CME Group

INTEREST RATES

Risk Management for Fixed Income Asset Managers

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Capital market volatility in recent years has introduced unprecedented challenges for fixed income asset managers. The subprime mortgage and credit crisis prompted the Federal Open Market Committee (FOMC) to push the target Fed Funds rate to the lowest level in history at 0-0.25%. Longer-term rates have generally declined as well as a result of the FOMC's asset repurchase programs.

But recent indications of economic growth and a possible pull-back from these easy money policies have led many managers seeking a hedge against possible rising rates and other market adjustments.

Throughout this market turbulence, CME Group has provided risk-management tools that serve to assist fixed income portfolio managers in this challenging environment. This document is intended to serve as a primer regarding how one may utilize CME Group fixed income products to balance risks and seize opportunities as they arise.

Four Critical Decisions

Fixed income asset managers face four critical decisions in their pursuit of investment value (or "alpha") while managing the attendant risks. Specifically, they must determine how to address risk that may be defined along four key dimensions including – (1) portfolio duration; (2) yield curve structure; (3) sector; and (4) security selection including credit risk and structural issues.

1. *Portfolio Duration* – All fixed income portfolios are profoundly impacted by the simple advance or decline of interest rates. Duration represents the most efficient way of measuring portfolio risk subsumed into a single value. Specifically, duration represents the expected percentage change in the value of a portfolio given a general fluctuation in interest rates.

   E.g., a portfolio with duration of 4 years is expected to experience a principal loss of 4% if rates increase by 100 basis points (1.00%).

   Portfolio managers generally target the appropriate interest rate sensitivity of the portfolio based on an analysis of investor's preferred performance benchmark or target, risk tolerance and interest rate trends. If yields are expected to decline, a longer-duration portfolio may be preferred; if yields are expected to advance, a shorter-duration portfolio may be recommended.

2. *Yield Curve Structure* – It is possible to construct a portfolio of any particular average weighted duration in many different ways using securities positioned along the yield curve.

   E.g., a portfolio with a duration of 4 years may be constructed exclusively of securities with durations of 4 years – a "bullet." Alternatively, one may use a combination of shorter and longer duration securities – a "barbell" - or simply purchase a range of securities along the yield curve - a "ladder" to achieve a portfolio duration of 4 years. While all three of these portfolio structures may exhibit similar sensitivity to a "parallel" shift in the yield curve, they may generate much different returns if the yield curve were to steepen, flatten or twist in shape.

   As a general rule, if the yield curve is expected to steepen, it is advantageous to maintain a bullet portfolio; if the yield curve is expected to flatten or invert, a barbell portfolio may be preferred.

3. *Sector Risk* – Fixed Income managers may allocate their holdings across a rather broad spectrum of securities including Treasuries, agencies, corporates, municipals, mortgage backed securities (MBS), commercial mortgage backed securities (CMBS) and other asset-backed securities (ABS). Each of these sectors offers their own unique characteristics, risks and yields. Astute managers must decide how much of the portfolio's duration should be attributable to each sector.

   E.g., if the average weighted portfolio duration equals 4 years, Treasuries with an average weighted duration of 4 years might be used to comprise 25% of the portfolio's composition. The remaining 75% of the portfolio might be allocated across other fixed income securities likewise with an average weighted duration of 4 years.

   Credit events such as the subprime mortgage crisis exert an impact the relative value of fixed income securities in different sectors. Note, for example, that yield spreads between corporate and Treasury securities widened considerably as

investors opted for the relative safety of government securities during the crisis.

Asset managers frequently adopt a practice of "rotating" or re-allocating investment amongst these sectors by reference to the relative value or yield spreads of the different types of securities in response to credit conditions.

4. *Security Selection* – Within each fixed income market sector, there are a wide variety of securities with different investment characteristics and structures.

   E.g., one might opt for a low or a high coupon security with similar durations. One might invest in investment grade (rated BBB- or Baa- or better by a rating agency) or "high-yield" corporate securities (rated BB+ or Ba+ or less). Some securities may be callable or offer other types of "optionality." Other securities may be available with no frills of that sort.

   It's incumbent upon the asset manager to select suitable individual securities to achieve the specific investment objectives and to remain bounded by the investment constraints of the ultimate investor.

In the final analysis, and no matter how the asset manager makes investment decisions, performance generally is judged by reference to a fixed income benchmark. The Barclays Capital U.S. Aggregate Bond Index stands out as common reference in this regard. Of course, there are many candidate indexes which might similarly serve as a "bogey." Thus, asset managers typically strive to make investment decisions relative to the benchmark on the four points as above in hopes of achieving enhanced returns, or beating the "bogey."

Many managers find that the suite of interest rate products offered by CME Group are essential tools in an active, disciplined portfolio management process which seeks to add alpha while relegating risk to acceptable levels. Let's discuss some practical examples of how CME Group interest rate products might be deployed to address risks relating to duration; the shape of the yield curve; sector; and, the security selection process.

