Introduction

This module applies to the Federal Home Loan Banks (FHLBanks), Fannie Mae, and Freddie Mac (collectively, the regulated entities). The regulated entities hold investments to meet sufficient current and potential liquidity needs and to augment income. Typically, the regulated entities invest for liquidity purposes in overnight and term Federal funds, certificates of deposit, commercial paper, repurchase agreements, money market accounts, and short-term Treasury obligations. For income generation, they generally invest in term instruments such as agency pass-through mortgage-backed securities (MBS) and commercial MBS (CMBS), pay-through private-label MBS (PLMBS) and collateralized mortgage obligations (CMOs)[1], mortgage revenue bonds (MRB)[2], and longer-term Treasury obligations. The two Enterprises invest in individual loans that they guarantee but have not yet securitized or that they are unable to securitize. While the Enterprises hold the loans in their investment portfolios, the examiner should use the workprogram and guidance found in the Examination Manual's Credit Risk Management module to review these assets.

Short-term liquidity portfolios typically contain some credit risk, but generally have negligible interest rate risk. Conversely, longer-term portfolios (term portfolios) have credit risk and interest rate risk, both of which can range from moderate to significant. Term investments are typically highly-rated at the time of purchase, although the basis for the high ratings can be different from those for the liquidity portfolio. In particular, the amount and quality of collateral and credit enhancements for PLMBS and CMOs usually drives the ratings, as opposed to the issuer's credit worthiness. The term portfolio is generally liquid absent systemic market stress and is comparatively higher yielding than the liquidity portfolio. The term portfolio is used primarily to generate earnings, but can also be used for other purposes, normally within broad balance sheet management context. Term portfolios are usually managed separately from the liquidity portfolios and require regular performance and interest rate risk monitoring.

In recent years, the investment portfolios of some of the regulated entities have grown to the point that these investments represent a significant portion of the balance sheet and source of income. With the increased investment activity, the portfolios have often presented greater risk to the institution.

For further information on investment portfolio management, see the tutorial on financial concepts that is attached as Appendix A at the end of this module.

Investment Securities Risks

A number of risks are associated with managing investment portfolios. As with most activities they engage in, the regulated entities need sound corporate governance that establishes the appropriate controls to guide and monitor certain activities. Investments present certain market,

[1] Also known as Real Estate Mortgage Investment Conduits (REMICs).
[2] The Federal Home Loan Banks refer to MRBs as Housing Finance Agency (HFA) bonds.

credit, operational and country risks to an organization and will affect the regulated entity's overall financial condition and performance. A discussion of the primary risks associated with investment securities and money market assets follows.

1) *Corporate Governance (Board and Senior Management Oversight)*

The board of directors and senior management are ultimately responsible for the regulated entity's investment activities. Risk management standards for investment portfolio management should be developed and included in policies and procedures. The board and senior management have the responsibility to fully understand the risks involved in the investment management practices and the potential exposure to loss resulting from investment activities. The board and management should determine the tolerance for risk and should ensure risks from investment activities are consistent with the institution's mission, and are effectively measured, monitored, and controlled. The board and management must ensure appropriate, regular reporting is in place to monitor potential risks to the institution.

Some of the more common weaknesses in a regulated entity's failure to establish a system of sound corporate governance include:

a) Key risks and controls are not adequately identified, measured, monitored, and controlled.
b) The regulated entity has not implemented a sound risk management framework composed of policies and procedures, risk measurement and reporting systems, and independent oversight and control processes.
c) Management has not sufficiently analyzed new products or activities, taking into account pricing, processing, accounting, legal, risk measurement, audit, and technology.
d) Risk management, monitoring, and control functions are not independent of the position-taking functions.
e) Duties, responsibilities, and staff expertise, including segregation of operational and control functions, are not adequately defined.
f) Independent audit coverage and testing is limited; auditors are inexperienced or lack the technical expertise to test the control environment.

2) *Market Risk*

The investment term portfolio, which often contains longer-term, fixed-rate assets, is usually a significant source of interest rate risk.[3] From an interest rate risk standpoint, "price sensitivity" refers to how much a security's price fluctuates when interest rates change. Regardless of the security type, a security's price sensitivity is primarily a function of the following:

a) Maturity;

[3] Fannie Mae and Freddie Mac use the term "retained portfolio" when referring to the investment portfolio.

b) Option features;
c) Coupon rate; and
d) Yield level.

A discussion of how each of these security's price sensitivity functions influences the interest rate risk exposure of a regulated entity follows.

Maturity

For securities, maturity is an important price sensitivity determinant. A long-term security's price will change more than the price of a short-term security under a parallel change in interest rates.

Example: If interest rates rise 100 basis points, a 30-year, 5 percent coupon Treasury bond would lose nearly 14 percent of its value, while a two-year, 5 percent coupon Treasury note would lose less than 2 percent.

