MILLIMAN ANALYSIS: CORPORATE PENSION ASSET PORTFOLIO FOR MILLIMAN PFI WITH MMRS RETURNED 2.0% IN Q4

FOURTH QUARTER 2015 REALIZED VOLATILITY WAS 4.9% FOR THE MILLIMAN PFI AND 4.5% FOR THE PFI WITH MMRS

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INTRODUCTION

MILLIMAN PFI 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 (PFI) returns since its inception in 2000. The results of the study are meant to illustrate MMRS's potential to help pension plans achieve their portfolio risk objectives—and in a market plagued with uncertainty, it seems as though it could not have come at a better time.

MMRS is a unique risk management solution that seeks to stabilize the ever-present systematic market risk faced by pension plans with an equity component. Systematic risk is inherent in the very structure of the market. MMRS explicitly combats unhealthy swings in portfolio value through a combination of volatility management and a capital protection strategy. Unlike a plan's investment policy, it is agile and dynamic by nature, reacting to news on a daily, rather than a monthly, quarterly, or even yearly, basis.

Chinese economic contractions, oil gluts, and Federal Reserve rate increases are all recent economic problems that have put stress on financial markets, and they have unfolded quickly. Pension plans may have long-term investment horizons, but benefit payments don't go down just because assets do, and contributions are dependent upon short-term market fluctuations. MMRS allows a pension plan with an equity component to maintain its long-term investment policy, and seeks to provide protection only when underlying market risk, or volatility, is above the plan's risk objective.

The cumulative benefit of MMRS is apparent over the 16 years of data analyzed. This update, however, focuses on the fourth quarter of 2015. For more information on MMRS, we recommend reading our introduction to the PFI with MMRS.[1] The 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, MMRS can be applied to the portfolio by buying and selling futures contracts on that mixture of indexes. These futures contracts are inexpensive, transparent, and highly liquid.

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 PFI is designed to be a barometer of the funded ratio of the 100 largest corporate pension plans in the United States. 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 obligations, while a ratio of less than one suggests that the assets fall short of being able to meet future liabilities.

The PFI is calculated by creating a hypothetical portfolio of the pensions' assets. The data used to create the PFI come from 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 PFI are rebalanced to reflect the actual asset class weights in the latest annual reports. In the interim, the PFI is updated monthly based on the returns of the respective underlying market indexes.

Through this simple, rules-based approach, the PFI 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. See the appendix at the end of the Milliman 2015 Pension Funding Study[2] for more details on the methodology.

The PFI 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 indexes. Before applying MMRS, the difference between the monthly versus daily return streams was approximately one basis point annually.

FOURTH QUARTER 2015 IN RETROSPECT

Bouncing back from a tumultuous Q3, corporate pension assets in the PFI made gains of approximately 2.2%, and the PFI with MMRS was not far behind. Heightened volatility equated to heightened protection—and thus higher effective cash levels—through much of October, drawing performance down, but only slightly. Assets in the PFI with MMRS returned 2.0% for the quarter, capturing about 90% of upside return coming off the Q3 market correction. These percentage returns translated to $14.4 billion in gains for the actual PFI, and $18.9 billion in gains for the PFI with MMRS.

The seemingly disparate performance when looking at percentage return versus actual dollar returns is an important concept, especially in risk management. Because the study looks at data from the previous 16 years, there is a wide separation between the

1 Burden, T.A. & Morin, M. (January 4, 2016). Milliman Q2-2015 Pension Study: Applying the Milliman Managed Risk Strategy. Available at http://www.milliman.com/MMRSPensionQ2.

2 Ehrhardt, J., Perry, A., & Wadia, Z. (April 2015). Milliman 2015 Pension Funding Study. Available at http://us.milliman.com/PFS/.

