



## MILLIMAN ANALYSIS: CORPORATE PENSION FUNDED STATUS FOR MILLIMAN 100 WITH MMRS DECLINED BY \$75 BILLION IN Q3

THIRD QUARTER 2015 REALIZED VOLATILITY WAS 6.0% FOR THE  
MILLIMAN 100, AND 5.75% FOR THE MILLIMAN 100 WITH MMRS



**Tamara Burden, FSA, CFA, MAAA**

Principal  
Milliman Financial Risk Management LLC  
tamara.burden@milliman.com

**Mitch Morin**

Actuarial Analyst  
mitch.morin@milliman.com

## INTRODUCTION

### MILLIMAN 100 WITH AND WITHOUT MMRS

At the end of Q2 2015, Milliman conducted a study applying the Milliman Managed Risk Strategy™ (MMRS) to the Milliman 100 Pension Funding Index (Milliman 100) returns (since inception of the Milliman 100 in 2000). The results illustrate the potential for MMRS to help pension plans achieve portfolio risk management goals, including:

- Short-term risk
- Long-term risk
- Acceptable levels of variability.

MMRS is a unique risk management solution that seeks to stabilize the ever-present systematic market risk faced by pension plans. Systematic risk is inherent in the very structure of the market. It is unpredictable and undiversifiable; no market participant is immune to it. MMRS seeks to explicitly combat unhealthy swings in portfolio value caused by this sort of risk through a combination of volatility management and a capital protection strategy. In an economic environment fraught with low interest rates, tepid growth, and large undiversifiable risks such as the actions of the Federal Reserve, MMRS seeks to allow a portfolio to react quickly and sensibly to sudden changes in the market. It is especially beneficial to pension plans, which must pay out benefits whether the market is up or down.

The cumulative benefit of MMRS is apparent over the 15+ years of data analyzed. This update, however, focuses on the most recent market drop in third quarter 2015. For more information and analysis, we recommend reading our introduction to the Milliman 100 with MMRS, which can be found here: <http://www.milliman.com/MMRSPensionQ2/>. That paper thoroughly describes MMRS, its benefits (as well as potential drawbacks), and its long-term effects on a pension plan's assets.

Operationally, both parts of the strategy are implemented with equity futures contracts. Asset allocations for each unique fund in the plan can be represented as a mixture of index exposures. Once that mixture is determined, volatility management and the capital protection strategy can be applied to the portfolio by buying and selling futures contracts on that mixture of indices. These futures contracts are inexpensive, transparent and highly liquid.

### THIRD QUARTER 2015 IN RETROSPECT

The funded status of the Milliman 100 with MMRS worsened by \$75 billion during 2015 Q3, while the actual Milliman 100 declined by \$66 billion. However, although the overall return was lower for the Milliman 100 with MMRS, so was volatility. In a quarter marred by economic trouble abroad and uncertainty over the Federal Reserve's rate-hike decision, MMRS reduced the volatility of the Milliman 100 by approximately 0.25%, which equates to a 5% drop in relative risk, as defined by standard deviation.

FIGURE 1: FINAL VALUES OF MILLIMAN 100 (M100) AS OF SEP-2015 (FIGURES IN \$ BILLIONS)

	Portfolio		Difference
	M100 Actual	M100 w/ MMRS	
Market Value of Assets	\$1,396	\$1,737	\$341
Projected Benefit Obligation	\$1,708	\$1,708	\$0
Funded Status	-\$312	\$29	\$341
Funded Percentage	81.7%	101.7%	20.0%
Internal Rate of Return Jan 2000 - Sep 2015	5.5%	6.6%	1.1%

The results shown are for informational purposes only, not reflective of any investment, and do not guarantee future results.

Despite the performance gap or difference of the Milliman 100 with MMRS in the most current quarter, its market value of assets remains high above its unhedged counterpart given the cumulative returns dating back to 2000. Its funded ratio of 101.7% compares to the Milliman 100's funded ratio of 81.7%. This 20% difference amounts to an aggregate improvement in funded status of \$341 billion.

