INTRODUCTION

Central banks play a paramount role in directing the course of the global economy. They are heavily relied upon by government policy makers and generally charged with a mandate to control inflationary pressures; and, sometimes with a further mandate to promote economic growth, often with a specific eye on employment growth.

Central banks may work to influence both interest rate and FX exchange rate policies. They often have a good deal of latitude and resources at their command to do so. Thus, they often command considerable influence and resources to dictate money supply policies; establish bank reserve requirements; set the rate paid on reserve deposits; and, to operate directly in the open marketplace by buying or selling securities as well as currencies.

But along with their mandates and resources, they also are increasingly exposed to market risks. Notably, risks associated with exposure to foreign security holdings. To the extent that the United States has run a very large current account deficit for many years, other nations have accumulated large U.S. dollar denominated reserves.

U.S. Treasuries loom large as the typical investment vehicle of choice for U.S. dollar (USD) denominated assets. Almost 50% of all U.S. Treasuries are now held outside of the U.S., frequently by central banks. Although U.S. Treasuries have generated exceptional returns (i.e., the total return on long-term Treasury holdings exceeded 30% in 2011), yields now stand at very low levels and, as such, provide little “coupon cushion” in a rising rate environment. This forebodes considerable principal or market risk from the perspective of central banks invested in U.S. Treasuries. CME Group offers a suite of U.S. Treasury and other interest rate derivatives instruments designed to address these risks.

This document is intended to summarize the nature and magnitude of interest rate risks to which central banks are frequently exposed. Then, we will review how central bankers may deploy CME Group interest rate derivatives products to manage these risks.
As an historic matter, central banks have generally not been thought of as “risk-takers.” Instead, central banks operated with a straightforward asset-liability model that implied minimal risk relative to the activities of a typical commercial bank.

Central banks frequently operate per reasonably tight restrictions, enforced through internally-imposed or legislative measures, with respect to the type of instruments that may be held on the asset side of the ledger. Thus, the plurality of central bank assets might be held as sovereign debt issues (including their own), gold and other foreign exchange reserves.

Unlike commercial banks, which may be heavily invested in commercial loans, central banks generally do not engage in direct commercial lending. This policy precludes conflicts of interest vis-à-vis their regulatory function and provides for a degree of neutrality with respect to specific business enterprises.

Liabilities typically consist of banknotes as well as deposits that commercial banks may be required by law to hold with the central bank. These deposits or reserve requirements often offer low interest rates. As such, central banks may readily enjoy a spread on the return of its assets over the cost of its liabilities. To the extent that most central banks operate as public institutions, their income and profits are remitted to the government.

This model has generally served central banks well. However, market conditions have changed in the wake of the financial crisis. Thus, the demands placed upon central banks are changing. As such, the risks associated with their asset-liability management activities have become elevated.

Prior to the subprime mortgage crisis, many central banks operated per a self-imposed limit on direct investment in their own government bonds. This policy is consistent with many monetarist views that central banks should not be a source of financing for the government. However, the deep global recession of 2008-09 has compelled amendments to this ideology as many nations, particularly in the so-called developed world, were faced with weak economic growth rates and high unemployment, conditions inconsistent with a stable social fabric.

Because rates have been pushed to historic lows, leaving little or no room for further easing, as is the case in the United States where the target Fed Funds rate remains at 0-0.25%, central banks have often behaved as outside to more imaginative methods to stimulate economic growth.

**EXPANDING BALANCE SHEETS**

These non-conventional measures have resulted in an expansion of central bank balance sheets. In some cases, central banks have felt compelled to engage in large scale repurchasing of their own government securities (e.g., the quantitative easing or “QE” programs engaged in by the U.S. Fed). Or, central banks may be compelled to accept a broader range of collateral from commercial banks; or, to take a more active posture in preventing currency appreciation and thereby avoid a decline in the nation’s export activity.