Option Features

Options can either increase or decrease a security's potential for price changes, depending upon the option type and who owns it. A call option allows the security's issuer to redeem the full amount of the obligation before its maturity date. When a callable bond is purchased, for example, the investor has sold, or is "short," the option, which means the issuer can call the bond prior to maturity according to the contractual terms. In exchange for selling this option, the investor receives a higher yield. A callable security's price sensitivity will behave differently depending upon whether it is a non-amortizing or amortizing security.

A put option allows the investor to return the bond at par value to the issuer prior to its stated maturity. Here, the investor owns the option and will exercise this right when interest rates have risen, since they can reinvest the proceeds at higher market yields. The put option thus limits price declines when rates rise, because the investor can redeem the bond at par on a specified date. When interest rates fall, however, the security's price will rise like an option-less bond. A put bond's asymmetry gives it an attractive risk-return profile, which is why investors will accept lower yields.

Non-Amortizing Securities

Non-amortizing securities, which are also referred as "bullet" securities, have only one principal payment. That payment sometimes occurs before maturity and it could even exceed par value if it has a call premium. For example, a security could be callable at a dollar price of 102 percent of its par value.

The call option on non-amortizing securities limits price increases when rates fall because investors are not willing to pay large premiums if the issuer can redeem the bonds prior to maturity. The three most common types of call options are listed below.

a) An American call option allows the issuer to call a security at any time prior to the expiration date.
b) A European call option only permits the issuer to call the security on the option's expiration date.
c) A Bermudan call allows the issuer to call the security at predetermined intervals over the security's life.

Example: The issuer of a five-year bond with a Bermudan call option could allow the issuer to call the bond in two years or on any coupon payment date thereafter. This type of bond is often referred to as a "five non-call two." Every possible call date will have a direct bearing on the security's price sensitivity.

If interest rates rise, a non-amortizing callable bond's price sensitivity will ultimately approach the same sensitivity of non-callable securities with an identical maturity. For instance, the previously described "five non-call two" bond will initially have the price sensitivity of a two-year non-callable bond. However, if interest rates rise, the bond would eventually depreciate like a non-callable five-year security. Therefore, callable securities can lose value at an increasing rate as the security's effective maturity becomes longer.

Amortizing Securities

Amortizing securities, such as MBS, have some of the non-amortizing securities' performance characteristics. In the case of MBS, the mortgage lender for the MBS's underlying loans sells a call option to the borrower since the borrower has the right to prepay the loan, in essence calling the debt. Likewise, a mortgage security investor has essentially sold a call option to the mortgage borrower since the investor is relying upon the continuation of the underlying loan's cash flow. Homeowners have an economic incentive to exercise the call option when interest rates fall because they can refinance at lower interest rates. The borrower's prepayment option limits a mortgage security's price appreciation when interest rates fall.

When interest rates rise, amortizing securities may also lose value at an increasing rate, as their average lives extend. Average life refers to the average length of time a dollar of principal remains outstanding. For example, a mortgage security could have an estimated average life of five years. However, as rates go up, the average life could extend to seven years because fewer homeowners would have an incentive to prepay and thus, its price sensitivity would become similar to a seven-year security, rather than a five-year security.

Amortizing securities can be pass-through[4] or structured securities. In a pass-through security, investors get their pro rata share of principal and interest payments. If an investor owns one percent of the security's par value, the investor will receive one percent of the cash flow. The underlying mortgages' cash flow "passes through" to investors. In a structured security, investors share the cash flows on a prioritized basis by purchasing into a "tranche" or class. The security's prospectus details when the investor will receive interest, principal, and/or prepayments.

Structured securities like CMOs often have very complex structures and can lose value at a significantly increasing rate. When rates change, a security can be structured so that some tranches could have limited cash flow variability and other tranches could have substantial cash flow uncertainty.

Example: A higher-risk CMO tranche could have an average life that changes from 2 years to 20 years with a 200 basis point increase in interest rates. In this example, higher-risk refers to the tranche's cash flow variability, not its credit quality, although underwriters can create structured securities that combine higher average life sensitivity with lower credit quality.

The highest yields go to those tranches that, by design, exhibit the most volatile average lives. Such tranches absorb the prepayment risk from the other tranches by receiving excess principal cash when prepayments rise. When prepayments are slower, these tranches may not receive principal cash flow at all in order to protect or support the CMO's other tranches. The protected tranches could even have lower risk than a pass-through security. Although there are partial calls in the underlying mortgages, some tranche's payment prioritization rules can result in a complete call of the tranche as rates fall, making it similar to a non-amortizing security.