The decrease in funded status over 2015 Q3 was the result of adverse conditions on three fronts. Equity markets dropped, plans withdrew assets to pay benefits, and interest rates fell. The drop in equities took a bite out of existing plan assets: the Milliman 100 with MMRS dropped -2.5%, or \$45 billion. Withdrawals were estimated at approximately \$15 billion. Benchmark corporate bond interest rates used to value pension liabilities also fell, increasing the projected benefit obligation by \$15 billion over the quarter.

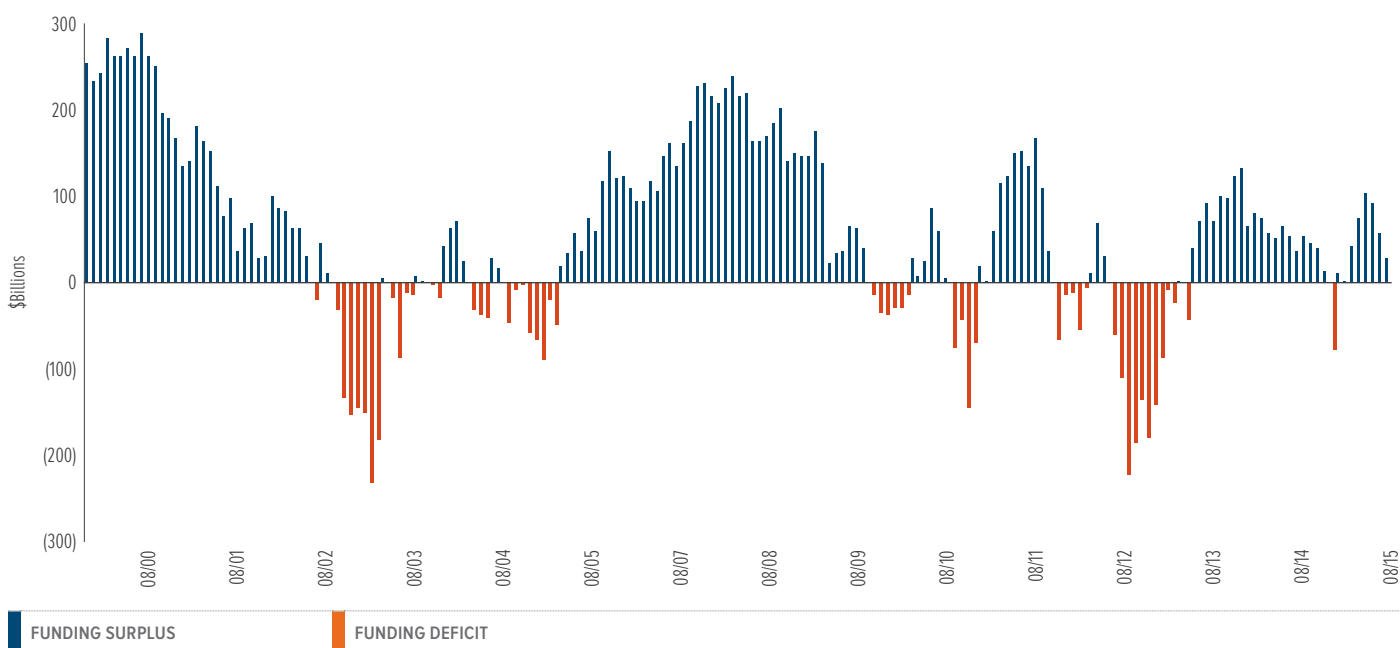
One thing that did not drop this past quarter: volatility. The VIX Index, generally used to estimate the risk underlying an investment in the S&P 500, jumped from 13% to 28% in August after 5 straight days of losses. It had not breached this level since 2011, when we observed the first historical downgrade of US sovereign debt.

