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Executive Summary

The steady reduction in bond yields throughout 2007 and 2008 pushed up the value of fixed income assets and proved to be a timely and much-needed boon, helping to offset losses in other parts of investors' portfolios. We are now four years on from that time, and although economic conditions remain difficult to forecast, it is possible that these capital gains will at some point be undone. When the world economy picks up speed, bond yields are likely to be driven back up as central banks increase bank funding rates and money flows out of government bonds and back into risky assets. Given the difficulty of predicting the timing of these rate rises, the lack of protection that is likely to be provided by other asset classes, and the asymmetric nature of fixed income returns at very low interest rates, we believe that now is the time to have a cold, hard look at how portfolios might be protected from this risk.

Rather than advocating a wholesale exit from fixed income assets, which would be expensive and would deprive investors of the benefits of that asset class, we describe three broad approaches - tail risk elimination, diversification, and neutralization - which can be used to shield portfolios against the risk of rising rates with minimal changes to the overall yield or risk position. The tail risk elimination and neutralization strategies focus on derivatives to protect against rising interest rates, while the diversification strategy relies upon repositioning investors' fixed income portfolios. Protection from losses in a non-disruptive way should not be seen as a bet in favor of rising rates; instead, it should be considered as a way to remove the falling rates bet that is inherent in all fixed income assets. Ideally, in the current environment, one should seek a portfolio that is neutral toward, or even benefits from, a rise in rates.

At the same time, we appreciate that many defined benefit pension investors value duration, as it aligns the interest rate risk of their assets and their liabilities, thereby stabilizing the funding position. Over the long term, many of these plans are attempting to increase, rather than reduce, their exposure to interest rates. We do not deny the logic of this course of action, and we would emphasize that rising rates protection should be seen as a tactical response to the current market environment, rather than a permanent deviation from existing allocations. This tactical shift can be seen as an adjustment to (rather than a replacement for) any strategic developments, and thus can occur at the same time as a long-term accumulation of duration by pension plans.

By considering the likely performance of a variety of asset types in a rising rate environment and how derivatives may be used to selectively manage interest rate risk, we are able to offer some practical asset allocation advice as to how decision-makers can use one or more of these strategies to mitigate the possibility of capital losses from rate rises, while leaving the remainder of the portfolio's characteristics largely unchanged.

Rate Rise Remedies: Three Approaches to Managing Interest Rate Risk While Protecting Return & Diversification Objectives

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* ISSG is a part of The Bank of New York Mellon,
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Fixed income: Like Cash, But With Tail Risk?

As the financial crisis took hold from 2007- 2009, the world's central banks, aware of the dire consequences of a contraction in credit to the real economy, dramatically lowered interest rates and supplied the financial system with more liquidity than it knew how to deal with. Simultaneously, investors were discovering that the risk levels of their portfolios were far higher than they had presumed, and that expectations of future returns from risky investments were shrinking sharply, encouraging them to shift into more conservative fixed income assets. This combination of circumstances led to bond yields dropping across the yield curve. This effect was less dramatic than the plummeting equity markets of the time, but also less transient. While equity markets have regained much or all of their losses, safe bond yields still seem to be on a downward path.

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Although bond assets' remarkable gains gave investors a badly needed windfall during the crisis, it is difficult now to see much value in traditional fixed income securities. The potential capital gains from "safe" fixed income assets, those that have negligible perceived default risk and low credit spreads, look undesirably asymmetric. There is great resistance to yields dropping below zero, meaning that investors can expect very limited gains should yields manage to shuffle any lower; whereas reversion of yields toward their historical levels would cause heavy losses. While the risk profile of the asset class has deteriorated because of this asymmetry of capital returns, the low yield also means that bonds are providing little income. Effectively, investors are being asked to take much more risk for much less return.

Exhibit 1 - Long-term Bond Yields Have Rarely Been Lower



Source: Global Financial Data, ISSG.

Though fixed income may currently seem unattractive on a risk/return basis, it continues to bring three intrinsic benefits to a diversified portfolio, which cannot be fully captured in terms of risk and reward.

Fixed Income Is Still Your Friend; But Duration Risk Is Not

If yields are low, capital gains unlikely and capital losses more possible than ever, it raises the question as to whether investors should hold onto fixed income assets at all. Investors who believe that equity or other assets offer better value – for a variety of potential reasons – may be tempted to sell their fixed income holdings and re-allocate. Should their views prove correct, they will stand to benefit from their boldness.

In reality, though, there are a number of obstacles to making such an asset allocation shift. It is very difficult to make accurate long-term market predictions, and many investors may not have sufficient confidence in their forecasting ability to do so, preferring instead to hold something closer to the market portfolio. Alongside this, the transaction costs from such a shift can be significant, and the pay-off must be seen to justify these. Furthermore, many organizations may not be culturally or operationally equipped to make such a significant change in their asset allocations. This is likely to be a particular issue for pension plans, which often have inflexible “policy” buckets or defined risk limits, and which may need to seek approval from regulators or sponsors before making major changes. Apart from these factors, we would argue that there are strong reasons to hold the fixed income asset class, even in a low yield environment.

Fixed income has some intrinsic benefits

Though fixed income may currently seem unattractive on a risk/return basis, it continues to bring three intrinsic benefits to a diversified portfolio, which cannot be fully captured in terms of risk and reward.

- **Liquidity:** The relative price stability and unparalleled liquidity of government bonds mean that they can be reliably sold at reasonable value to meet both expected and unexpected cash-flow needs.
- **Risk reduction:** Developed market fixed income, particularly government bonds, tend to benefit from a “flight to quality” effect during crises, meaning that their price movements become inversely correlated to risk assets. They therefore provide risk diversification to a portfolio of risky assets at the time when it is most needed.
- **Predictability:** The pre-defined cash flows available from bond assets are useful for any investors with complex cash-flow requirements (such as pension plans). From a Liability-Driven Investing (LDI) perspective, having pre-defined cash flows to meet pre-defined liabilities stabilizes a defined benefit plans’ aggregate funding position.

In light of these benefits, as well as the difficulty of correctly forecasting market direction and enacting a successful asset allocation shift, we consider a more measured approach.

We suggest that investors may alter their portfolios so that they retain the desirable aspects of owning fixed income assets but protect against the asymmetry of capital returns and the possibility of significant losses if interest rates revert to their historical level.

