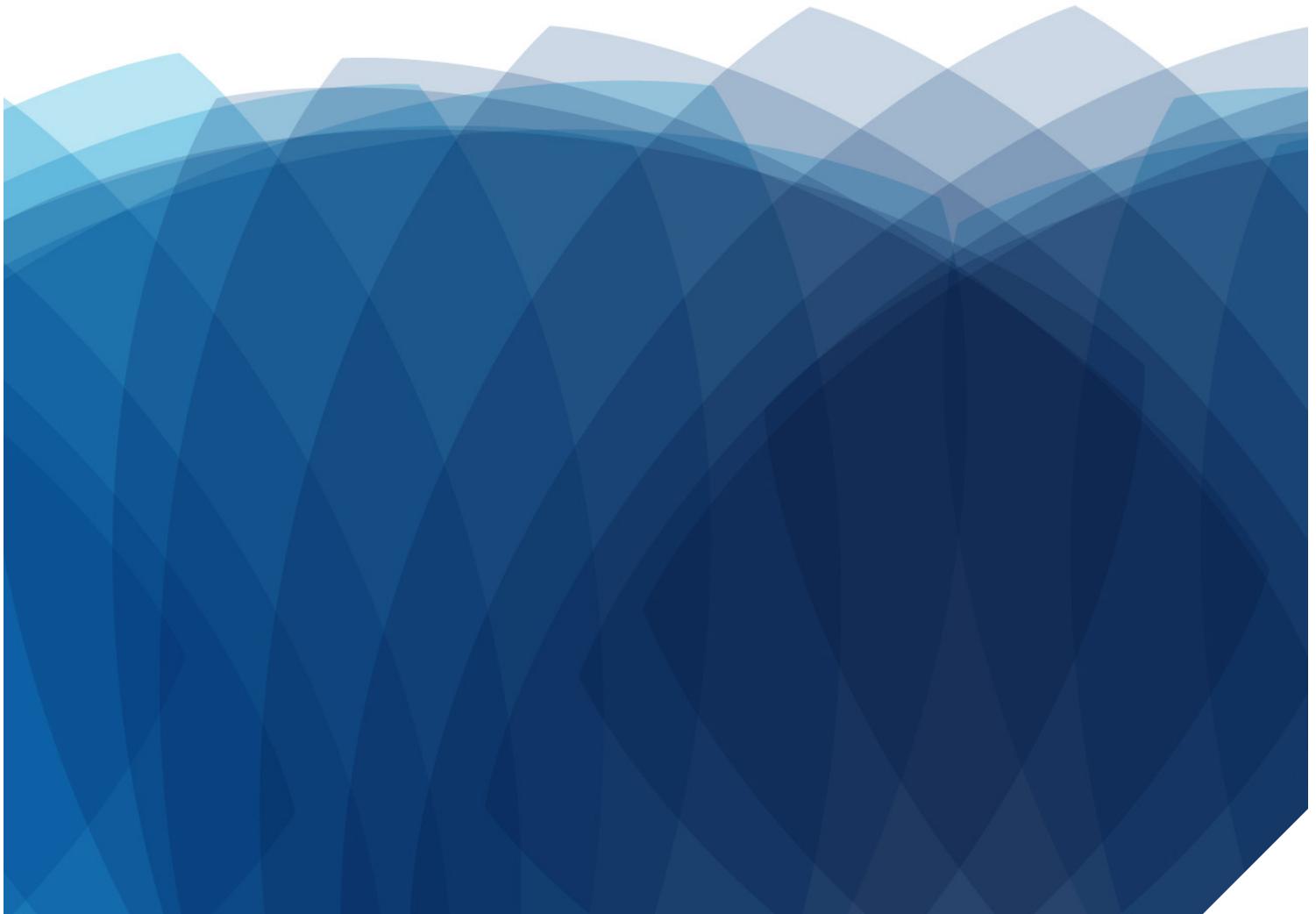


Milliman Managed Risk Strategy

THE METHODOLOGY



OVERVIEW

Today the risk management techniques used by many of the world's largest financial institutions to stabilize portfolio volatility and weather market crises can be accessed by financial advisors and their clients. This paper provides a brief look at the models behind the Milliman Managed Risk Strategy™—one of the most widely used risk management strategies in the market today.