MMRS is meant to be a hedge where traditional diversification fails. By August 25, 2015, the Milliman 100 Index was estimated to have lost approximately 4% of its asset value, and this is when MMRS recognized a need for a hedge against additional losses, transitioning 5% of the portfolio's equity allocation into cash.

### OVERVIEW OF THE MILLIMAN 100 PENSION FUNDING INDEX

In order to appreciate the potential effect of MMRS on pension funded ratios as explained in this paper, it is useful to first have a basic understanding of the Milliman 100 Pension Funding Index and how it works. Put simply, the Milliman 100 is designed to be a barometer of the funded ratio of the 100 largest pension plans of publicly traded companies in the U.S. The funded ratio is a measure of current pension assets, expressed as a percentage of projected pension benefit obligations. A ratio of one or greater implies that the plan's assets are currently sufficient to meet its expected

FIGURE 2: MILLIMAN 100 WITH MMRS FUNDED STATUS



obligations, while a ratio less than one suggests the assets fall short of being able to meet future liabilities.

The Milliman 100 Index is calculated by creating a hypothetical portfolio of the pensions' assets. The data used to create the Milliman 100 come from the Form 10-K annual reports, (which all publicly traded companies are required to file each year), as well as from other publicly available data. In addition to nominal asset and liability amounts, Milliman also uses reported asset allocation data; in the absence of a detailed list of individual plan holdings, asset allocations represent a reasonable proxy for estimating returns. The return estimates are created by matching the asset classes found in the pension plans with financial market indexes that are believed to best represent the performance of each asset class. Once a year, the asset classes in the Milliman 100 index are rebalanced to reflect the actual asset class weights in the latest annual reports. In the interim, the Milliman 100 Index is updated monthly based on the returns of the respective underlying market indexes.

Through this simple, rules-based approach, the Milliman 100 is able to generate ongoing estimates of pension assets and liabilities and provide a valuable real-time indicator of the health of the largest U.S. corporate pension plans. The Milliman 2015 Pension Funding Study can be found at <http://us.milliman.com/PFS/>. See the appendix at the end of this report for more details on the methodology.

The Milliman 100 uses monthly index returns, but MMRS is implemented on a daily basis. To address this, we generated a series of daily returns using the same underlying indices. Before applying MMRS, the difference between the monthly versus daily return streams was approximately one basis point annually.

## MMRS PERFORMANCE

### PERFORMANCE OF ASSETS

International equities performed the worst this quarter. The MSCI ACWI ex. US returned -9.61%, contributing most to the portfolio's losses. China was the biggest reason for the pullback in international equities. Investor concern for perpetually sluggish growth on the European front added fuel to the fire. Problems in China surprised many investors and this is precisely what made it so dangerous. Over the past decade, international corporations have poured capital into a booming China. This slowdown came as a shock, and it came quickly. Many investors panicked at the news and pulled out before the dust could settle.

Domestic equities were not far behind foreign markets, with the Russell 3000 returning -7.25%. After economic woes deepened across the Pacific, US stocks began to finally feel the growing pains of 2013 and 2014. The S&P 500 was expensive compared to long-term averages. Mixed market data added to investor confusion. To the detriment of the average investor, strong GDP growth, poor job growth, strengthening consumer spending, and weak inflation obscured an already murky economic future. Investors began questioning if the US could combat the stronger headwinds coming from abroad.

On the other hand, bonds benefited from the flight to quality (e.g. Barclay's Aggregate Bond Index returned 1.23%). Private equities and real estate served to further offset losses, but as figure 2 shows, pension plans still felt the sting of the equity sell-off. The Milliman 100's funded percentage decreased by approximately 3.7%, while the Milliman 100 with MMRS dropped by 4.4%.