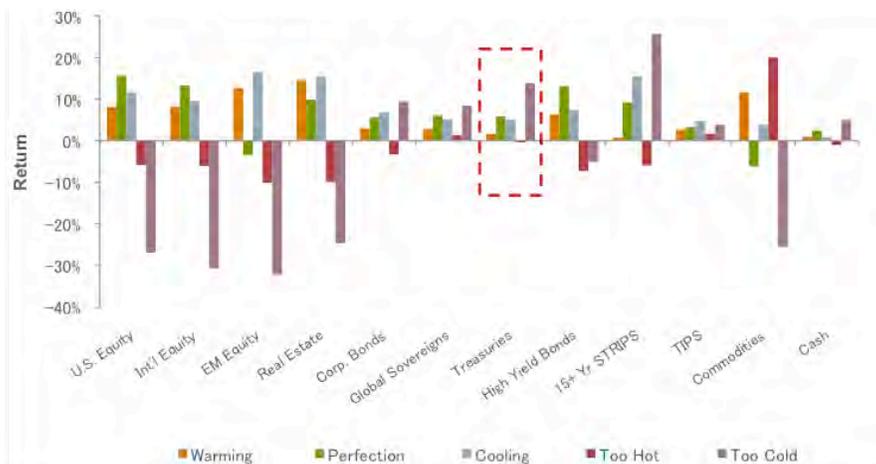
Keep your fixed income assets, but not your interest rate risk

We suggest that investors may alter their portfolios so that they retain the desirable aspects of owning fixed income assets but protect against the asymmetry of capital returns and the possibility of significant losses if interest rates revert to their historical level. We aim to do this in minimally disruptive ways that 1) are mindful of transaction costs; 2) do not significantly change the portfolio's other risk characteristics; and 3) do not impair the portfolio's yield.

We would emphasize that these portfolio changes are not placing a bet on rising interest rates. At the moment, any bond assets investors hold have an inherent risk exposure such that they benefit from falling rates, and suffer from rising rates. We suggest that there has rarely been a worse time to own this risk exposure, and that if it can be eliminated in a painless way, investors should seriously consider doing so.

Our earlier research on regime-based asset allocation examined how changes in inflation and growth expectations affect asset prices.¹ We categorized different growth and inflation conditions along a temperature scale as described in Exhibit 2. U.S. Treasuries are one of the few assets that perform well in a "too cold" environment, marked by falling inflation and rapidly falling growth.

Exhibit 2: Asset Returns by Regime (annualized, real)
U.S. Treasuries Are One of the Few Assets to Perform Well in a "Too Cold" Environment



The regimes described above refer to different states of the economy, characterized by different combinations of economic growth and inflation. More details of these regimes are shown in Exhibit 7.

Source: ISSG, time period covered 4/30/73 - 7/31/12

Don't Rely on Hope

We believe investors should avoid depending exclusively on active management to prevent losses if interest rates rise. One reason is that it is extremely difficult to accurately time interest rate rises. Many managers may avoid this kind of view entirely, instead preferring to generate performance by taking relative value positions elsewhere in the portfolio. Another impediment for active managers is the benchmarking of mandates to a bond index, with (in

¹ For more information on the ISSG's work on regime-based asset allocation, please see "Great Expectations: Regime-Based Asset Allocation Seeks Higher Return, Lower Drawdowns," BNY Mellon Investment Strategy and Solutions Group, October 2011.

Although active management cannot be relied upon as a way to protect against interest rate rises, some fixed income sectors have shown a long-term resilience to interest rate increases.

many cases) duration limits that prevent excessive deviations. Although managers may reduce duration relative to the index, both the index and (to a slightly lesser extent) the portfolio will lose money if interest rates rise.

However, although active management cannot be relied upon as a way to protect against interest rate rises, some fixed income sectors have shown a long-term resilience to interest rate increases. Exhibit 3 shows the effective duration of various fixed income sectors, in relation to U.S. Treasury yields. Here we use effective duration since it is an empirical observation of the relationship between yields and bond prices. It therefore takes into account all features that affect a bond's sensitivity to yield changes. For example, in recent history, high yield bond credit spreads have increased as government bond yields have declined. These credit spread increases overwhelmed the government bond yield decreases, meaning that the overall yield of these bonds rose. High yield bonds therefore have a negative effective duration – a negative correlation between interest rates and their actual yields. This important effect is not captured by modified duration and so in this sense, effective duration is superior to modified duration for the analysis of risky assets.

Below we see that U.S. Treasuries and investment grade credit have a fairly static positive effective duration, and are therefore likely to lose money if interest rates rise. However, emerging market bonds (despite their high modified duration) have a low effective duration, and over the financial crisis period, high yield bonds have had a strongly negative effective duration. We will discuss how investors can take advantage of these discrepancies in order to optimally protect against interest rate rises. The effective durations in Exhibit 3 are measured during an unusual period in the capital markets. However, for all the alternative fixed income sectors with the exception of MBS, there are principled reasons to believe they will have lower effective durations due to: 1) investor base (e.g., municipal bonds); 2) structural features (TIPS); or 3) partial anti-correlation with real rates (credit sectors). For municipal MBS, we think current valuations and liquidity make them candidates for at least consideration in a rate-rise protected portfolio.

Exhibit 3 - Effective Duration May Be Very Different From Modified Duration

Asset Class	Modified Duration	Eff. Duration – Long-term	Eff. Duration – Past 1 Year	Eff. Duration – Past 3 Years	Eff. Duration – Past 5 Years
US Treasuries	5.63	4.33	6.94	6.19	5.61
US Investment Grade	6.95	4.24	3.44	2.9	2.57
US ABS	3.32	2.25	3.03	1.48	0.63
US Municipal Bonds	4.98	3.34	4.87	2.78	1.61
US MBS	3.38	3.21	2.66	2.68	2.62
EM Sovereign Bonds	7.21	2.46	0.98	1.79	1.36
TIPS	8.51	4.40	4.94	4.82	4.71
US High Yield	3.97	0.12	-5.33	-4.65	-4.65