Milliman Financial Risk Management LLC (Milliman FRM)—a global leader in financial risk management, and creator of the Milliman Managed Risk Strategy—provides investment advisory, hedging, and consulting services over \$152 billion of global assets (as of September 30, 2018). Established in 1998, the practice includes over 170 professionals operating from three trading platforms around the world (Chicago, London, and Sydney). Milliman FRM is a subsidiary of Milliman, Inc. (Milliman)—one of the world's largest independent actuarial and consulting firms.

It is important to note this paper is intended solely for the audience in which it was distributed, is written in a manner deemed sufficient for a financial professional to obtain an understanding of the Milliman Managed Risk Strategy, and is void of any proprietary formulaic theorem. The material herein should not be copied or distributed in any manner.

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Milliman Managed Risk Strategy

The Milliman Managed Risk Strategy™ is a sophisticated financial risk management strategy that seeks to stabilize the volatility of portfolio around a target level, (e.g., 12%), capture growth in rising markets, and reduce the downside exposure of a fund during periods of significant and sustained market decline.

The strategy is used in a variety of institutional and retail products. It is employed in mutual funds and target-date funds in an effort to improve the likelihood of meeting clients' retirement income goals. It is also used within variable annuity insurance products (with guaranteed living benefit riders) that are intended to provide clients guaranteed lifetime income.

The Milliman Managed Risk Strategy is comprised of two risk management techniques:

1. **A volatility management process**, which seeks to stabilize portfolio volatility around a target level, and
2. **A capital protection strategy**, which seeks to provide portfolio put-like protection.

The Milliman Managed Risk Strategy is carried out via exchange-traded futures contracts (on major equity indices, U.S. Treasury bonds, and currencies). These instruments have been selected based on their high levels of liquidity, as well as the security provided by major exchanges as the counterparty in a hedging transaction. As such, the value can be readily accessed by investors should their investment goals change. In particular, this approach readily accommodates changes in investor priorities with respect to capital growth and income (e.g., accumulating investors vs. decumulating investors).

It is important to note that futures contracts are used only in an effort to reduce risk relative to a long-equity portfolio, and not in an effort to generate alpha.

Volatility Management Process

The volatility management process within the Milliman Managed Risk Strategy is designed to stabilize the volatility of a portfolio around a shorter-term (e.g., one month) standard deviation (e.g., 12%). This potentially keeps the risk level of a fund from increasing significantly during periods of market turbulence. The volatility management process also seeks to earn additional returns based on the tendency of market volatility to decrease during extended periods of favorable market returns.

Most asset allocation models prescribe a static allocation to a set of funds to generate the most return for a given long-term volatility (e.g., 60% stocks/40% bonds). The prescribed risk tolerance allocations are updated infrequently and are highly reliant on historical volatility norms as a forecast of future

volatility. Because past is not always prologue, Milliman FRM's volatility management process involves a dynamic approach to forecasting short-term volatility, and synthetically adjusting portfolio weights (via exchange-traded futures contracts) to ensure that a target level of volatility is maintained. This potentially avoids the volatility "hot spots" investors are accustomed to experiencing from static allocation investments.

The following section describes the methodology around the volatility management process. It includes:

- the rebalancing process,
- computing the historical return stream of the high risk and low risk bucket, and
- the methodology for forecasting volatility and correlation.

REBALANCING PROCESS

To achieve a target volatility, the underlying portfolio allocations are synthetically rebalanced between a group of assets with expected volatility that is typically above the target volatility—the "high risk bucket" (e.g., a group of equity funds), and cash (or another short term fixed income investment).

Again, this synthetic rebalance is enacted via exchange-traded futures contracts. No actual movement of underlying portfolio assets is required. To the extent that the portfolio also holds fixed income investments (the "low risk bucket"), volatility and correlation of these investments will be measured and incorporated into the calculation. To determine the recommended weight to the high risk bucket, Milliman FRM's volatility management process produces a forecast of the covariance of the buckets.

When a rebalancing trade is executed, the futures amounts that are traded are taken from the mapped exposures within the high risk bucket.

Because a volatility forecast may be noisy, and transaction costs are incurred when a rebalancing trade is executed, a trading threshold based on the change in recommended allocation is used. This helps reduce trading costs, as well as improve the volatility targeting process.

COMPUTING THE HISTORICAL RETURN STREAM OF THE HIGH RISK AND LOW RISK BUCKET

The historical high and low risk bucket returns are the primary state information used in the calibration of the volatility and correlation models. To this extent, careful consideration must be taken to construct the historical returns.