Measuring Risk

There is an old adage to the effect that "you can't manage what you can't measure." In the fixed income security markets, one generally measures portfolio risk by reference to duration or its close cousin "basis point value" (BPV).

Duration is a concept that was originated by the British actuary Frederick Macauley. Mathematically, it is a reference to the weighted average present value of all the cash flows associated with a fixed income security, including coupon income as well as the receipt of the principal or face value upon maturity.

E.g., the most recently issued or "on-the-run" 10-year Treasury note as of January 11, 2012 was the 2% security maturing November 15, 2021. Its duration was 8.87 years. This suggests that if yields were to advance by 100 basis points (or "bps"), the price of the security should decline by approximately 8.87%.

On-the-Run Treasury Notes & Bonds
(January 11, 2012)

Tenor	Coupon	Maturity	Duration	BPV (per million)
2-Year	1/8%	12/31/13	1.96 Yrs	$196
3-Year	1/4%	1/15/15	2.98 Yrs	$297
5-Year	7/8%	12/31/16	4.85 Yrs	$486
7-Year	1-3/8%	12/31/18	6.62 Yrs	$664
10-Year	2%	11/15/21	8.87 Yrs	$898
30-Year	3-1/8%	11/15/41	19.41 Yrs	$2,012

Source: Bloomberg

Basis point value (BPV) is a concept that is closely related to duration. The BPV measures the expected change in the price of a security given a 1 basis point (0.01%) change in yield. It may be measured in dollars and cents based upon a particular face value security, commonly $1 million face value. It is sometimes also referred to as the "dollar value of an 01" or simply "DV of an 01."

E.g., the on-the-run 10-year T-note had a basis point value of $898 per $1 million face value unit, as of January 11, 2012. This implies that if yields were to advance by 1 basis point, the price of a $1 million face value unit of the security might decline by $898.

Breakeven Risk Analysis

While we may attempt to measure the risks associated with a specific Treasury security, we may also attempt to identify the risks associated with Treasury portfolios in general. One method for assessing risk is to conduct what is known as a "breakeven (B/E) rate analysis." This technique addresses the questions – how much do rates need to advance before suffers a loss by holding a particular security?

In order to address this question in a current context, we examined the characteristics of various U.S. Treasury indexes as published by Barclays Capital including the U.S. Treasury Index (inclusive of all maturities); the Intermediate Treasury Index (1-10 year maturities); and, the Long Treasury Index (10+ year maturities).

Breakeven Rate Analysis
(Barcap Treasury Indexes as of 12/30/11)

	Duration	Yield	B/E Rate Advance
U.S. Treasury	5.92 Yrs	1.03%	17.4 bps
Intermediate Treasury	4.0 Yrs	0.72%	18 bps
Long Treasury	16.2 Yrs	2.68%	16.5 bps

This analysis is generally conducted over a twelve-month time horizon and takes into account any income generated by holding the security. One may estimate the rate advance required to offset income over a 12-month period by simply dividing the yield on the index by its duration.

E.g., if rates advance just 17.4 basis points (bps) or 0.174% over the course of the next 12 months, the returns associated with the U.S. Treasury Index will equate to zero, or the breakeven point. This is calculated as the yield in basis points divided by duration or 17.4 bps = (103 bps / 5.92 years).

E.g., the breakeven rate advance for intermediate Treasuries is 18 bps (=72 bps / 4.0).

E.g., the breakeven rate advance for long-term Treasuries is 16.5 bps (=268 bps / 16.2).

Alarmingly, these breakeven rate advances are at the lowest levels observed for many, many years. This analysis underscores the vulnerability associated with U.S. Treasury security holdings.

Managing Duration

Interest rate futures may readily be utilized to adjust the average weighted duration of a portfolio of fixed income securities. Certainly one might wish to increase duration when rate declines (or price advances) are anticipated; or, decrease duration when rate increases (or price declines) are forecast. One must buy futures to extend duration; or, sell futures to reduce duration.

E.g., consider a hypothetical fixed income portfolio valued at $100 million with a weighted average duration of 4 years. In anticipation of increasing rates and declining prices, the asset manager decides to execute a temporary tactical shortening of portfolio duration from 4 years to 3.8 years.

This may be executed by selling CME Group Treasury note futures. CME Group offers 2-year, 3-year, 5-year, 10-year, 30-year and "Ultra" 30-year Treasury futures. But 5-year Treasury note futures will have an effective duration closest to the current portfolio duration of 4 years. The motivation to utilize 5-year T-note futures may be underscored if the manager believes that the portion of curve surrounding a 5-year maturity may experience a more significant rate advance than other segments of the curve.