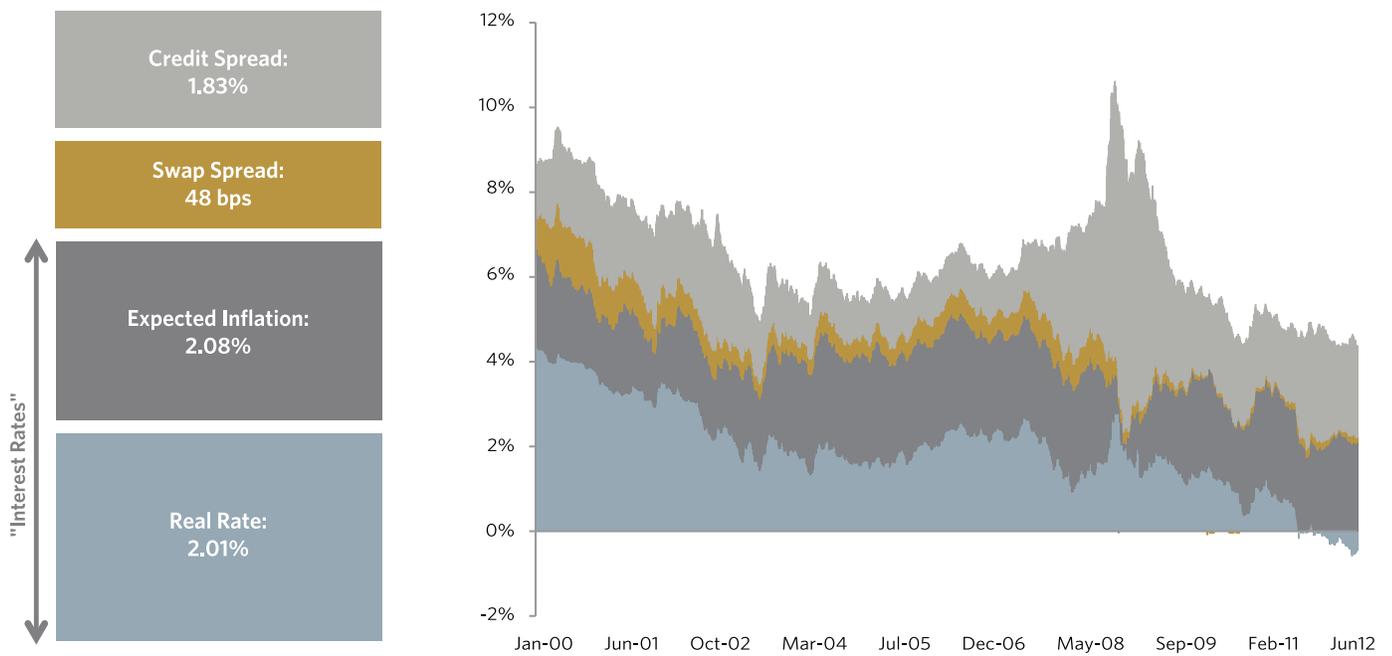
Source: Bloomberg, Barclay's and ISSG

Durations calculated as of 31-May-2012

Anatomy of an Interest Rate

Analyzing bond spreads usually involves breaking down the total yield of a bond into its component parts: 1) the real rate (the compensation lenders need for their deferred consumption); 2) inflation compensation (for the loss of spending power over the lending period); 3) swap spread (the difference between government yields and market yields); and 4) credit spread (to compensate for the potential loss of principal in a risky investment). Not all bonds are exposed to all of these risks; developed world government bonds are usually considered to have no credit risk, whereas TIPS and other inflation-protected bonds have no expected inflation spread. The object of our exercise is to mitigate the risk arising from increases in the combination of expected inflation and real rates, which is what we refer to as “interest rates,” as shown in Exhibit 4. It is not our intention to imply that investors protect themselves against movements in either swap spreads or credit spreads, though we do propose that investors take advantage of the non-correlated nature of the components of a bond’s yield in order to obtain some measure of interest rate protection.

Exhibit 4 - The Decline and Fall of Bond Yield Components



Based on generic Bloomberg 10-year data for U.S. fixed income markets. The yield components shown on the left-hand side are an average of all data used.

Source: ISSG, Bloomberg

Protecting Against Rising Rates

Your strategy will depend upon your interest rate outlook

We believe there are two main approaches investors can take to protect themselves against interest rate rises, while retaining the benefits of their fixed income assets. We refer to these methods as **tail risk elimination** and **diversification**. Of these two options, tail risk elimination is less thorough but also less difficult to implement. In our view, it is most suitable for investors who believe that a low rate environment is a transitory phenomenon; it can be thought of as the “lite” option for rate rise protection. Diversification, by contrast, requires significant asset allocation changes, but carries the advantages of being more effective and imposing no reduction in the portfolio’s yield potential. If investors believe that interest rates are set to stay low for some time, then we think they should consider the model portfolio we present in the diversification section, since compared to a traditional fixed income asset allocation, it offers significantly superior risk and return characteristics. We also give honorable mention to a third option – **neutralization** – which requires extensive use of interest rate swaps and is therefore most suitable for investors who are already set up to use derivatives on a large scale, such as those with a pre-existing LDI program. To summarize the three options:

- Tail risk elimination: A simple and unobtrusive solution, whereby investors use options to protect themselves against falls in the value of their fixed income assets.
- Diversification: Investors make sector shifts within their fixed income assets, moving away from interest rate-sensitive assets and towards interest rate-insensitive assets.
- Neutralization: Investors keep their existing asset allocation largely unchanged, but use a full-scale derivatives program to thoroughly insulate their assets from interest rate rises.

The least obtrusive approach, tail risk elimination means using options or programs of options to protect against a fall in the value of a portfolio’s fixed income assets.

Tail Risk Elimination

The least obtrusive approach, tail risk elimination means using options or programs of options to protect against a fall in the value of a portfolio’s fixed income assets. This can potentially be done by a number of different instruments (including rate caplets and fixed income index options), but we have chosen to focus on swaptions, which are liquid and highly customizable. A swaption can be thought of as an option on the future direction of interest rates. The swaption required in this respect is a payer swaption, which gives the holder the right to pay a fixed rate of interest in exchange for receiving a floating rate.