FIGURE 1: FINAL VALUES OF PFI AS OF DEC-2015 (FIGURES IN $ BILLIONS)

	Portfolio		
	PFI Actual	PFI w/MMRS	Difference
Market Value of Assets	$1,410	$1,756	$346
Projected Benefit Obligation	$1,705	$1,705	$0
Funded Status	-$294	$52	$346
Funded Percentage	82.7%	103.0%	20.3%
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.

underlying assets of the actual PFI and the theoretical PFI that has been employing MMRS. In other words, a 1.0% return on $10 is still more dollar earnings than a 2.0% return on $1. Coming off of both the bursting of the dot-com bubble and the 2008 financial crisis, the PFI with MMRS simply had more assets to grow in the recovery. It still does. Even the most knowledgeable investor cannot predict the next crisis, but MMRS equips pension plans with a tool that helps both predict and manage its daily risk. In dollar terms, the value of the equity risk management MMRS provided over the years of the study has been $346 billion.

On the liability side, projected benefit obligations decreased by $3 billion for the quarter. This drop was largely attributable to the Federal Reserve's December announcement of its decision "to raise the target range for the federal funds rate to ¼ to ½ percent" (12/16 FOMC Minutes).

Rising rates and positive asset returns together caused an approximate $17 billion dollar increase in the actual PFI's funded status, versus a $22 billion increase in the PFI with MMRS's funded status.

Good news on the balance sheet translated into a rosier risk-outlook as well. Volatility came down from the high it reached in September as markets recovered. In response, the PFI with MMRS gradually removed its hedge position over the course of the quarter.

MMRS is meant to be a hedge where traditional diversification fails. Pension plans, because of their month-to-month benefit outflows and quarterly contribution requirements, are particularly susceptible to negative market fluctuations affecting their long-term funded status. This problem is illustrated in Figures 1 and 2. A $346 billion dollar difference in funded status, a 1.1% increase in IRR, and a >20% difference in funded ratios are all the product of MMRS's volatility management and capital protection strategy working to protect the portfolio against the full impact of crisis markets.

MMRS PERFORMANCE

Performance of assets

Domestic equities drove the growth in plan assets underlying the PFI this quarter. Investors seemed to shake off, at least temporarily, the initial shock of a Chinese economic slowdown. Even with precariously low oil prices, a strengthening U.S. dollar threatening demand for exports, and a near-certain federal funds rate increase, the S&P 500 experienced a total return of 8.4% during October and 7.03% for the quarter. It remains to be seen if the third quarter of 2015 portends the gradual tilt of the world's financial markets into choppy waters. However, what is certain is that in this past quarter, investors in domestic equities seemed optimistic once again.