The appropriate number of 5-year futures to sell, or the "hedge ratio" (HR), may be calculated using the following formula.

$$HR = \left(\frac{D_{target} - D_{current}}{D_{current}}\right) x \left[BPV_{portfolio} \div \left(\frac{BPV_{ctd}}{CF_{ctd}}\right)\right]$$

Where D_{target} is the target duration; $D_{current}$ is the current duration; CF_{ctd} is the conversion factor of the security that is cheapest-to-deliver against the particular futures contract that is being used; $BPV_{portfolio}$ is the basis point value of the portfolio; and, BPV_{ctd} is the basis point value of the cheapest-to-deliver security. [1]

[1] Treasury note and bond futures contracts permit the delivery of a variety of Treasury securities within a certain maturity window, at the discretion of the short. E.g., the 10-year T-note futures contract permits the

E.g., assume that the $100 million portfolio had a BPV equal to $40,000. As of January 11, 2012, the cheapest-to-deliver (CTD) security against March 2012 5-year T-note futures was the 1-3/4% coupon security maturing on May 15, 2016. The 1-3/4%-16 note had a conversion factor (CF) of 0.8453 with a BPV of $44.25 per a $100,000 face value unit, corresponding to the deliverable quantity against a single futures contract.[2] Using these inputs, the appropriate hedge ratio may be calculated as short 38 futures contracts.

$$HR = \left(\frac{3.8 - 4}{4}\right) x \left[\$40{,}000 \div \left(\frac{\$44.25}{0.8453}\right)\right] = -38$$
$$= Sell\ 38\ Futures\ Contracts$$

By selling 38 Five-year T-note futures against the portfolio, the asset manager may be successful in pushing his risk exposure as measured by duration from 4 to 3.8 years.

Sell 38 Five-year T-note futures ➔ **Reduces portfolio duration from 4.0 to 3.8 years**

If yields advance by 100 bps, the value of the adjusted portfolio may decline by approximately 3.8% or $3.8 million. But this is preferable to a possible $4 million decline in value if the asset manager maintained the portfolio duration at the original benchmark duration of 4 years. Thus, the asset manager preserved $200,000 in portfolio value. Or, viewed from the perspective of the client, the asset manager successfully generated 20 bps (0.20%) in alpha relative to the performance bogey, which we assume maintains a static 4-year duration for purposes of this example.

Of course, the asset manager may readily accomplish the same objective simply by selling off a portion of the portfolio holdings in favor of cash. But Treasury futures tend to be more liquid than the cash markets. Moreover, the futures hedge allows the asset manager to maintain his current holdings while adjusting duration exposures quickly and at minimal costs.

Managing Yield Curve Exposure

Just as an asset manager may utilize interest rate futures to adjust the effective duration of a portfolio, in anticipation of fluctuating yield levels, interest rate futures also provide utility in preserving or enhancing value as a result of the dynamic shape of the yield curve.

E.g., as of January 11, 2012, the 10-year on-the-run (OTR) T-note was trading to yield 1.905% while the 2-year OTR T-note was at 0.229%. Thus, the 10-2 year yield spread was 168 bps (=1.905% less 0.229%). This yield spread had declined sharply over the past year as a response to generally weak economic conditions and driven further by the Fed's current version of Operation Twist announced in September 2011. But assume that an asset manager believes that this spread may advance as the yield curve reverses to steepen once again.

Let's consider the scenario that may inspire a steepening yield curve. First, assume that the FOMC adheres to its policy statement of August 9, 2011 when it announced it will maintain current rates until mid 2013. Secondly, let's assume that economy

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delivery of T-notes with a remaining maturity between 6-1/2 to 10 years. This includes a rather wide variety of securities with varying coupons and terms until maturity. Because these securities may be valued at various levels, the contract utilized a Conversion Factor (CF) invoicing system to determine the price paid by long to compensate the short for the delivery of the specific security. Specifically, the principal invoice amount paid from long to short upon delivery of securities is calculated as a function of the futures price multiplied by the CF. Technically, CFs are calculated as the price of the particular security as if they were yielding the "futures contract standard" of 6%. The system is intended to render equally economic the delivery of any eligible for delivery security. However, the mathematics of the CF system is such that a single security tends to stand out as most economic or cheapest-to-deliver (CTD) in light of the relationship between the invoice price of the security vs. the current market price of the security. Typically, long duration securities are CTD when prevailing yields are in excess of the 6% futures market standard; while short duration securities are CTD when prevailing yields are less than 6%. It is important to identify the CTD security because futures will tend to price or track or correlate most closely with the CTD.

[2] These relationships are in fact dynamic and subject to constant change. In particular, the BPV associated with any portfolio or security will change of its own accord in response to fluctuating yield levels. As a general rule, an asset holder might wish to review the structure of a hedge transaction upon a 20 basis point movement in prevailing yields. Further, the CTD will change as a function of changing yield levels, particularly when prevailing yields are in the vicinity of the 6% futures contract standard which may be regarded as an inflection point of sorts. However, this information may readily be obtained with use of a Bloomberg device or by navigating to the www.cmegroup.com website.

continues in its (early and mild) improvement, highlighted by declining unemployment, growing GDP and creeping inflationary pressures.