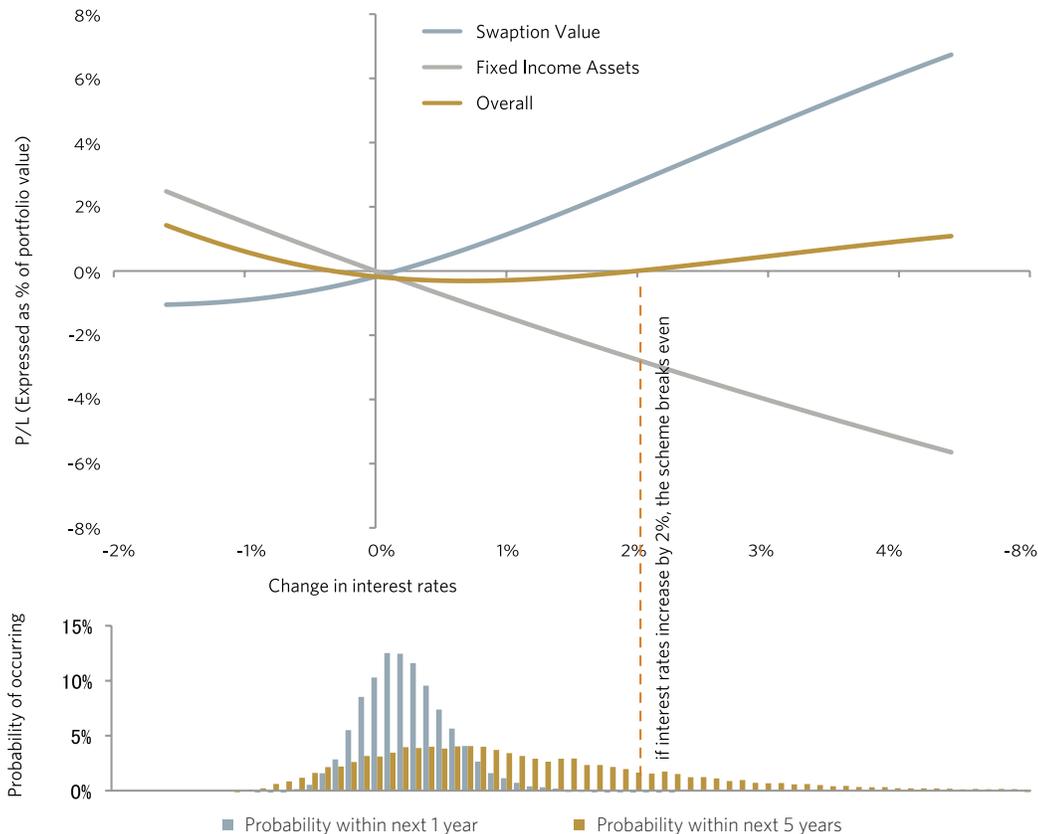
With tail risk elimination, the main trade-off is between the “moneyness” of the option and its cost. At-the-money options fully protect investors against interest rate rises, but are very expensive. Out-of-the-money options offer partial protection against interest rate rises and therefore involve sharing interest rate risk between the investor and the swaption counterparty, but are cheaper to purchase. Given that other assets in the investor’s portfolio

will likely experience a boost in value if interest rates rise, our view is that the option should be set some way out of the money.

The most effective implementation for this kind of strategy is as a series of options that are rolled when they expire, and therefore the cost of a tail risk elimination strategy should be seen as an ongoing reduction of portfolio yield, rather than a one-off cost. As an example, a swaption that offers an investors' fixed income assets² limited protection against interest rate rises of up to 2%, but offers protection on all increments above 2%, would decrease the yield of those fixed income assets by 78 basis points.³ For the average pension plan, which has 28% of its assets in fixed income, this would mean a reduction in total portfolio yield of 22 basis points.

Combining swaptions and fixed income assets can alter the profit and loss profile of the pension plan when interest rates change, as shown in Exhibit 5; with the histogram underneath showing a Monte Carlo-derived probability of interest rates at that level in either one or five years' time (we discuss this Monte Carlo method in more detail in the next section on diversification). The probability of interest rates having increased by 2% or more over the next five years is 20.4%; since the option expiry of the swaption is five years, and since the swaption strike is 2% higher than current interest rate levels, this means that there is a 20.4% chance that the option will expire in the money.

Exhibit 5 - The Pay-off Profile from Swaptions Can Be Attractive...



Source: ISSG, Bloomberg

² Assumes that investors hold fixed income assets in the following allocation: 72% Treasuries, 22% US Corporate bonds, 6% International Fixed Income, with resultant effective duration of 5.2 years

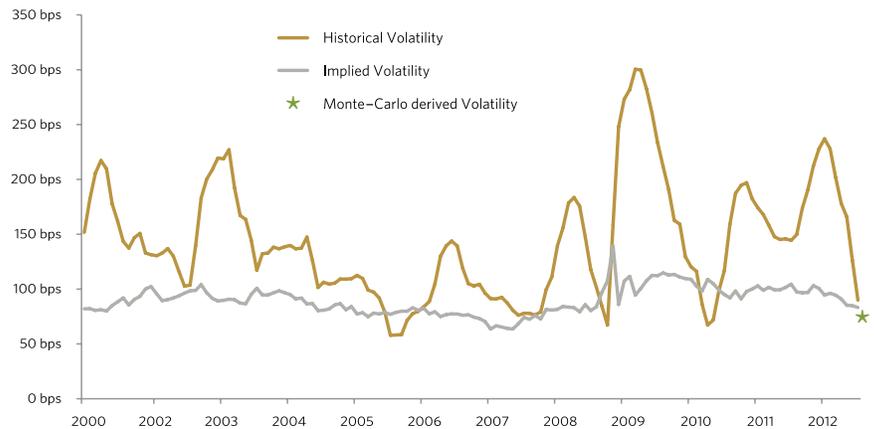
³ Analysis is based on a 5y10y USD payer swaption.

A general concern with options is that the volatility of the underlying asset implied by the market may be inconsistent with its actual volatility, making the option either too cheap or too expensive.

As can be seen in Exhibit 5, the further interest rates increase, the greater the effectiveness of the swaption in mitigating against or even benefitting from interest rate rises. Under a larger increase – say 3.5%, which would put interest rates at a level by no means inconsistent with their historical range – the swaption will turn an 18% fall in the value of the fixed income assets into a moderate gain. In our view, for investors who expect a short- or medium-term mean reversion of interest rates, this is an attractive pay-off profile that can be purchased at a moderate yield cost.

A general concern with options is that the volatility of the underlying asset implied by the market may be inconsistent with its actual volatility, making the option either too cheap or too expensive. Although it is difficult to have any ex-ante certainty on this issue, when initiating an option program, we think it makes sense to find a metric that provides some kind of insight as to whether this is the case. In Exhibit 6, we use two separate metrics: we compare the implied volatility to both the historical volatility of the underlying and to a volatility level derived from our Monte Carlo simulation. Though the results of this comparison are subject to some uncertainty, both of these metrics suggest that market implied volatility is at a reasonable level, and that the market is not adversely tilted against the swaption buyer.

Exhibit 6 - ... and They Are Roughly Fairly Priced



Source: ISSG, Bloomberg

Pros of tail risk elimination:

- Conceptually simple; cost and level of protection can be customized to investors' requirements.
- No re-allocation of assets needed, and the advantages of fixed income assets (e.g., diversification benefits) are not lost.

Cons of tail risk elimination:

- All else constant, reduces portfolio yield, as the option premiums must be paid.
- Depending on moneyness, does not prevent against all losses from rising interest rates.