FIGURE 2: CUMULATIVE DIFFERENCE BETWEEN PFI WITH AND WITHOUT MMRS

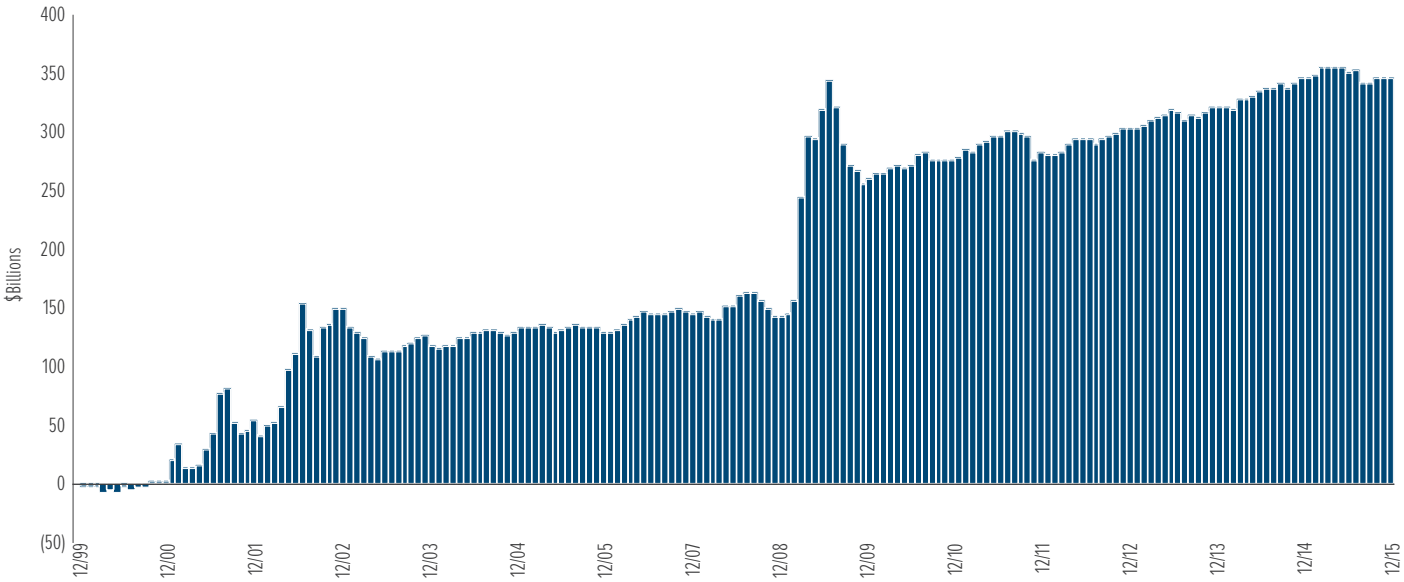
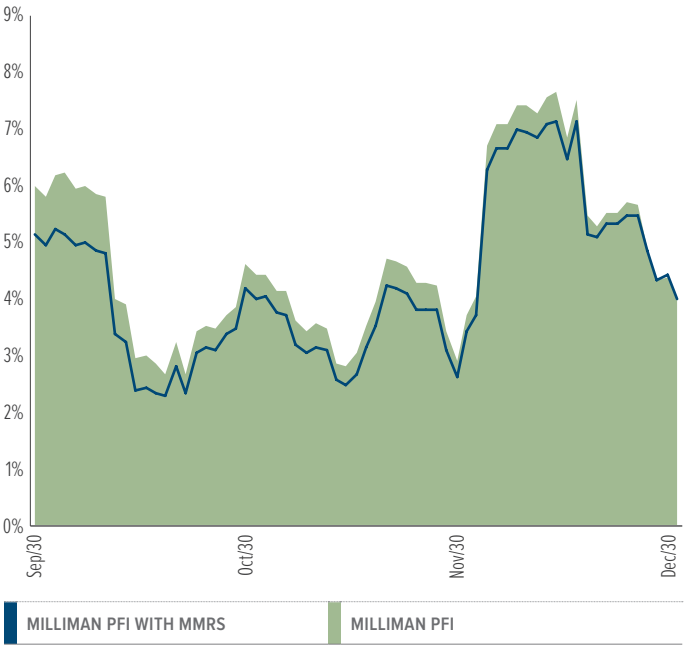


FIGURE 3: Q4 VOLATILITY COMPARISON



The story is a bit more unclear outside the United States. Q4 offered international equities a season of relief after a tempestuous year. The MSCI All-Cap World excluding the U.S. ended up 4.82%[3] for the quarter. Differing monetary policies between the Federal Reserve and the European Central Bank seemed to spur some of this growth. With tightening U.S. monetary policy, there is a possibility that the euro will become less expensive relative to the dollar. This could hurt U.S. exports to Europe but it could be a boon for European exports to the U.S.

Bonds, unlike equities, were down this quarter. With a delayed Federal Reserve rate increase and the initial panic of a financial sell-off behind them, investors were once more peeking out from their low-risk, quality assets. Expectations for a jump in December's interest rates fueled the tapered demand for fixed income assets. Why lock in a low interest rate now, when an interest rate increase seems imminent? This drop began in November, and December saw U.S. bonds fall even further. Thus, Barclay's Aggregate Bond Index fell by -0.32% in December and -0.56% for the quarter.

Performance of MMRS

MMRS entered the fourth quarter of 2015 with a 5% reduction of the index's equity holdings in place. Back in Q3, volatility of the underlying funds for the PFI with MMRS had spiked. Portfolio risk, as measured by volatility, had increased sixfold, from a touch above 2% to 12%. The risk faced by the underlying funds in the PFI did not abate overnight. It decreased gradually over Q4, and as it did, the MMRS overlay allowed the equity allocation to grow back to the investment policy targets. Quarterly realized volatility for the PFI was 4.9%, versus 4.5% for the PFI with MMRS. Realized volatility of both the actual PFI and the PFI with MMRS can be seen in Figure 3.