With the short-end of the curve anchored by Fed monetary policy and the long-end of the curve reacting to potential growth and inflationary pressures, it is readily conceivable to witness a steepening yield curve.

Let us further assume that the asset manager's Treasury holdings are structured to reflect a benchmark or bogey against which investment performance may be measured. As such, the current portfolio duration may represent a carefully targeted risk exposure that the portfolio manager may wish to maintain. Still the prospect of a shift in the yield curve may represent an opportunity that an astute investment manager may view as an opportunity to enhance returns, or to create "alpha" per current investment vernacular.

CME Group Treasury futures may readily be utilized to enhance investment returns based on an expectation of a steeping yield curve (or a flattening yield curve as well). Specifically, one may "buy the curve" or buying 2-year and selling 10-year T-note futures on a duration-balanced basis.

The key to capitalizing on the changing shape of the yield curve is to use a "spread ratio" (SR) that balances the effective duration of each futures contract. By balancing the outright risk exposure, as measured by BPV in each leg of the spread, one can be reasonably assured that the spread will be responsive only to the changing shape of the yield and not to outright yield movements. As such, an asset manager may enhance performance in anticipation of a dynamic yield curve shape without affecting the original portfolio duration.

$$SR = \frac{BPV_{10-yr\ futures}}{BPV_{2-yr\ futures}}$$

Where $BPV_{10\text{-yr futures}}$ is the effective basis point value of the 10-year T-note futures contract; and, $BPV_{2\text{-yr futures}}$ is the effective basis point value of the 2-year T-note futures contract.

The effective BPV of a Treasury futures contract ($BPV_{futures}$) may be found using the following formula.

$$BPV_{futures} = \frac{BPV_{ctd}}{CF_{ctd}}$$

Where BPV_{ctd} is the basis point value of the cheapest-to-deliver security against that futures contract; and, CF_{ctd} is the conversion factor associated with the cheapest-to-deliver security.[3]

E.g., as of January 11, 2012, the CTD security against the March 2012 Ten-year T-note futures contract was the 3-3/4% note maturing November 15, 2018. This security had a BPV of $71.23 per $100,000 face value contract and a CF of 0.8804. Thus, the BPV of the 10-year T-note futures contract may be calculated as $80.91.

$$BPV_{10-yr\ futures} = \frac{\$71.23}{0.8804} = \$80.91$$

E.g., the CTD security against the March 2012 Two-year T-note futures contract was the 1-1/2% note maturing December 31, 2013. This security had a BPV of $39.86 per $200,000 face value contract and a CF of 0.9263. [4] Thus, the BPV of the 2-year T-note futures contract may be calculated as $43.03.

$$BPV_{2-yr\ futures} = \frac{\$39.86}{0.9263} = \$43.03$$

E.g., plugging this data into our formula, we arrive at a value of 1.880. This suggests for every Ten-year futures contract that is sold, 1.880 Two-year contracts should be purchased. [5]

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[3] As discussed above, Treasury futures tend to price, track or correlate most closely with the cheapest-to-deliver (CTD) security. Thus, it is important to identify the CTD security as the key to managing a hedging transaction. Note that the CTD security is typically not found in the on-the-run (OTR) security.

[4] Most CME Group Treasury futures call for the delivery of $100,000 face value in Treasuries. However, the 2-Year T-note futures contract calls for the delivery of a $200,000 face value unit.

[5] It is, of course, not possible to transact fractional futures contracts. Thus, one might buy the spread on a ratio of 19:10 (1.90=19 ÷ 10); or, buy nineteen (19) 2-year T-note futures; and, sell ten (10) 10-year T-note futures. A 19:10 ratio should be effective in neutralizing the spread to a parallel shift in the yield curve. Consider that, if rates decline by one (1) basis point, 19 long 2-year T-note futures should generate a return of profit of $818 (=19 contracts x $43.03); while 10 short 10-year T-note futures should generate an offsetting loss of $809 (=10 contracts x $80.91). Thus, the two positions offset in the event of a parallel shift in the curve.

$$SR = \frac{\$80.91}{\$43.03} = 1.880$$

How much of this spread should the portfolio manager transact? This decision is contingent upon the investor's view of potential spread movement; and, risk tolerance relative to the benchmark.

E.g., assume that the portfolio manager believes the yield curve spread between 10-year and 2-year Treasuries may steepen, or advance, by 30 bps. [6] The manager further determines to limit risk to no more than $100,000 if the curve flattens by 30 bps. Thus, the asset manager may sell 41 Ten-year futures [=($100,000 ÷ 30) ÷ $80.91]; and, buy 77 Two-year futures (=1.880 x 41 contracts).