- As with all derivatives, this is a non-traditional asset that may be unfamiliar to some investors and comes with some additional risks (e.g., counterparty) and monitoring requirements.

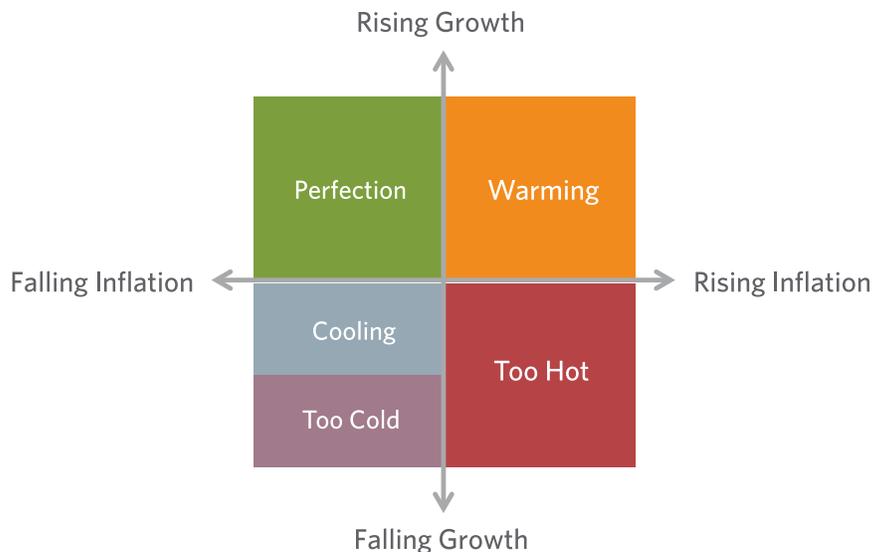
Diversification

The diversification approach is the most involved of the three solutions we discuss, and involves a partial or full re-allocation of the fixed income part of an investors' portfolio.

The diversification approach is the most involved of the three solutions we discuss, and involves a partial or full re-allocation of the fixed income part of an investors' portfolio. There are three main elements of this re-allocation: 1) lowering the effective and perhaps modified duration; 2) choosing fixed income sectors that offer a yield premium to compensate for the drop in yield from lowering duration; and 3) examining the diversification benefits from a particular mix of fixed income sectors to ensure that the remaining risks are of an acceptable level and nature. To examine the level and nature of any remaining risks we use the same Monte Carlo simulation methodology previously mentioned to evaluate the probability of future interest rate levels.

The simulation uses a Monte Carlo generator to create 20,000 five-year alternative futures to examine the potential outcomes of investing in a particular portfolio. The Monte Carlo generator uses our regime-based asset allocation analysis to create paths for interest rates, inflation, defaults and fixed income sector yield spreads. Exhibit 7 lays out the five regimes we use to describe changes in inflation and growth expectations. In our regime-based Monte Carlo simulation, each path is modeled as a set of transitions between those regimes. The transition probabilities are set such that lengths of regimes and sequencing between regimes are similar to what we have seen historically.

Exhibit 7 - Temperature Matrix for Macroeconomic Regimes



Source: ISSG

The primary advantage we gain by using our own regime-based generator comes when we examine the drivers of extreme outcomes, such as 5% or 10% negative tails.

The primary advantage we gain by using our own regime-based generator comes when we examine the extreme outcomes, such as 5% or 10% negative tails. The regime-based generator allows us to see what economic and market conditions might give rise to those extreme outcomes. The framework of the economic/market regimes in our generator have been “field tested” with a wide array of institutional investors, and we believe they provide intuitive historical explanations of market outcomes for various asset classes.

Our Monte Carlo simulations start from current market conditions and simulate 20,000 paths of monthly simulated returns so that each path represents a sample five-year holding period. For every type of Monte Carlo simulation, initial conditions and any drift assumptions are extremely important. Exhibit 8 below gives the starting value, expected change (over the course of the next five years) and variability for key variables.

Exhibit 8 - Regime-Based Monte Carlo Simulations

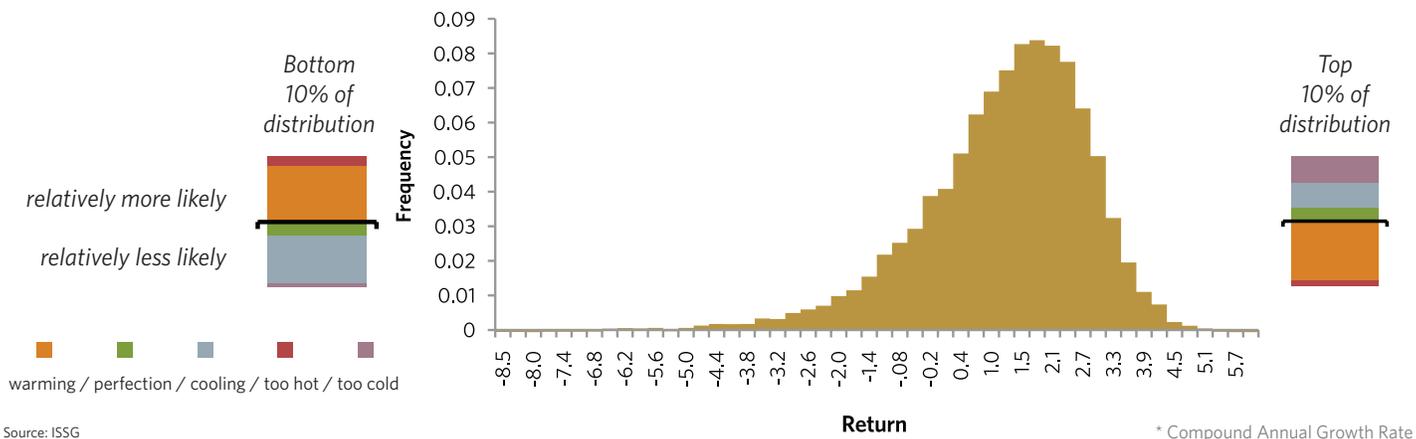
Variable	Starting value	5-year expected change	Volatility of values
UST 10y Yield	1.58%	+110BP	140BP
US CPI	1.7%	+94BP	175BP
IG Corp Spread	2.3%	+0BP	100BP
HY Spread	7%	+0BP	200BP
10y Real Yield	0%	+16BP	200BP

Source: ISSG

The expected changes for the 10-year U.S. Treasury and the U.S. consumer price index are taken from the forward curves for the U.S. dollar on May 31, 2012. These assumptions place most of the emphasis on changes in the inflation component of yields. However, because of the variability of the underlying parameters, the Monte Carlo simulations explore a wide range of real yield changes; the expected changes are merely the mean of this extensive distribution. On average, the simulations assume no change in absolute or relative value among the sectors, but as with the yield and CPI assumptions, the main advantage of the Monte Carlo approach is in exploring the distribution of values around the mean, rather than simply finding that mean.