Figure 3 encapsulates the level of worry that may have been felt by pension plans over the quarter. That is why MMRS employs equity volatility as a key metric in evaluating and achieving a plan's risk objectives. In the beginning of October, plans were under attack on dual fronts. Assets were down and projected liabilities were up. Coming off of a market correction, volatility dissipated by late October, and MMRS had increased the portfolio's exposure to equity risk once again. By December, investors once more felt jittery about the state of the world's economy, but it remained to be seen whether or not those fears would escalate.

FED FUNDS RATE INCREASE

As Q4 drew to a close, it seemed as though the buzz around every plan sponsor's water cooler focused on those three familiar words: "Fed funds rate." The timing, the magnitude, the impact on the dollar—these were and are uncertainties open to speculation and debate. Pre-2008 and post-2008 feel like very different worlds, and one of the driving factors of that has been the Federal Reserve's highly accommodative monetary policy.

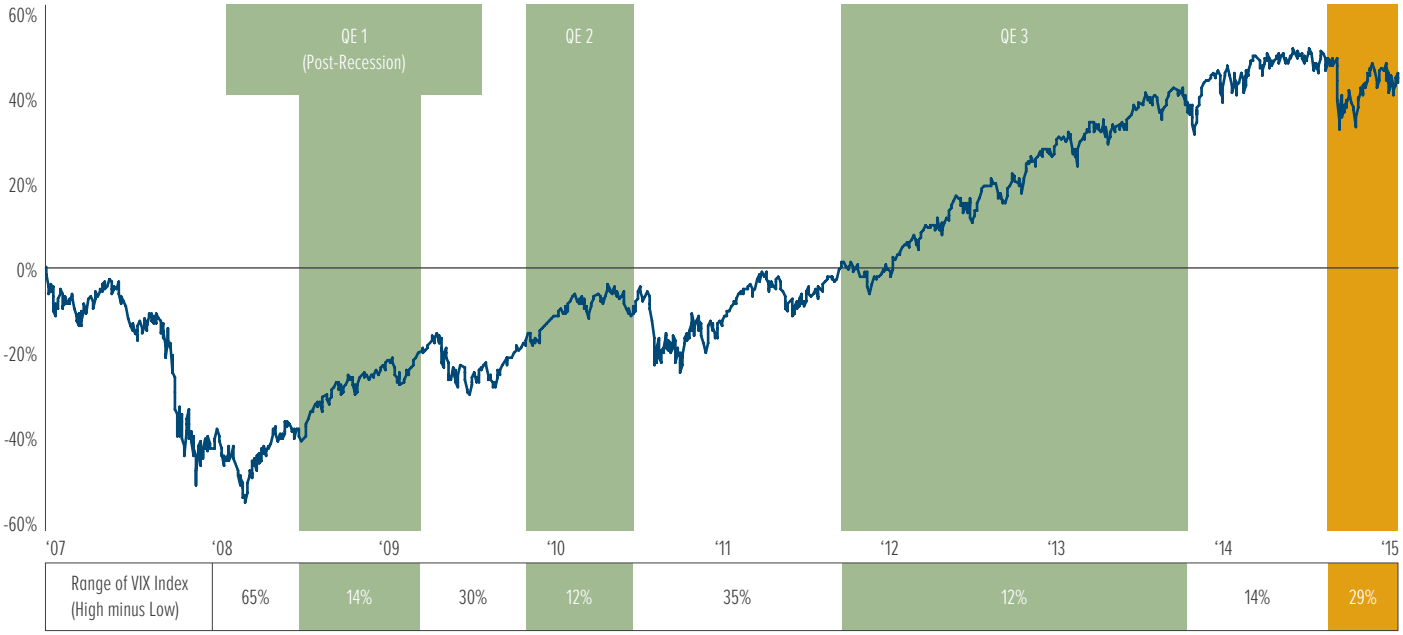
Easy monetary policy and Central Banks' preemptive strikes to perceived financial turmoil have had multifaceted impacts on investor behavior. We've seen huge growth in equity markets during quantitative easing (QE), but one topic that remains largely undiscussed is how Central Banks have been muting market volatility as well. Figure 4 captures the entire story in miniature. The graph takes a look at key actions by the Federal Reserve and their relationship with both risk and reward in U.S. equity markets since the 2008 financial crisis.