Buy 77 Two-year T-note futures & sell 41 Ten-year T-note futures ➔ **"Buying the curve" enhances yields if curve steepens**

Assume the yield curve steepens by 30 bps as 6- to 10-year Treasury yields rise 40 bps; and, 2-year Treasury yields rise 10 bps.

This implies that the 41 short 10-year futures may advance in value by roughly $132,692 (=41 contracts x 40 bps x $80.91). This further implies that the 77 long 2-year futures will decline in value by roughly $33,133 (=77 contracts x 10 bps x $43.03). Thus, the spread advances in value by $99,559 (=$132,692 - $33,133), adding roughly 10 bps of "alpha" to the $100 million portfolio relative to the benchmark.

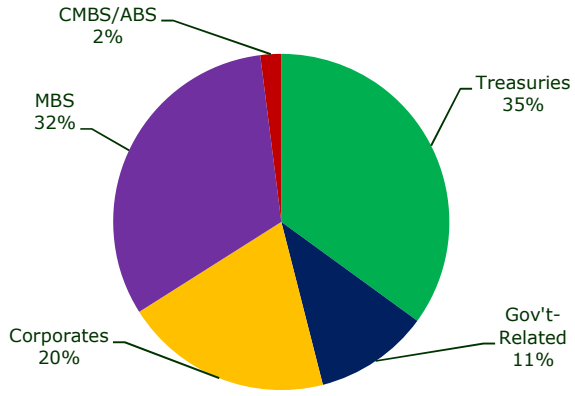
Sector Weighting Strategy

Fixed income asset managers will generally allocate their funds across various fixed income market sectors, including Treasuries, agencies, corporate, municipal securities, mortgage backed securities (MBS), commercial mortgage backed securities (CMBS) and other asset backed securities (ABS).

Some asset managers conform the composition of the portfolio to match that of the benchmark or bogey. This strategy assures that the performance of the portfolio generally will parallel performance of the benchmark.

E.g., the Barclays Capital U.S. Aggregate Bond Index represents a popular benchmark for U.S. fixed income asset managers. It is comprised of securities drawn from several sectors as indicated below.

Barclays U.S. Aggregate Bond Index
(2012)



Source: Barclays Capital

However, asset managers may subsequently re-allocate, or rotate, portions of the portfolio amongst these various sectors in search of enhanced value. If, for example, an asset manager believed that the Treasury sector may outperform the corporate sector in coming months, he might re-allocate investment away from corporates in favor of Treasuries.

This may be accomplished simply by liquidating corporate securities and buying Treasury securities in their stead. Or, one might utilize CME Group interest rate futures similarly to restructure the portfolio. In either case, the asset manager effectively may "underweight" corporate and "overweight" Treasury investments relative to the benchmark.

The futures strategy offers the advantage of leaving undisturbed the underlying cash investments

6 The cheapest to deliver (CTD) security against 10-year T-note futures was the 3-3/4% note of November 2018, as of January 11, 2012. As such, 10-year T-note futures were pricing or tracking or correlating most closely with a security with a maturity of just under 7 years. Thus, as a technical matter, the 10-year/2-year T-note futures spread might be characterized as a spread between 7- and 2-year Treasuries. But for most practical purposes, we refer to it as a 10- vs. 2-year spread.

weighted according to the benchmark. Thus, this may be referred to as an "overlay" strategy. Further, CME Group futures generally offer superior liquidity, *i.e.,* you may generally transact more size on tighter bid/ask spreads than may be possible in the cash fixed income markets.

E.g., assume our asset manager with the $100 million portfolio with a duration of 4 years wished to shift 10% of the portfolio from corporates into Treasuries. As discussed above, the portfolio had an aggregate BPV=$40,000. Thus, the transaction should be constructed such that $4,000 (10% of $40,000) in additional exposure, measured by BPV, is allocated to Treasuries and away from corporates.

This may be accomplished by spreading Treasury futures against Deliverable Swap Futures (DSF). [7] There are no viable corporate bond futures contracts available. Thus, one may utilize CME Group Deliverable Swap Futures (DSFs) as a reasonable proxy for investment grade corporate risks, noting that this implies some "basis risk." In particular, the correlations between 5-year IRS rates and corporate bond yields are, while not perfect, reasonably high. Still, some measure of basis risk is implied in this strategy.

Correlation of Weekly Yield Fluctuations of 5-Year Swap Rates vs. Corp Bond Yields (Jan-05 thru Dec-11)

Bloomberg AAA 5-Year Industrials	0.7777
AA 5-Year Industrials	0.7938
A 5-Year Industrials	0.7545
BBB 5-Year Industrials	0.7484

The spread must be constructed such that an equivalent risk exposure, measured by reference to BPV, is bought and sold on each leg of the spread. First, we must identify the BPV associated with each futures contract.