Exhibit 9 shows the distribution of returns from a five-year Monte Carlo simulation of what we consider to be a typical institutional investor’s fixed income portfolio composed of 25% U.S. Treasuries and 75% U.S. investment grade corporate bonds, which we call the 25/75 portfolio. The duration of the 25/75 portfolio, as of May 31, 2012, is 6.67 years, assuming allocations to the Barclays Treasury and Investment Grade Corporate Credit Indexes.

Exhibit 9 – Monte Carlo, 5-Year, CAGR* Distribution for Diversified Portfolio, starting point and drift assumptions from Exhibit 8



Of our five regimes, the best outcomes for this portfolio are obtained when there are above-average incidences of the “too cold,” “cooling” and “perfection” regimes.

Focusing first on the distribution, it is clear that the portfolio offers a relatively moderate return (the mean expected return is around 2%), with wide potential variability around this. That distribution therefore supports our earlier argument that conventional fixed income allocations offer poor risk and return characteristics. The bars on either side of the distribution also require some explanation. They show the regimes that are relatively more likely (shown above the black line) and relatively less likely (shown below the black line) to give rise to the lowest returns of the portfolio (the bottom 10%) and the highest returns of the portfolio (the top 10%). For example, if the returns of the portfolio are in the bottom 10% of the distribution, it is highly likely that a “warming” regime has been in effect, while it is highly unlikely that a cooling regime has occurred. As one might expect, our five economic regimes do not occur with equal frequency. These charts therefore show the probability that a particular regime was in effect (or not in effect, if below the line), relative to the frequency with which they have historically occurred.

Of our five regimes, the best outcomes for this portfolio are obtained when there are above-average incidences of the “too cold,” “cooling” and “perfection” regimes. All three exhibit below average or falling inflation; and the “perfection” regime offers the most benign environment for growth and the appreciation of risky assets. Historically it has been rare for this set of regimes to dominate. Three candidate periods for this regime set occurred directly after the U.S. Civil War, the period after WWII and the years 1982-1987. Each of these followed periods of high official or black market inflation and the last of them ended very badly for risky assets.

As can be seen from the left-hand colored bars, the 25/75 portfolio suffers severely below average performance in paths with a lack of “cooling” periods and an abundance of “warming” periods. The “warming” regime is characterized by modestly rising inflation expectations. This particular regime concentration would correspond to a successful reflation by the use of fiscal stimulus.

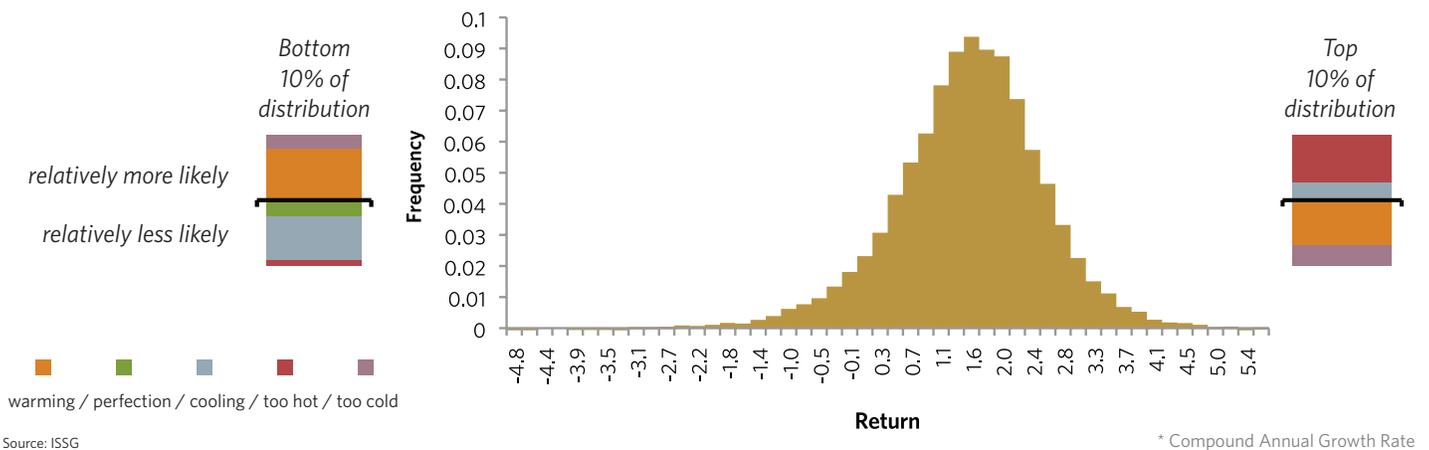
Having analyzed how a representative fixed income portfolio behaves across growth and inflation regimes, we can then construct a model “diversified”

Having analyzed how a representative fixed income portfolio behaves across growth and inflation regimes, we can then construct a model “diversified” portfolio that is less exposed to interest rate rises and provides better risk and return characteristics in a low interest rate environment.

portfolio that is less exposed to interest rate rises and provides better risk and return characteristics in a low interest rate environment. Our intention is not necessarily that investors should make a wholesale switch to this exact portfolio (though neither would we rule this option out) but rather that it serves as an exemplar of what can be achieved through the diversification approach.

We show the distribution of returns for the candidate diversified portfolio in Exhibit 10. The portfolio contains a 25% allocation each to municipal bonds, agency mortgages and U.S. TIPS. The remaining 25% is a basket of credit exposures: high yield, investment grade and floating rate loans. This particular portfolio provides approximately the same yield as the original 25/75 portfolio, and in our view has better performance potential in regimes that would raise concerns about rising rates. The returns in the Monte Carlo simulation are based on the following indexes and yields: (1) municipal bonds: Barclays Municipal Bond Index Yield to Worst; (2) MBS: Barclays U.S. MBS Index Yield to Worst; (3) 10-year TIPS: U.S. Generic Government TII 10 Year; (4) investment grade bonds: Barclays U.S. Corp: Investment Grade - Redemption Yield; (5) high-yield bonds: Barclays U.S. High Yield Corporate - Redemption Yield; and (6) loans: S&P/LSTA Leveraged Loan Total Return Index.