FIGURE 3: Q3 VOLATILITY COMPARISON

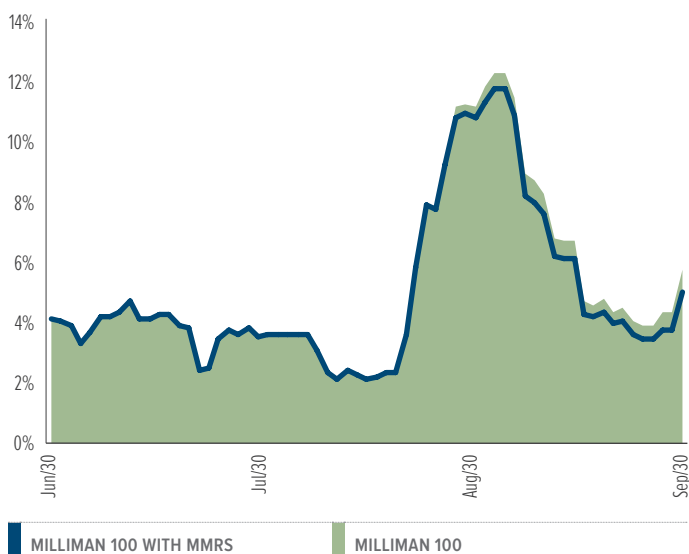
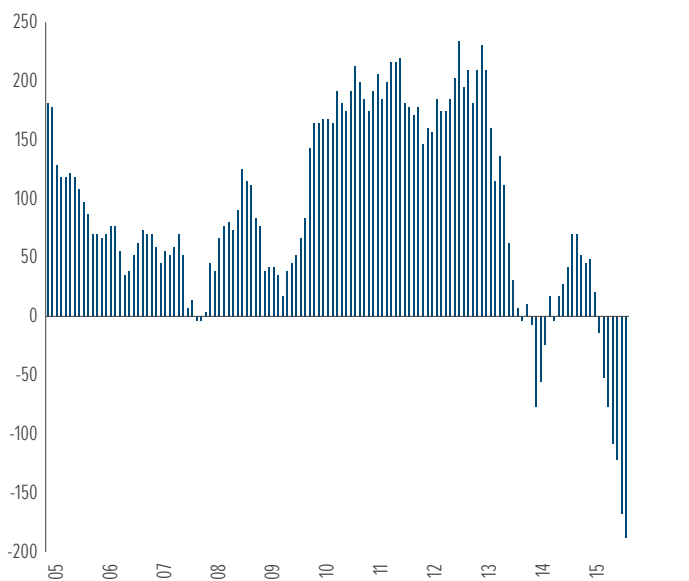


FIGURE 4: SOVEREIGN DEBT PURCHASES

NET FOREIGN OFFICIAL TRANSACTIONS OF U.S. TREASURY NOTES AND BONDS, 12-MONTH ROLLING SUMS

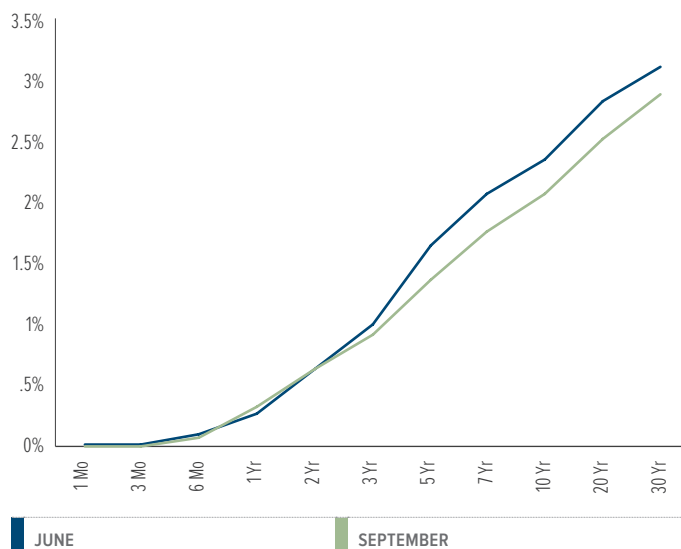


## PERFORMANCE OF MMRS

With only 40% allocated to equities, the broad diversification of the pension funds of the Milliman 100 Index provided an effective hedge against the initial market decline. However, as we see time and again, diversification is not enough when crises loom and correlations increase. Where diversification stops, MMRS starts. To attempt to manage volatility and curb against further losses, MMRS deallocated from equities on August 25, 2015, when the index dropped just over -4% from its quarter high. Figure 3 shows how volatility leveled off at ~12%.