E.g., the CTD security into the March 2013 10-year Treasury note contract was the 3-3/8%-19 with a BPV=$72.90 per $100,000 face value and a CF=0.8604. Thus, the futures contract had an effective BPV = $84.73 per $100,000 face value (=$72.90/0.8604), as of 11/28/12. A (hypothetical) 10-year DSF contract with a 2% coupon has a BPV = $99.21. [8]

This suggests one may construct a spread on a ratio of 1 Treasury per 0.85 DSFs (=$84.73/$99.21). To the extent that the portfolio manager wishes to shift 10% of the portfolio or $4,000 in duration, this requires 47 10-year T-note futures (= $4,000/$84.73). A position of 47 long 10-year T-note futures may be matched with the 40 short 10-year DSFs (=0.85 x 47).

Buy 47 Ten-year Treasury futures & sell 40 Ten-year DSF futures ➔ **Effectively rotates 10% of portfolio from corporates to Treasuries**

If Treasury yields decline relative to swaps by 10 basis points, *i.e.,* Treasuries outperform swaps, this strategy may effectively enhance portfolio performance by 4 basis points [=($84.73 x 10 basis points x 47 contracts) / $100MM].

Selecting Securities

Sometimes opportunities in cash fixed income markets are limited by the availability or unavailability of certain investment structures.

Callable bonds offer a good example. Despite the tremendous increase in the amount of Treasury securities issued in recent years, the Treasury does not currently issue callable securities. Since 2008, the availability of callable U.S. agency securities has similarly become limited. But callables may be attractive investments, particular in low yield environments to the extent that they offer a premium yield to entice investors.

[7] Deliverable Swap Futures (DSF) call for the delivery of interest rate swap (IRS) instruments that are cleared and carried through the CME Clearing House facility. They are offered in several varieties that call for the delivery of $100,000 face value of 2-, 5-, 10- or 30-year IRS instruments. They are traded based upon an Exchange established coupon that is set near prevailing market rates, e.g., 0.5%, 1.0%, 1.5%, 2.0%, etc. Delivery occurs on the Monday prior to the 3rd Wednesday in the contract months of March, June, September and December. They are quoted as 100% of par plus the Non-Par Value (NPV) of the delivered swap. The final NPV of the futures contract is paid upon delivery of the IRS as it is booked in the Clearing House.

[8] Note that DSFs were not launched until December 2012.

Options on Treasury futures contracts may be utilized synthetically to transform a Treasury security holding into a callable security. To understand, consider that when one purchases a callable security, you effectively convey the right to retire the security to the issuer. That right is likely to be exercised if yields should decline as prices advance. Thus, the call feature of a security may be considered analogous to the sale of a call option.

Thus, let us consider the sale of call options as a means of altering the risk/reward profile of a fixed income portfolio. Further, let us consider the purchase of puts as a form of "price insurance."

Yield Enhancement with Calls

If the asset manager's forecast calls for an essentially static or stable yield environment, the portfolio manager may pursue a "yield enhancement" or "income augmentation" strategy by selling call options against the fixed income portfolio.

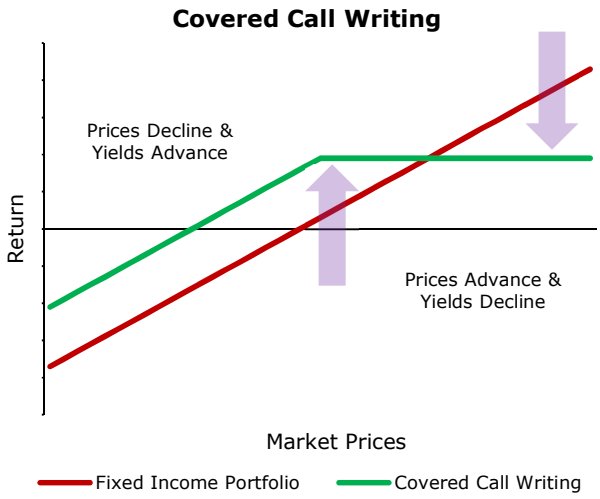
This is also known as "covered call writing" in the sense that your obligation to deliver the instrument underlying the option as a result of writing a call is "covered" by the fact that you may already be long the instrument or similar instruments. [9]

Sell call options → **Enhances income in neutral market & lock-in ceiling return**

E.g., let's revisit our example of the asset manager holding $100 million of Treasury securities with an average weighted duration of 4 years. Assume that our manager sells 764 at-the-money call options as discussed above in the context of the long put hedge.

If the market remains stable or declines (on advancing yields) below the strike price, then the short calls fall out-of-the-money and eventually expire worthless. As such, the portfolio manager retains the full value of the option premium received up front upon sale. The receipt of this premium serves to enhance portfolio returns in a neutral or bear market.

But if the market should advance above the call strike price, the options will go in-the-money. As such, they may be exercised, compelling the asset manager to sell futures at the fixed strike price even though market prices may be trading at higher levels. This implies a loss which offsets the advancing value of the Treasury portfolio.