Exhibit 10 - Monte Carlo, 5-Year, CAGR* Distributions for Sample Fixed Income Portfolio, starting point and drift assumptions from Exhibit 8



Regimes with the potential for the highest performance in the candidate portfolio are shown above the black line in the right-hand colored bars. They contain an overabundance of high inflation or too hot regimes. In this particular simulation set, given that the starting point is a relatively low level of inflation, 1.7% from Exhibit 8, that concentration of too hot regimes results in an average inflation of 5.4% at the end of a five-year period. The above-average performance is primarily caused by a significant weighting to U.S. TIPS.

The colored bars above the black line on the left-hand side show the regime mixture that causes below-average performance for the candidate portfolio. This mixture is a combination of warming and too cold regimes. One scenario for that regime mixture within the U.S. economy would be for the U.S. Federal Reserve to tighten rates too soon after reflating the economy, thereby causing a serious dip in economic activity. Looking within these two regimes,

negative returns during warming regimes are caused by poor performance in interest-rate sensitive sectors, such as municipal bonds and mortgage-backed securities. Additionally, negative performance is exacerbated by losses on corporate credits in a too cold regime.

A summary of the two portfolios' reaction to various combinations of changes to inflation and real yields is shown in Exhibit 11:

Exhibit 11 - Representative vs Diversified Portfolio in Rising Rate Scenarios

Inflation	Real Yields	Impact on 25/75 portfolio	Impact on diversified portfolio
Up	--	Negative	Positive
Down	--	Neutral	Neutral
--	Up	Negative	Negative
--	Down	Positive	Positive

Source: ISSG

The portfolio could provide a custom benchmark for a fixed income mandate, or it could provide a starting point for a discussion about a lower duration, more flexible mandate that relies less on corporate credit and allows for the use of less liquid sectors such as municipal bonds and loans.

As can be seen from Exhibit 11, the diversified model portfolio achieves a return profile considerably more suitable to a low rate environment than the representative 25/75 portfolio. Most crucially, it benefits from rising inflation, and maintains its value during periods of rising rates. However, as we stated earlier, our goal in suggesting these approaches is not simply to immunize against interest rate rises; it is to immunize against interest rate rises in a way that does not detract from the other characteristics of the portfolio. We believe that the candidate portfolio meets this goal in that, even though it offers protection against rate rises, it still has the characteristics of a manageable, diversified fixed income portfolio. In comparison to the representative portfolio, the diversified portfolio:

- lowers duration by approximately 1.25 years
- raises the credit quality slightly from A+ to somewhere between A+ and AA- (assuming AA+ for the UST and MBS)
- contains a more diversified set of sectors and risk exposures
- includes explicit inflation protection

While the diversified portfolio has a similar yield to the 25/75 portfolio, it has the advantage of having an expected volatility that is approximately 85 basis points (bps) lower than the 25/75 portfolio. To bring the analysis back to the three elements of diversification, we need to examine the sources of volatility and yield. The lowering of duration reduces volatility by about 95 bps. The yield gained by allocating to spread sector adds about 35 bps. Even with diversification, allocating to more volatile spread sectors adds about 10 bps to expected portfolio volatility.

The portfolio could provide a custom benchmark for a fixed income mandate, or it could provide a starting point for a discussion about a lower duration, more flexible mandate that relies less on corporate credit and allows for the use of less liquid sectors such as municipal bonds and loans.

Though we would argue that in a low-rate environment, the default position of investors should be to avoid owning interest rate risk, investors can use neutralization approaches to deviate from this view in whichever direction they want – incorporating long or short positions in interest rates, combined with customized curve positions if desired.

All portfolios have environments in which they perform poorly. We believe in this instance it is best to follow the dictum that one should accept the risks one can manage for outcomes that one can see coming. The successful reflation of a major global economy is an outcome that by definition can only be identified after the fact. The premature tightening by a major central bank is an outcome that many market participants have observed over the last 20 years; for example, in Japan in the early 1990s. We believe that a premature tightening is an outcome that an active fixed income manager can see coming. Downside risk can therefore be mitigated by shifting assets out of credit-sensitive sectors and into nominal Treasuries.

We have demonstrated that the regime-based approach allows investors to look at potential ways diversification can and cannot offer downside protection. We believe the particular causes of poor performance in our diversified portfolio are more manageable and therefore more acceptable risks. It is also clear that no portfolio can be left unchanged to weather market forces for five years. Active management is required to avoid the worst outcomes.

Pros of diversification:

- No need for derivatives.
- Implementation is nothing more complex than a rebalancing of asset classes.
- If handled well, likely to be effective while maintaining the fund's current yield levels.
- The proposed diversified portfolio is not just insurance against a near-term interest rate rise but also potentially a more effective asset allocation mix for a protracted low interest rate environment.

Cons of diversification:

- Though yield levels are maintained, diversification significantly changes the general characteristics of the portfolio.
- Expressed as a one-off cost, implementation is likely to be more expensive than the (purely derivative-based) tail risk hedging and neutralization approaches, though will vary depending on which asset classes are bought and sold.
- The more diversified fixed income portfolio is less liquid than the 25/75 portfolio. In addition, for some very large funds, sectors such as TIPS and loans may not offer enough capacity.

Neutralization

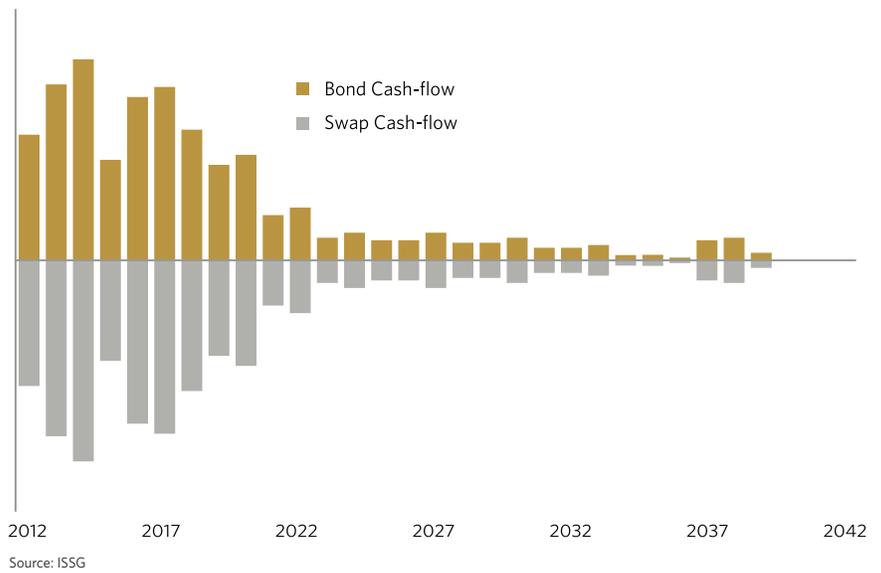
For most investors, we believe that tail risk hedging and diversification are the two central approaches they should consider. However, for investors with a pre-existing facility to use derivatives, neutralization is a third option. Here interest rate swaps (or similar instruments) are used to manage the plan's interest rate risk. Though interest rate swaps are conceptually and operationally complex, they provide the investor with an exceptionally high degree of freedom, flexibility and precision over which risks they wish to own.