This past quarter provides an interesting case study into how and when MMRS reacts to significant market events. On the cusp of

FIGURE 5: Q3 SHIFT IN TREASURY RATES



the drop, the index's volatility was measured at approximately 2%. By the beginning of September, it was six times higher. When systematic risk is low and markets are up, MMRS behaves as though it is not even there, as it reinvests any extra cash into equities. When systematic risk spikes beyond the risk management goals, MMRS ramps up its protection.

The market may have increased from August 25th to September 30, 2015, but the spike in volatility that occurred warranted extra caution over that time. MMRS put in place a 5% reduction of the index's equity holdings for the sake of stabilizing future returns and, thus, future contributions.

## INTEREST RATES

### INTEREST RATES & FLIGHTS TO QUALITY

During Q3, the funded status loss was exacerbated by the drop in interest rates used to value pension plans. The projected benefit obligation (PBO) increased by \$15 billion over the period, raising the Milliman 100's liability projection from \$1.692 trillion in June to \$1.708 in September. This increase was due to a 6bps decrease in the discount rate used to value liabilities, from 4.25% in June to 4.19% in September.

The fact that rates fell this quarter was an interesting occurrence. As of August 2015, foreign countries are estimated to hold approximately 30% of US Sovereign debt (treasury.gov). Due to the recent turmoil in emerging markets and slow growth in Europe's developed economies, foreign governments began to sell off some of their debt positions, as displayed in figure 4. This should have driven rates up. However, the upward pressure their selling generated was outweighed by demand from the other 70% of investors seeking a safe haven amidst an equity market selloff of more than 10%, and ultimately, the yield curve shifted down (figure 5).

## INTEREST RATES & MMRS

As uncertainty hits investors, they flee to high-quality investments, and pension plans are forced to fight a battle on both sides of the balance sheet. Lower interest rates increase liability projections. Lower returns decrease a plan's ability to pay those liabilities. When markets move as they did in Q3, the hedging capability of MMRS has an added benefit: it controls the risk of a rise in contributions.

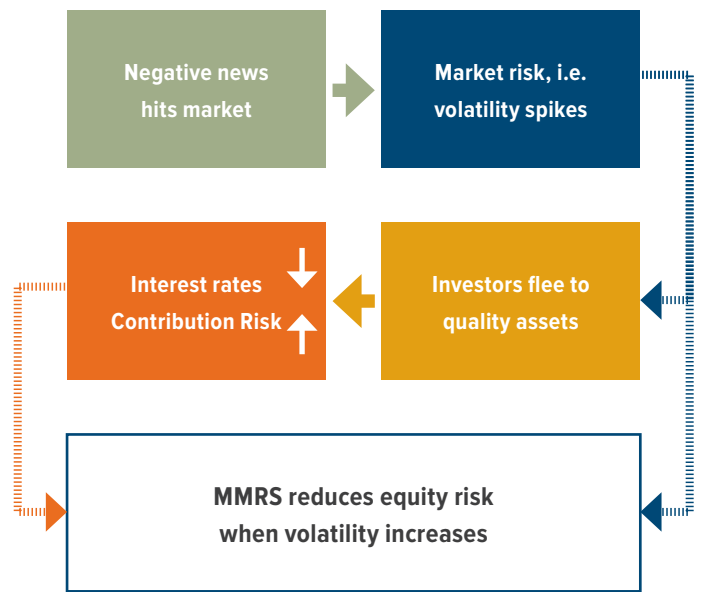
Before the sudden and dramatic drop from 8/17 to 8/25, the Milliman 100 with MMRS matched its unhedged counterpart in riskiness. Once plan assets began to significantly shrink, MMRS put on an appropriate hedge position by combining real-world reasoning in two ways. First, it recognized a shift in market riskiness. Second, it recognized the inherent increase in the marginal utility, or importance, of a plan's existing dollars. MMRS is not connected with interest rate movements, but it is connected with volatility. Figure 6 shows how this hems in both sides of contribution risk.