Equity markets churned steadily higher as the Federal Reserve pumped trillions of dollars into the banking system via QE. But in addition to supporting high equity valuations, the Fed's actions had a huge impact on equity volatility. Notice the drastic differences in volatility between periods with and without quantitative easing. The VIX Index had a high-to-low range of 14% during QE1, but a range of 30% afterwards. During QE2, markets rose and volatility stayed within a 12% range. But when QE2 stopped, equity volatility went from a low of 13% to a high of 48%.

Push into 2014 and 2015, and one can see another uptick in volatility, especially in the last five months of this year (highlighted in red).This coincides with when investors truly began to expect a rate increase, and unlike previous announcements, the July FOMC meeting did not portend another wave of fresh green to stimulate the economy. On July 29, 2015, the New York Times succinctly described this sentiment by stating, "Surveys of economic forecasters show that most expect the Fed to start raising interest rates at their September meeting" (Applebaum).

3 Reported in local currency.

FIGURE 4: FEDERAL RESERVE ACTIONS, VOLATILITY, AND THE RUSSELL 3000



Investors benefit from stability in equity markets, and Figure 4 shows how Federal Reserve policy has served as a source of volatility management for the latest bull market. However, quantitative easing alone does not explain all equity trends. There are significant macroeconomic problems underlying the latest drop in August and September of 2015. This is where MMRS's volatility management is more direct and more reliable.

Without the Fed stepping in, equity markets tend to fall with increased volatility on bad macroeconomic news. After some time, the economy stabilizes, volatility subsides, and equity markets rise again. A risk management approach such as that used by MMRS performs well in this environment, seeing less participation in the high volatility falling market and more participation as the market rises with lower volatility. Having both MMRS and the Federal Reserve working to mitigate volatility is a bit like having too many cooks in the kitchen. When central banks step in at the first sign of market weakness and shock the system out of its pattern, this tends to obfuscate the relationship between market movements and market risk.

Recently, we've seen investors essentially price in the federal intervention to which they have grown accustomed. Despite no macroeconomic improvements, markets rally behind the promises of central banks. This was the experience after August and September. Placated by a delay in monetary tightening in the United States, an influx of cash in China, and a promise to continue easy monetary policy in Europe, equity markets promptly shot back up over October. This phenomenon tends to cause drag for the portfolio that employs an equity risk management strategy like MMRS because it means the market is rising sharply even though volatility is high.

As seen in this past quarter, although the PFI with MMRS had fully allocated back into equities by quarter-end, a heightened hedge position in October and November caused a 20 basis point drag. However, the lesson to be garnered from both Figure 4 and 2016 is that the market stability that comes with Fed promises ends with Fed promises. Given the Federal Reserve's December announcement to end its seven-year-long zero interest rate policy, it is possible that markets will revert to historical norms, where market stabilization once again stems from organic economic factors.

As the Fed looks to continue its policy normalization in 2016 and remove itself from the role of volatility manager, pensions will continue to face the risks and challenges they always have: rising correlation of assets and paying benefits in down markets. MMRS helps address both. The risk mitigation from MMRS persists where traditional diversification falls short. Moreover, MMRS's dynamic hedge does not leave a plan overly exposed to losses when market risk increases. In 2016, plan sponsors with equity assets must ask themselves: If their equity risk increases, will the Federal Reserve be there?

MILLIMAN PFI METHODOLOGY—TAKEN FROM MILLIMAN 2015 PENSION FUNDING STUDY

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 PFI, our expected realized volatility is currently 7%. This number is lower than the volatility target in figure 7 because it includes the additional effect that the capital protection strategy has on stabilizing portfolio return.

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 plan sponsor's sensitivity 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 managed risk fund 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 PFI 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 indexes 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 overcompensated 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.

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