In other words, central banks have shifted their risk profile to become a lender of last resort of sorts, featuring increasingly more aggressive “pro-growth and reflationary” policies.

The U.S. Federal Reserve stands out as a leading example of this phenomenon. The Fed balance sheet has more than tripled since late August 1, 2007 when its total assets were reported at $874.1 billion. As of January 4, 2012, the Fed’s total assets were reported at $2,920.2 billion.¹
This balance sheet growth is partially attributable to programs such as the development of various Fed liquidity facilities. But while the Fed recently renewed its central bank liquidity facility with an eye on the European sovereign debt crisis, the balance sheet expansion attributable to liquidity facilities had seen its peak by early 2009.  

A much more profound and longer lasting impact has been felt as a result of asset repurchase programs, notably the quantitative easing (QE) and QE2 programs. Some $1.7 trillion worth of U.S. Treasury, Agency, and mortgage backed securities (MBS) was purchased by the Fed as a result of the as the 1st round of QE conducted between December 2008 and March 2010. An additional $600 million in purchases was authorized in connection with the 2nd round (QE2) between November 2010 and June 2011.

While the U.S. Federal Reserve balance sheet has grown to levels which have triggered alarm bells in some sectors, other central banks around the world likewise have accumulated massive holdings. The Peoples Bank of China (PBC) stands out with FX reserves estimated at $3,201 billion in value. Japan, Russia, Saudi Arabia and Taiwan follow up on the list with reserves estimated at $1,138, $516, $484 and $400 billion, respectively.

<table>
<thead>
<tr>
<th>Country</th>
<th>FX &amp; Gold Reserves (Billions USD)</th>
<th>Current Account Balance (Billions USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>$3,201 (Sep-11)</td>
<td>$305.4</td>
</tr>
<tr>
<td>Japan</td>
<td>$1,138 (Jun-11)</td>
<td>$166.5</td>
</tr>
<tr>
<td>Russia</td>
<td>$516 (Sep-11)</td>
<td>$71.1</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>$484 (Aug-11)</td>
<td>$70.1</td>
</tr>
<tr>
<td>Taiwan</td>
<td>$400 (Aug-11)</td>
<td>$40.6</td>
</tr>
<tr>
<td>Brazil</td>
<td>$352 (Aug-11)</td>
<td>($47.4)</td>
</tr>
<tr>
<td>India</td>
<td>$320 (Nov-11)</td>
<td>($51.8)</td>
</tr>
<tr>
<td>Korea</td>
<td>$311 (Jul-11)</td>
<td>$36.4</td>
</tr>
<tr>
<td>Switzerland</td>
<td>$289 (May-11)</td>
<td>$70.4</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>$277 (Jun-11)</td>
<td>$14.8</td>
</tr>
<tr>
<td>Singapore</td>
<td>$249 (Jul-11)</td>
<td>$46.3</td>
</tr>
<tr>
<td>Germany</td>
<td>$231 (Jun-11)</td>
<td>$188.4</td>
</tr>
<tr>
<td>Thailand</td>
<td>$186 (Jul-11)</td>
<td>$12.3</td>
</tr>
<tr>
<td>France</td>
<td>$182 (May-11)</td>
<td>($54.4)</td>
</tr>
<tr>
<td>Algeria</td>
<td>$175 (Dec-10)</td>
<td>$12.7</td>
</tr>
<tr>
<td>Italy</td>
<td>$170 (May-11)</td>
<td>($67.9)</td>
</tr>
<tr>
<td>United States</td>
<td>$143 (Jul-11)</td>
<td>($470.2)</td>
</tr>
<tr>
<td>Mexico</td>
<td>$140 (Nov-11)</td>
<td>($5.6)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>$134 (Jun-11)</td>
<td>$34.1</td>
</tr>
<tr>
<td>Indonesia</td>
<td>$122 (Jul-11)</td>
<td>$6.3</td>
</tr>
</tbody>
</table>