More often than not, plans become increasingly sensitive to losses as markets drop, but their static allocations do not allow them to reflect this drop in risk appetite. By providing a dynamic hedge, the Milliman Strategy seeks to allow a plan to take advantage of equity exposure during bull-markets and not leave it overly exposed to losses when the riskiness of the assets it holds goes up. If plans had employed MMRS, they would have expected to see a decrease in risk as equities and interest rates dropped. In other words, in the types of markets experienced this past quarter, MMRS controls a portfolio's volatility right when it counts: when a plan's projected contributions are more likely to increase.

## ABOUT THE MILLIMAN 100 WITH MMRS

For the past 15 years, Milliman has conducted an annual study of the 100 largest defined benefit pension plans sponsored by U.S. public companies. Milliman's Financial Risk Management used this index to conduct a study on the Milliman Managed Risk Strategy. We asked the question, "What would the Milliman 100 look like with MMRS applied to it?" Although these backward-looking studies have the benefit of hindsight, the rules-based methodology of MMRS makes it relatively simple to apply it retroactively. The Milliman 100 with MMRS takes its asset allocations, projected liabilities, and underlying returns all from the original index.

FIGURE 6: INTEREST RATES & MMRS



## APPENDIX

### CHANGES IN VOLATILITY ASSUMPTION

Since the initial release of the Milliman 100 with MMRS for June, 2015, the constant 12% target volatility has been altered to better reflect reality. While the initial asset allocation of the Milliman 100 is well suited for this target, the gradual shift away from equities to bonds and alternatives changed the expected underlying risk in the portfolio. Figure 7 shows the new, downward-trending risk target line that we put in place for the Milliman 100 with MMRS. The asset allocations are those of the underlying Milliman 100 Index.

Scaling the volatility target according to the portfolio allocation increased the market value of assets over the period of the study. Heightened levels of protection during 2002 and 2008 caused the funded status of the Milliman 100 with MMRS to increase by \$13 billion. Although this is a small annual difference over the 15-year study, we believe going forward these risk targets better reflect what clients using MMRS really experience.

### MILLIMAN 100 METHODOLOGY

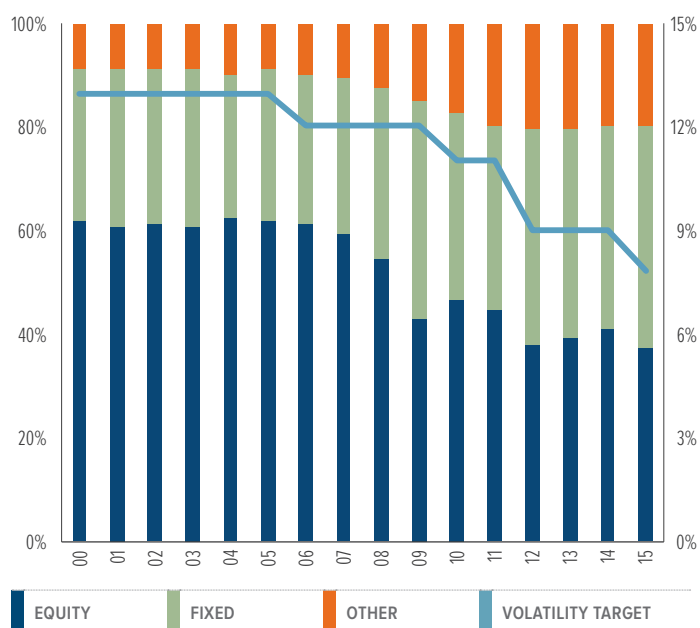
The results of the Milliman 2015 Pension Funding Study are based on the pension plan accounting information disclosed in the footnotes to the companies' Form 10-K annual reports for the 2014 fiscal year and for previous fiscal years. These figures represent the GAAP accounting information that public companies are required to report under Financial Accounting Standards Board Accounting Standards Codification Subtopics 715-20, 715-30, and 715-60. In addition to providing the financial information on the funded status of their U.S. qualified pension plans, the footnotes may also include figures for the companies' nonqualified and foreign plans, both of which are often unfunded or subject to different funded standards from those for U.S. qualified pension plans. The information, data, and footnotes do not represent the funded status of the companies' U.S. qualified pension plans under ERISA.