For each investment (e.g., mutual fund, ETF, single stock, fixed income security) within a particular bucket, the relative weight of each investment is calculated, taking into account the absolute weight of the investment in the portfolio, the relative weight of the investment in the bucket, and the historical returns of each investment (continuously compounded). The timestep

for constructing these returns is daily. Then, a single return stream is compiled for each bucket, which captures the implicit volatility and correlation of the investment within each bucket.

VOLATILITY AND CORRELATION FORECASTING

A key to the success of any volatility targeting methodology is the accuracy of the forecast. While there is inherent inexactness to any forecasting mechanism; Milliman FRM aims to reduce this error via separate, customized forecasting models for the high risk bucket, low risk bucket, and correlation.

High Risk Bucket Forecast: The model used for the high risk bucket describes the volatility of returns in terms of a transient component and a persistent component. Milliman FRM's volatility management process uses both of these components to respond to rapidly changing market conditions, while adapting to variations in the longterm outlook (via trades in futures contracts).

Low Risk Bucket Forecast: Funds in the low risk bucket are typically fixed income funds, and as such, do not exhibit the same stylistic characteristics of volatility as the high risk bucket. Because of this, a single factor model sufficiently provides a dynamic forecast for fixed income volatility.

Correlation Forecast: A correlation forecast between the high risk bucket and the low risk bucket may be used in the volatility targeting of the overall portfolio. In cases where the correlation forecast is shown to improve the volatility targeting and the correlation forecast changes significantly, Milliman FRM's volatility management process will allocate more to the low volatility bucket when the buckets show positive correlation, and vice versa when the forecast is negative.

Capital Protection Strategy

One of Milliman FRM's core disciplines is the proven operational capability to use futures contracts to manufacture a long-dated put option on a portfolio. This process is referred to as the "capital protection strategy."

The capital protection strategy adjusts futures positions daily (subject to market-based thresholds) in an effort to preserve the capital of a portfolio on a rolling five-year basis. In a severely declining market, futures gains may be harvested and reinvested in growth assets in an effort to maximize long-term returns.

MANUFACTURING A PUT OPTION WITH FUTURES CONTRACTS

Over the past 30 years, various trading vehicles have been used to hedge portfolio risk; namely, options and futures contracts. For example, today, one may go into the market and purchase a put option directly, which, for a price (the premium), will provide downside protection should the underlying portfolio decline beyond a certain threshold (the strike).

This put "protection" is composed of the following parameters: valuation interest rate, the maturity, the strike, and a volatility input. All of these components are critical to the standard Black-Scholes option pricing model. Knowing these parameters, it is often advantageous to synthetically replicate the payout features of a put option using other instruments, such as financial futures contracts. Manufacturing a put option in this manner offers the creator of the option the ability to customize the parameters of the option in order to meet the needs of the underlying portfolio, and in a potentially more efficient manner. For example, it would not be feasible for a financial advisor or investor to purchase a five-year evergreen put option with a dynamically moving strike. They simply do not exist in the open market.

By manufacturing a put option using futures contracts, Milliman FRM is able to set the maturity and strike at levels the Milliman Managed Risk Strategy deems appropriate. Additionally, Milliman FRM is able to set these levels on a daily basis. Milliman FRM carries out this process by managing a portfolio that seeks to exhibit a target level of equity market sensitivity per dollar invested (delta), and a target level of interest rate sensitivity per dollar invested (rho), depending on the interest rate environment. These sensitivities are derived from standard actuarial models and option pricing techniques. The portfolio also seeks to hold an amount of cash similar to the value of the put option. This cash position naturally supports the margin requirements of the hedge instrument.

Overall, this approach provides greater flexibility in managing overall risk within the portfolio, and controlling the potentially negative impact of volatility premiums, time decay, and static strikes.

SETTING STRATEGY PARAMETERS

As stated previously, the key parameters that define the value of the manufactured put option at any point in time along a particular path are:

- the valuation interest rate,
- the maturity,
- the strike, and
- a basket volatility.

The next section will explain each parameter in greater detail.

INTEREST RATE

The interest rate is fundamental to determining the discounting rate of the manufactured put option, as well as the discounted strike. Generally, this is the market zero coupon rate of the same maturity as the manufactured put option.