Notes
(1) Data from IMF and various central bank reports
(2) Data from CIA World Factbook for calendar year 2010

While the U.S. Federal Reserve website at http://www.federalreserve.gov/monetarypolicy/bst_renntrends_accessible.htm

The Fed announced a coordinated action in November 2011 with other central banks “to provide liquidity support to the global financial system.” Specifically, “[t]hese central banks have agreed to lower the pricing on … U.S. dollar liquidity swap arrangements by 50 basis points so that the new rate will be the U.S. dollar overnight index swap (OIS) rate plus 50 basis points.” This is effective between December 5, 2011 and February 1, 2013. See Federal Reserve Press Release dated November 30, 2011.
Thus, the composition of U.S. debt issuance is now heavily tilted towards Treasuries and away from mortgage related items that had historically dominated the statistics. Some $1,654.3 billion or 35.9% of the $4,609.3 billion in fixed income securities issued in the United States during the 1st through 3rd quarters 2011 represented U.S. Treasury debt. This figure is expanded substantially from the $752.3 billion in Treasury debt or 12.5% of $5,998.1 billion in total fixed income debt issued prior to the financial crisis in 2007.

The U.S. Treasury has increasingly looked to overseas customers to invest in its debt. The Peoples Republic of China (PRC) has become a prime customer and, as of September 2011, held some $1,134.1 billion in marketable U.S. Treasury debt securities, or 12.0% of the total of $9,466.4 billion. China surpassed Japan within the past year to become the single largest overseas holder of U.S. marketable debt. Overseas lenders now account for almost half (49.2%) of all U.S. Treasury debt holdings.

<table>
<thead>
<tr>
<th>Major Foreign Holders of U.S. Treasuries (September 2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holdings (Billions)</td>
</tr>
<tr>
<td>China</td>
</tr>
<tr>
<td>Japan</td>
</tr>
<tr>
<td>United Kingdom</td>
</tr>
<tr>
<td>Oil Exporters</td>
</tr>
<tr>
<td>Brazil</td>
</tr>
<tr>
<td>Caribbean Banking Centers</td>
</tr>
<tr>
<td>Taiwan</td>
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<tr>
<td>Switzerland</td>
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<tr>
<td>Hong Kong</td>
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<tr>
<td>Russia</td>
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<tr>
<td>Canada</td>
</tr>
<tr>
<td>...</td>
</tr>
<tr>
<td>Total Foreign</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Source: U.S. Treasury Department and SIFMA

The trend has been on the upswing as overseas holdings of marketable U.S. Treasury securities has increased rapidly in recent years and continues to grow, albeit at a somewhat decelerating rate.

SAFE HAVEN?

These sizable Treasury holdings obviously expose central banks to the risk of adverse price movement. Treasury securities are typically less volatile than other securities with comparable maturities that have greater perceived credit risks, but risks remain nonetheless. In particular, action on the part of Standard & Poor’s to downgrade U.S. sovereign debt in August 2011 has raised significant concerns.³

U.S. interest rates had declined to very low levels by early 2009 in the wake of the financial crisis. As such, the target Fed Funds rate, the Federal Open Market Committee’s (FOMC) primary monetary policy tool, continued to languish at an anemic 0-0.25%. While the FOMC announced in August 2011 its intent to hold rates at these low levels until mid 2013, that intent is certainly not binding.⁴
The Fed brought down rates even further with its current version of “Operation Twist” announced in September 2011. Per this policy, the Fed extended the average maturity of its security holdings, previously acquired through its QE and QE2 programs, by “rolling out” on the yield curve, i.e., selling shorter-term in favor of buying longer-term Treasury securities. This had the immediate impact of flattening the yield curve.\(^5\)

If the cumulative weight of these Fed programs to reduce rates on both the short- and long-ends of the yield curve should achieve their objective of stimulating growth, this implies that rates may reverse upwards.