### MMRS METHODOLOGY

MMRS has two components: volatility management and a capital protection strategy. These two components consist of numerous parameters that must be specified before running a backtested analysis.

The first element of MMRS is volatility management. Volatility management adjusts portfolio exposure between high-risk assets (equities) and low-risk assets (bonds and/or cash) in order to target a defined level of volatility. Given the asset allocation of the hypothetical portfolio based on the Milliman 100, our expected realized volatility is currently 7%. This number is lower than the volatility target in figure 7 because it includes the additional effect the capital protection strategy has on stabilizing portfolio return.

FIGURE 7: ALLOCATION BY ASSET CLASS VS. RISK TARGET



Whereas volatility management aims to maintain a stable level of portfolio risk, the capital protection strategy's main purpose is to hedge against losses. The capital protection strategy is directional and recognizes that the larger the loss the portfolio has experienced, the higher the sensitivity the plan sponsor is to further losses. Therefore, in periods of sustained equity losses, the capital protection strategy decreases a portfolio's exposure to further declines in the market. In periods of high positive returns, MMRS allocates excess cash back into equities.

The capital protection strategy relies on the sale of futures contracts to replicate portfolio performance. To implement both components of MMRS, the Milliman 100 with MMRS includes a futures overlay (in addition to static allocations to the underlying investment holdings).

In an effort to maximize transparency and reliability, the hypothetical portfolio based on the Milliman 100 with MMRS uses the most liquid exchange-traded hedge assets. Trades are assumed to occur once per day, at end-of-day prices. Futures contracts on the S&P 500, Russell 2000, MSCI Emerging Markets, and MSCI EAFE indices are modeled. The number of futures contracts traded each day in the analysis is based solely on the output of the MMRS algorithm, and pre-specified trading thresholds. The payoffs for each futures contract are calculated based on index returns, interest rates, and the futures multipliers. The analysis assumes that all cash held to support the margin for futures contracts earns interest based on the shortest interest rate input into the model. An additional fee of 25 basis points is taken out of the hypothetical portfolio to simulate the MMRS fee charged by Milliman to implement the strategy.

The results discussed in this paper are based on hypothetical indexes and trading. Hypothetical results have certain inherent limitations. Unlike the results shown in an actual performance record, these

---

results do NOT represent actual trading. Also, because these trades have not actually been executed, these results may have under-or-over compensated for the impact, if any, of certain market factors, such as lack of liquidity. Simulated or hypothetical trading programs in general are also subject to the fact that they are designed with the benefit of hindsight. No representation is being made that any account will or is likely to achieve profits or losses similar to these being shown.



# Creating transformational improvement in the retirement savings industry.

Milliman Financial Risk Management LLC is a global leader in financial risk management to the retirement savings industry. Milliman FRM provides investment advisory, hedging, and consulting services on over \$190 billion in global assets (as of July 31, 2015). Established in 1998, the practice includes over 130 professionals operating from three trading platforms around the world (Chicago, London, and Sydney). Milliman FRM is a subsidiary of Milliman, Inc.

Milliman, Inc. (Milliman) is one of the world's largest independent actuarial and consulting firms. Founded in Seattle in 1947, Milliman has 55 offices in key locations worldwide that are home to over 2,600 professionals, including more than 1,300 qualified consultants and actuaries.

for more information:

[MILLIMAN.COM/FRM](http://MILLIMAN.COM/FRM)  
+1 855 645 5462

The information, products, or services described or referenced herein are intended to be for informational purposes only. This material is not intended to be a recommendation, offer, solicitation or advertisement to buy or sell any securities, securities related product or service, or investment strategy, nor is it intended to be to be relied upon as a forecast, research or investment advice.