Pension plans that already have a derivatives-based LDI program in place can easily implement an interest-rate neutralization approach by adjusting their net interest rate risk position, or hedge ratio.

Though we would argue that in a low-rate environment, the default position of investors should be to avoid owning interest rate risk, investors can use neutralization approaches to deviate from this view in whichever direction they want: incorporating long or short positions in interest rates, combined with customized curve positions if desired. In this way, investors could even choose negative total duration in order to benefit from, rather than lose from, rising interest rates.

As mentioned, in the absence of any market views, we would encourage investors to consider reducing their interest rate risk to zero. This means executing interest rate swaps that have interest rate sensitivity directly opposite to that of the existing bond portfolio. Interest rate swaps are available as over-the-counter instruments, so this can (if desired) be done with a very high degree of precision, as shown in Exhibit 12.

Exhibit 12 - Using Interest Rate Swaps to Neutralize Interest Rate Risk



Pension plans that already have a derivatives-based LDI program in place can easily implement an interest-rate neutralization approach by adjusting their net interest rate risk position, or hedge ratio. An LDI manager will already have insight into the interest rate sensitivity of the bonds in the portfolio, and therefore it is just a matter of negating these (or customizing them to fit investors' or fund managers' market views). Note that the neutralization approach allows investors to retain the credit exposure of their bonds, as it purely hedges the interest rate risk rather than the credit risk of the existing bond holdings.

Taking a position in interest rate swaps has (theoretically, at least) no effect on the ongoing yield of the portfolio. This is because it is assumed that the market pricing for interest rate swaps reflects the market's view of the future levels of interest rates. If market prices are an accurate predictor of future interest rates in this way, then the swap will, at all times, have a value close to zero, and therefore no economic effect on the portfolio. However, if the market

systematically misprices interest rate swaps – say, because the investor base has a systematic bias towards reducing, rather than increasing, the duration of their portfolios – then the interest rate swap market may not be an accurate predictor of interest rates. If this is the case then there is an implicit cost or benefit to the swaps that is not captured in their trading costs or initial value. Various academic studies have attempted to quantify this term risk premium or cost of reducing duration without arriving at a consensus on the matter, with estimates varying wildly in either positive or negative territory.

Pros of neutralization:

- A very precise approach, which allows for customization (rather than simple hedging) of interest rate risk to suit investors’ views.
- Cheap and easy to execute for investors with existing synthetic LDI programs.

Cons of neutralization:

- For investors without a pre-existing LDI program, this kind of derivative program is operationally challenging to execute and comes with additional risks and requirements.
- If it has been fully neutralized, then fixed income loses some of its diversification advantage.

Conclusion

In sum, there are advantages and disadvantages to each of these three approaches, as outlined below:

Exhibit 13 - Pros and Cons of Tail Risk Hedging, Diversification and Neutralization

	Tail Risk Hedging	Diversification	Neutralization
Is the approach effective against interest rate rises?	✓	✓✓	✓✓✓
How well does the approach maintain yield?	XX	✓	—
Does the approach involve significant change to the existing holdings?	✓✓✓	X	✓✓
How significant are the initial transaction costs?	X	XX	—
Is the approach simple from an operational and governance perspective?	X	✓	XX
✓ = positive, X = negative, — = neutral			

If investors do not have an LDI program or an existing operational capability to use interest rate swaps for any other reason, then they are likely to find either diversification or tail risk hedging to be the simpler and more desirable approach.

If investors do not have an LDI program or an existing operational capability to use interest rate swaps for any other reason, then they are likely to find either diversification or tail risk hedging to be the simpler and more desirable approach. Comparing these two, the diversification approach is more disruptive, and requires more work and expense to implement, but has

We especially want to underscore that protecting portfolios against rising rates need not be a costly or return-compromising exercise, if implemented thoughtfully.

the significant advantage of greatly improving the risk characteristics of the portfolio without impairing its yield. The tail risk hedging method, on the other hand, is very little trouble to implement, but presents a constant drag on return, not necessarily an attractive feature in an environment of already depressed yields. Investors' views on how long they expect yields to stay low will be a key arbiter as to which approach may be preferred. If investors believe that the current low yield environment will persist, then diversification is probably the better choice. Over a long time, the amortized transaction costs of switching to a diversified portfolio are low, while the dollar costs of a multi-year yield drag created by the tail risk hedging approach can be severe.

A third possibility would be for investors to combine the tail risk hedging and diversification approaches. The diversification approach can be partially implemented via a few select sector shifts (such as out of credit assets and into high yield and MBS). Similarly, tail risk hedging need not cover all of an investor's fixed income assets. Our intention in outlining three potential approaches for rising rates protection is to illustrate the range of possibilities available to investors rather than to be prescriptive. We especially want to underscore that protecting portfolios against rising rates need not be a costly or return-compromising exercise, if implemented thoughtfully. We believe this is an especially important message for institutional investors with significant allocations to rate-sensitive assets, a rare situation in which investors can have their cake and eat it, too.

Indexes are unmanaged, are not available for direct investment and are not subject to management fees, transaction costs or other types of expenses that a portfolio may incur.

HYPOTHETICAL OR SIMULATED PERFORMANCE RESULTS HAVE CERTAIN INHERENT LIMITATIONS. UNLIKE AN ACTUAL PERFORMANCE RECORD, SIMULATED RESULTS DO NOT REPRESENT ACTUAL TRADING. SIMULATED TRADING PROGRAMS IN GENERAL ARE ALSO SUBJECT TO THE FACT THAT THEY ARE DESIGNED WITH THE BENEFIT OF HINDSIGHT. ALSO, SINCE THE TRADES HAVE NOT ACTUALLY BEEN EXECUTED, THE RESULTS MAY HAVE UNDER OR OVER COMPENSATED FOR THE IMPACT OF CERTAIN MARKET FACTORS. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK. NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF THE TRADING LOSSES ARE MATERIAL FACTORS WHICH CAN ADVERSELY AFFECT THE ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE ECONOMY OR MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS, ALL OF WHICH CAN ADVERSELY AFFECT

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