MATURITY

The maturity of the manufactured put option determines the intensity of the "protection level." For example, a hedge is more active on a manufactured put option with a shorter maturity, and

vice versa for a longer maturity. Typically, hedges with shorter maturities require more frequent delta rebalancing trades; thus, incurring a greater degree of trading cost. For this reason, the Milliman Managed Risk Strategy™ synthetically manufactures an evergreen, longer-dated (5-year), put option. Generally, the maturity is reset daily, subject to market-based thresholds.

Additionally, while the Milliman Managed Risk Strategy™ is intended to cushion downside risk and reduce volatility, it does so without a guaranteed floor on losses. This type of strategy does not require a large amount of intra-day trading, and avoids the pitfalls commonly associated with hedging strategies that implement a floor. Namely, this avoids a selling spiral that has the potential to push a sudden bear market down even further (e.g., portfolio insurance during the crash of 1987).

STRIKE

The strike is the most direct indication of the intensity of the capital protection strategy. If the strike is unchanged throughout the life of the portfolio, investors who purchase and sell the same risk managed portfolio at different points in time will have markedly different experiences. To keep the strike current, a dynamic strike update rule is applied.

The goal of the Milliman Managed Risk Strategy in relation to the strike is to provide asymmetry in the return distribution. In other words, the right tail is reduced by less than the left tail.

VOLATILITY

Within an option pricing model (e.g., Black-Scholes), volatility is an unknown value, and is assumed to be constant. Because of this uncertainty, purchasing a put option directly incurs a price premium in order to account for fluctuations in volatility. As market volatility increases, the cost of the hedge inherently becomes more expensive. This is counter intuitive to any risk management strategy, as the cost of hedging becomes relative to the volatility in the market.

With the Milliman Managed Risk Strategy, the volatility “input” of the put option model is set based on the parameters from the volatility management of the portfolio. By managing the portfolio’s volatility around a target level, the once unknown volatility input becomes a relatively stable value. This not only creates a more efficient hedge, but creates the potential to smooth out the overall investment experience.

Net Equity Exposure

The final recommendations of the Milliman Managed Risk Strategy involves futures trades from both the volatility management process and capital protection strategy.

The Milliman Managed Risk Strategy then provides a net trade recommendation to be executed. This is accomplished by calculating the sum of the futures recommendations

for each component. This execution provides an overall futures position on the underlying portfolio. In application, this futures position creates a net equity exposure level of the underlying portfolio. The net equity exposure within a portfolio changes continuously (daily) in an effort to help stabilize volatility, capture growth in up markets, and reduce the impact of sustained market declines. As equity markets become more volatile, a risk managed portfolio’s net effective equity exposure generally decreases, and vice versa. Net equity exposure reflects all aspects of a portfolio’s overall investment strategy, including the Milliman Managed Risk Strategy. This includes all portfolio holdings, cash, and futures.

Conclusion

For decades, conventional wisdom has said, “When the market goes down, ride out the storm. Eventually, the damage to your portfolio will be repaired.” In short, “Wait it out; and batten down the hatches.”

For those nearing or in retirement, “wait it out” may not be the best answer. This group of investors is facing a stock market at alltime highs, low yields, and the looming threat of inflation, making it difficult to meet both income and risk management needs; investing heavily in equities may expose this group of investors to untimely amounts of risk, while allocating to fixed income assets may not adequately fulfill income needs.

Today, financial advisors and investors can seek to address these concerns through the Milliman Managed Risk Strategy.

FUTURES CONTRACTS

- are agreements to trade cash back and forth with the exchange at the end of each trading day based on movements of market indices.
- are based on broad market indices, both domestic (S&P 500, Russell 2000, etc.) and international (EAFE, MSCI Emerging Markets, FTSE, Nikkei, etc.).
- have leveraging power.
- enable the Milliman Managed Risk Strategy to operate based upon the allocation of a small cash position (typically 5% to 7% of portfolio assets).
- have virtually zero counterparty risk, as any changes in their values are settled in cash at the end of every day.
- are backed by Central Counterparty Clearing Houses.

Creating transformational improvement in the retirement savings industry.

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There are risks associated with futures contracts. Futures contract positions may not provide an effective hedge because changes in futures contract prices may not track those of the securities they are intended to hedge. Futures create leverage, which can magnify the potential for gain or loss and, therefore, amplify the effects of market, which can significantly impact performance.

There are risks associated with investing in fixed income securities, including interest rate risk, and credit risk.

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