The products or services described or referenced herein may not be suitable or appropriate for the recipient. Many of the products and services described or referenced herein involve significant risks, and the recipient should not make any decision or enter into any transaction unless the recipient has fully understood all such risks and has independently determined that such decisions or transactions are appropriate for the recipient. Investment involves risks. Any discussion of risks contained herein with respect to any product or service should not be considered to be a disclosure of all risks or a complete discussion of the risks involved. Investing in foreign securities is subject to greater risks including: currency fluctuation, economic conditions, and different governmental and accounting standards. 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 also risks associated with investing in fixed income securities, including interest rate risk, and credit risk.

The recipient should not construe any of the material contained herein as investment, hedging, trading, legal, regulatory, tax, accounting or other advice. The recipient should not act on any information in this document without consulting its investment, hedging, trading, legal, regulatory, tax, accounting and other advisors. Information herein has been obtained from sources we believe to be reliable but neither Milliman Financial Risk Management LLC ("Milliman FRM") nor its parents, subsidiaries or affiliates warrant its completeness or accuracy. No responsibility can be accepted for errors of facts obtained from third parties.

Past performance is not indicative of future results. Index performance information is for illustrative purposes only, and does not represent the performance of any actual investment or portfolio, and should not be viewed as a recommendation to buy/sell. It is not possible to invest directly in an index. Any hypothetical, backtested data illustrated herein is for illustrative purposes only, and is not representative of any investment or product. **RESULTS BASED ON SIMULATED OR HYPOTHETICAL PERFORMANCE RESULTS HAVE CERTAIN INHERENT LIMITATIONS. UNLIKE THE RESULTS SHOWN IN AN ACTUAL PERFORMANCE RECORD, THESE RESULTS DO NOT REPRESENT ACTUAL TRADING. ALSO, BECAUSE THESE TRADES HAVE NOT ACTUALLY BEEN EXECUTED, THESE RESULTS MAY HAVE UNDER-OR OVER-COMPENSATED FOR THE IMPACT, IF ANY, OF CERTAIN MARKET FACTORS, SUCH AS LACK OF LIQUIDITY. SIMULATED OR HYPOTHETICAL TRADING PROGRAMS IN GENERAL ARE ALSO SUBJECT TO THE FACT THAT THEY ARE DESIGNED WITH THE BENEFIT OF HINDSIGHT. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THESE BEING SHOWN.**

For any hypothetical simulations illustrated, Milliman FRM does not manage, control or influence the investment decisions in the underlying account. The underlying accounts in hypothetical simulations use historically reported returns of widely known indices. In certain cases where live index history is unavailable, the index methodology provided by the index may be used to extend return history. To the extent the index providers have included fees and expenses in their returns, this information will be reflected in the hypothetical performance. Milliman FRM does not intend the use of such indices to be construed as investment advice or a recommendation to invest in similar accounts.

The materials in this document represent the opinion of the authors at the time of authorship; they may change, and are not representative of the views of Milliman FRM or its parents, subsidiaries, or affiliates. Milliman FRM does not certify the information, nor does it guarantee the accuracy and completeness of such information. Use of such information is voluntary and should not be relied upon unless an independent review of its accuracy and completeness has been performed. Materials may not be reproduced without the express consent of Milliman FRM. Milliman Financial Risk Management LLC is an SEC-registered investment advisor and subsidiary of Milliman, Inc.

## Chicago

71 South Wacker Drive  
Chicago, IL 60606  
+1 855 645 5462

## London

11 Old Jewry  
London  
EC2R 8DU  
UK  
+ 44 0 20 7847 1557

## Sydney

32 Walker Street  
North Sydney, NSW 2060  
Australia  
+ 61 0 2 8090 9100