While some central banks, including the U.S. Federal Reserve, are charged with a mandate of achieving economic and employment growth, an even more universal mandate assigned to central banks is maintaining a restrained rate of inflation. Actually, this mandate was generally interpreted rather differently by central banks in the wake of the subprime mortgage crisis where the concern was the deflationary pressures might cripple economic growth.

But after some years of near zero rates (at least in the United States), we are starting to observe creeping inflationary pressures. These pressures are demonstrable by examining the overall rate of growth in the U.S. Consumer Price Index (CPI) which was reported at +3.4% on a year-on-year (Y.O.Y) basis for November 2011. Clearly this figure is impacted by strong emerging market demand for raw commodities including food and energy. But even the CPI ex-food & energy is reported on the upswing at +2.2%.

Some early indications of growth are already creeping into economic releases. While the U.S. unemployment rate remains at an (unacceptably) high level, it has declined from its 2009 peak of 10% to 8.5% by December 2011. While 3rd quarter 2011 GDP was reported at only 1.8%, the figure has nonetheless been rising, after threatening to fall into negative territory, invoking discussion of a “double-dip” recession.

\(^3\) Standard & Poor’s downgraded the credit rating of long-term U.S. sovereign debt from a stellar AAA to AA+ based on “political risks and rising debt burden” with a negative outlook on August 5, 2011. This represented the first time that one of the three major credit rating agencies has downgraded U.S. sovereign debt since such ratings were initiated. Please refer to Standard & Poor’s Global Credit Portal Ratings Direct, “Research Update: United States of America Long-Term Rating Lowered to ‘AA+’ On Political Risks and Rising Debt Burden; Outlook Negative” (August 5, 2011).

\(^4\) The Federal Open Market Committee (FOMC) announced its intent to maintain the target Fed Funds rate at 0 to ¼ percent “at least through mid 2013.” See Federal Reserve Press Release dated August 9, 2011.

\(^5\) The Fed’s press release explained that it “decided today to extend the average maturity of its holdings of securities. The Committee intends to purchase, by the end of June 2012, $400 billion of Treasury securities with remaining maturities of 6 years to 30 years and to sell an equal amount of Treasury securities with remaining maturities of 3 years or less. See Federal Reserve Press Release dated September 21, 2011.
While the short-end of the U.S. yield curve is anchored by Fed monetary policy, the long-end of the yield curve is often said to be driven by economic growth and inflation prospects. This creeping inflation may, therefore, be a precursor to rising Treasury rates. And should these economic and inflation trends continue, that will eventually pressure rates higher and prices lower, with the obvious consequence of losses realized by Treasury investors including foreign central banks.

Thus, we submit that there is every reason for central banks with large U.S. Treasury security holdings to be wary in the pursuit of investment safety, liquidity and return. Just as a fixed income asset manager may seek to address the risks of declining investment values, central banks may seek to introduce similar risk management or hedging programs with the use of derivatives instruments including CME Group Treasury futures.

**MEASURING RISK**

There is an old saying – “you can’t manage what you can’t measure.” In 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%.

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 a 01” or simply “DV of a 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)**

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

Source: Bloomberg

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).

**MANAGING DURATION**

Interest rate futures may readily be utilized to adjust the average weighted duration of a portfolio of fixed income securities. Certainly fixed income portfolio managers routinely seek to increase duration when rate declines (price advances) are anticipated; or, decrease duration when rate increases (price decline) are forecast. Thus, a central bank may likewise manage its Treasury holdings by buying futures to extend duration; or, selling futures to reduce duration, as conditions dictate.

E.g., consider a hypothetical fixed income portfolio held by a central bank and valued at $100 million (USD) with a weighted average duration of 4 years. In anticipation of increasing rates and declining prices, the portfolio manager at the central bank decides to execute a temporary tactical shortening of portfolio duration from 4 years to 3 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.