Still, the initial receipt of the option premium ensures that a positive return is realized nonetheless. Thus, the covered call strategy implies that you lock-in a ceiling return, limiting your ability to participate in any upside potential. The covered call writer is compensated, however, to the extent that he receives the option premium which at least partially offsets downside losses.

The short call hedge works best when the market remains basically stable. In this case, time value decay results in a gradual decline in the premium. Thus, you "capture" the premium, enhancing yield.

Buying Protection with Puts

The idea behind the purchase of puts is to compensate loss associated with the potentially declining value of bond prices (rising yields) with the rising intrinsic value of the puts. As market prices decline, puts will go deeper and deeper in-the-

[9] These examples assume that the asset manager owns Treasury securities and trades options exercisable for Treasury futures. While Treasury futures call for the delivery of Treasury securities, the two instruments are, of course, different. But to the extent that Treasury securities and futures perform similarly in response to dynamic market conditions, one may be a reasonable proxy for the other. Hence, the term "covered" call writing remains appropriate.

money, permitting the put holder to exercise the options for a profit.

If the market should rally instead, the puts go out-of-the-money. Having paid the option premium up front, however, the put holder's loss is limited to that premium. Any advance in the underlying market price (decline in yields) represents profit in the value of the fixed income portfolio, limited only to the extent of the premium forfeit up front to purchase the puts.

E.g., our fixed income asset manager holding a $100 million Treasury portfolio with a duration of 4 years might elect to purchase 764 at-the-money put options. This assumes that the portfolio manager wishes to completely hedge the portfolio using puts.

$$HR = \left[BPV_{portfolio} \div \left(\frac{BPV_{ctd}}{CF_{ctd}}\right)\right] = \left[\$40{,}000 \div \left(\frac{\$44.25}{0.8453}\right)\right] = 764\ contracts$$

If market prices should decline as yields advance, the portfolio suffers a loss. However, that loss is offset to the extent that the long put options travel in-the-money and permit a profitable exercise at or before expiration. The long puts are exercised by selling futures at the put strike despite the fact that the market has declined below the strike price. If the hedge was ratioed as described above, it is as if the asset manager locked in a "floor price" for his portfolio.

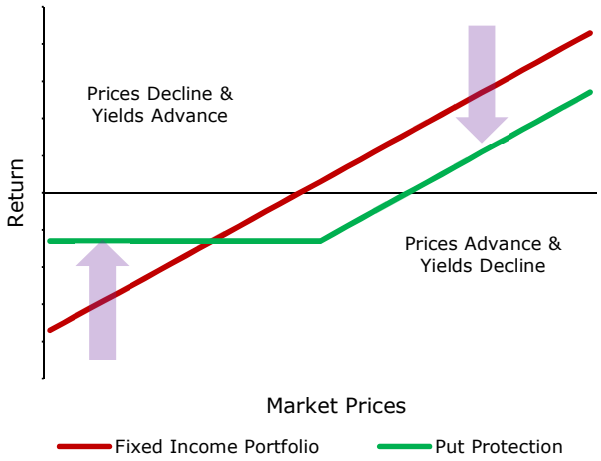
Buy put options ➔ **Lock in "floor return" & retain upside potential**

If, on the other hand, the market should advance above the put strike price as yields decline, the options will go out-of-the-money and eventually expire worthless. As such, the portfolio manager has forfeit the premium paid up front to secure the options. However, this payment may be offset and more by an advance in the portfolio value.

As such, the long put hedge allows one to lock-in a floor return while still retaining a great deal of the upside potential associated with a possibly favorable market swing, limited to the extent that you pay the premium associated with the purchase of the put options up front.

Option premiums are, of course, impacted by a variety of factors including the movement of price, time and volatility. So while the purchase of put options in the context of a hedging application reduces price risks, it also entails the acceptance of other types of risk uniquely applicable to options. Still, price impact is the foremost of these factors.

Buying Put Protection



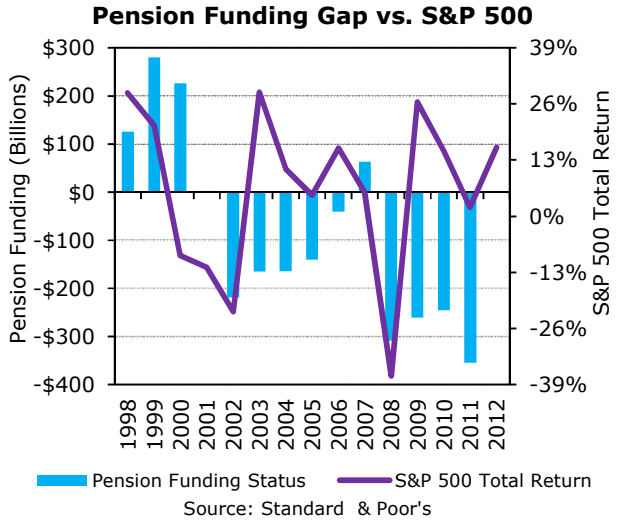
The purchase of put options as a means of locking in a floor price for the investment portfolio implies concern that yields may advance while prices decline. But a portfolio manager may not always be quite so confident in the market forecast. Certainly there are circumstances where the market may appear to be generally stable, albeit with some downside risk. Thus, other option strategies may be recommended.