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

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.\(^6\)

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.\(^7\)

Using these inputs, the appropriate hedge ratio may be calculated as short 191 futures contracts.

\[ HR = \left( \frac{3 - 4}{4} \right) \times \left( \frac{40,000}{44.25} \frac{0.8453}{0.8453} \right) = -191 \]

By selling 191 Five-year T-note futures against the portfolio, the asset manager may be successful in pushing his risk exposure as measured by duration from 3 to 4 years.

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\(^6\) 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 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.

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If yields advance by 100 bps, the value of the adjusted portfolio may decline by approximately 3% or $3 million. But this is preferable to a possible $4 million decline in value if the central bank had maintained the portfolio duration at the original duration of 4 years. Thus, the asset manager preserved $1 million in portfolio value. Or, to put it in a slightly different perspective, the central bank successfully preserved 100 basis points (1.00%) in portfolio value. In current vernacular, this may be considered an “alpha” preservation or enhancement technique.

Of course, the central bank portfolio 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 portfolio manager to maintain his current holdings while adjusting duration exposures quickly and at minimal costs.

**MANAGING YIELD CURVE EXPOSURE**

Just as a central bank portfolio 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 a central bank is forecasting 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 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 central bank’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 central bank 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 BPV10-yr futures is the effective basis point value of the 10-year T-note futures contract; and, BPV2-yr futures is the effective basis point value of the 2-year T-note futures contract.

The effective BPV of a Treasury futures contract (BPVfutures) may be found using the following formula.

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7 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.
Where BPV<sub>futures</sub> is the basis point value of the cheapest-to-deliver security against that futures contract; and, CF<sub>ctd</sub> is the conversion factor associated with the cheapest-to-deliver security.

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. Thus, the BPV of the 2-year T-note futures contract may be calculated as $40.96.

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

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.

\[
SR = \frac{80.91}{43.03} = 1.880
\]

How much of this spread should the portfolio manager transact? This decision is contingent upon the central bank’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. 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 \[=1.880 \times 41\] contracts.

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 \[= 41 \text{ contracts} \times 40 \text{ bps} \times 80.91\].

This further implies that the 77 long 2-year futures will decline in value by roughly $33,133 \[= 77 \text{ contracts} \times 10 \text{ bps} \times 43.03\]. 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.

**USING OPTIONS TO ALTER PORTFOLIO**

CME Group Treasury futures contracts provide central bank portfolio managers with the flexibility to alter the risk exposure of a Treasury portfolio quickly and efficiently. As discussed above, futures are ideal for altering the effective duration of a portfolio in anticipation of possibly advancing or declining yields. They may further be used to alter the risk profile of the portfolio in response to a changing shape of the yield curve.

8 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.

10 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 \[=19 \text{ contracts} \times 43.03\]; while 10 short 10-year T-note futures should generate an offsetting loss of $809 \[=10 \text{ contracts} \times 80.91\]. Thus, the two positions offset in the event of a parallel shift in the curve.

11 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.
But in addition to the use of futures, CME Group further offers options exercisable for Treasury futures. These products provide further flexibility to alter one’s risk exposure in anticipation of changing market conditions.

Let’s consider two straightforward and popular strategies – the purchase of put options as a form of “price insurance” and the sale of call options or “covered call writing” as a means of enhancing yields in a generally stable yield environment.

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-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 central bank wishes to completely hedge the portfolio using puts.

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

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.

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 central bank has forfeited 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.

Buy put options → Lock in “floor return” & retain upside potential

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.

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.
YIELD ENHANCEMENT WITH CALLS

If the central bank’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. 12

E.g., let’s revisit our example of the central bank 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 central bank 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.

CONCLUDING NOTE

The role of the world’s central banks has expanded dramatically over the years to the point that they are heavily relied upon by their respective governments as well as the private sector to provide economic leadership. This role has become particularly enhanced as a result of recent episodes including the subprime mortgage crisis and the European sovereign debt crisis.

12 These examples assume that the central bank 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.