Liability Driven Investing (LDI)

Pension plans face a unique investment dilemma insofar as they are driven by a necessity to fund future benefits (*i.e.,* liabilities) for retirees, as well as the desire to generate competitive returns. The importance of calibrating returns to anticipated future liabilities is driven home by the fact that many U.S. pension funds currently face significant "funding gaps."

The funding gap between the present value of future liabilities and assets held by the pension funds of the corporations comprising the S&P 500 stood at $355 billion at the conclusion of 2011. This gap has arisen as traditional investment strategies in equities have generally failed to keep pace with the pension fund obligations.

Accordingly, many pension funds have reconsidered their traditional investment methodologies of simply pursuing what may be considered the most attractive investment returns. In particular, an increasing number of pension fund managers reference future liabilities as a more practical benchmark for investment performance. This practice is known as "liability driven investing" (LDI).



The implication of LDI is that assets should be structured to increase the probability of funding liabilities. An effective LDI strategy is one where asset durations are structured to parallel the characteristics and behavior of the pension plan's liabilities at the lowest possible risk level.

Thus, the first step is simply to identify the magnitude of any possible funding surplus or gap. Secondly, one must identify mismatches between the duration of pension plan assets and future liabilities. A typical defined benefit pension may carry liabilities with durations in excess of 10 years and assets with durations less than 10 years. If rates should decline, the liability values may increase faster than asset values.

The Ultra T-Bond futures contract was designed to provide investment managers with a tool to hedge "long tail" liabilities and risks.[10] Like other Treasury futures contracts, the Ultra contract will track the cheapest-to-deliver cash security.

E.g., as of February 1, 2011, the CTD security against the March 2011 Ultra T-bond futures contract was the 5% note maturing May 15, 2037. This security had a BPV of $156.06 per $100,000 face value contract and a CF of 0.8692. Thus, the BPV of the Ultra contract may be calculated as $179.54. [11]

$$BPV_{Ultra} = \frac{\$156.06}{0.8692} = \$179.54$$

E.g., assume the $100 million pension plan has $15 million in expected benefit payments that come due in 25 years with a BPV of $37,500. Investment managers may create overlay strategies by going long or buying 209 Ultra T-bond futures calculated as follows.

$$HR = BPV_{portfolio} \div BPV_{Ultra} = \$37{,}500 \div \$179.54 = 209\ contracts$$

Overlay strategies of this nature enables asset managers to adhere to the pension plan's core asset allocation strategy, while extending duration with capital efficiencies.

Buy 209 Ultra T-bond futures ➔ **Extend asset duration to more closely match $15 MM in anticipated liabilities**

A major challenge in implementing an LDI strategy is that liabilities may be uncertain and not amenable to measurement in the same way as one might assess the risks of a bond investment. In particular, liabilities may be contingent upon factors such as retirement schedules and inflation. Moreover,

[10] The Ultra T-bond futures contract calls for the delivery of $100,000 face value of U.S. Treasury securities with a minimum maturity of 25 years. This represents a departure from the original 30-year T-bond contract that provides for the delivery of U.S. Treasuries with a minimum maturity of 15 years. Note that, in a low rate environment, the cheapest-to-deliver bond vs. the original T-bond futures contract tends to be a low duration or short maturity security. Hence, the original T-bond contract tends to track, price or correlate most closely with seasoned securities with maturities just above 15 years. But because the Ultra T-bond futures contract constricts the "delivery window" to securities with at least 25 years to maturity, it is much more reactive to events impacting the longest portion of the yield curve.

[11] Information on BPVs of Treasury futures may be referenced at www.cmegroup.com/trading/interest-rates/duration.html

liabilities are marked to market based on corporate yield curves which are not directly investable in the cash, futures or over the counter derivative markets. As such, a certain level of basis risk will be inherent in any strategy.

Pension plan managers faced with a deficit position are further faced with the dilemma of deciding when to "lock-in" prevailing interest rates. Instead of simply buying futures at current rates, they may opt to sell out-of-the-money (OTM) put options on Treasury futures.

This strategy represents an effective way of providing for possible yield enhancement without locking in low interest rates. Often, this strategy is pursued on a "scalable" basis. In particular, the sale of OTM puts allows the asset manager to establish target rates at which they might extend portfolio duration to more closely match liability durations.

Conclusion

CME Group is committed to finding effective and practical risk-management solutions for fixed income asset managers in a dynamic economic environment. While the recent financial crisis has sent shivers through the investment community, it is noteworthy that CME Group performed flawlessly throughout these trying times. Our products offer deep liquidity, unmatched financial integrity and innovative solutions to risk management issues.