As is illustrated in the above examples, the risk-return profile of callable (non-amortizing) and prepayable (amortizing) securities is not symmetrical. Investors in these securities have limited upside price potential and are therefore unwilling to pay large premiums for callable assets. Investors use the term "price compression" to refer to these securities' inability to trade at prices significantly above par. However, these securities can have significant downside price potential when rates increase. To compensate investors for these asymmetric and unfavorable risk profiles, callable and prepayable securities must offer higher yields. The following table summarizes callable and prepayable securities:

[4] Sometimes referred to as a pay-through security.

Type	Cash Flow Priority	Sensitivity
Callable	Not applicable.	Limited price upside; can depreciate at an increasing rate when interest rates rise as effective maturity lengthens.
Amortizing: pass-through	Pro-rata. Examples: Ginnie Mae, Fannie Mae & Freddie Mac MBS.	Limited price upside; can depreciate at an increasing rate as effective maturity lengthens.
Amortizing: structured	Determined by payment rules. Examples: CMO tranches.	Depends upon security structure. Some tranches can have very high price and cash flow risk and others very low price and cash flow risk.

Coupon Rate

There is an inverse relationship between a security's coupon and price sensitivity. Securities purchased at a discount have more price sensitivity than securities purchased at a premium. A discount security has a coupon lower than the required market yield and will be priced below par value. A premium security has a coupon that exceeds the required market yield and will be priced above par value. The most discounted of all securities is a zero-coupon bond, which is priced at a discount and redeemed for par value at maturity. Its only cash flow is the return of par value at maturity. For any given maturity, a zero-coupon bond will have the most price sensitivity.

The inverse relationship between coupon rate and price sensitivity results from the cash flow distribution. A high-coupon security's cash flows will include more interest payments throughout the security's life than a lower coupon bond. Therefore, a higher-coupon bond will have a higher proportion of its cash flow returned sooner than a lower coupon bond. Securities with earlier cash flow will have less price sensitivity. A zero coupon bond will have the most price sensitivity of bonds with the same maturity because its only cash flow is the par value received at maturity.

Yield Level

Non-callable bonds have more price sensitivity when market yields are low as opposed to when market yields are high, because of the curved or "convex" nature of the relationship between price and yield.[5] This relationship means that non-callable bonds rise in value at an increasing rate when interest rates fall and their value declines at a decreasing rate when interest rates rise.

[5] Refer to the Interest Rate Risk Management module for information pertaining to convexity.

The following table summarizes the above price sensitivity factors:

Factor	Higher Sensitivity	Lower Sensitivity
Maturity	Long maturities	Short maturities
Options	Sold calls: limited upside price gains; full downside price exposure	Purchased puts: limited downside price losses; full upside price potential
Coupon	Lower coupons	Higher coupons
Yield Levels	Low yields	High yields

Floating-Rate Securities

Investors often mistakenly assume that floating-rate securities have little price sensitivity risk, although there are features that can cause them to have higher price sensitivity including embedded options, long maturities, and credit risk.

Example: Consider a security that has a LIBOR plus 50 basis points coupon with a 7 percent cap. The cap prevents the coupon rate from exceeding 7 percent, even when LIBOR exceeds 6.50 percent.

The longer cash flows remain outstanding on floating-rate securities, the greater their potential price decline, since the investor faces a lengthier period of having the coupon capped at a below-market rate. If a floating rate CMO's average life increases from 3 years to 15 years when rates rise, reducing prepayments, the investment's value is likely to fall sharply. This explains why CMO floaters with high average life variability offer greater spreads over LIBOR than floaters with lower average life variability. Adjustable-rate mortgage securities generally have both periodic and lifetime caps and floors.

Floating-rate assets can also have high price sensitivity without caps.

Example: An investment with a LIBOR plus 50 basis points coupon, issued at a time when investors demanded 50 basis points over LIBOR. The security will be issued at par, but if at some future date investors demand a 150 basis point spread over LIBOR, then the security's spread is 100 basis points "below the market" and will trade at a discount. This 100 basis points loss would be comparable to a fixed-rate security yielding 5 percent when the market demands a 6 percent yield.

The longer a security's maturity, the more depreciation it will have.

A more complex type of floater is an inverse floating-rate security, which has a coupon that increases when market rates decrease.

Example: An inverse floater could have a coupon of 8 percent minus three-month LIBOR. Investors typically purchase these securities when the yield curve is very steep, as the coupon

formula often creates a rate well above short-term financing rates. However, if LIBOR increases, the coupon could drop very low and possibly to zero.

As inverse floaters could lose significant value depending on the coupon formula, regulated entities should exercise caution with such securities.

Some floating-rate securities have traded with prices well below par value, even without credit problems due to structural risks such as interest rate caps and highly variable cash flows. Regulated entities should therefore fully understand the price sensitivity imposed by the security's structure, maturity, option features, and credit risk.

Portfolio Sensitivity Limits and Measurement

The investment portfolio typically has a significant effect on a regulated entity's overall interest rate risk profile. Therefore, the regulated entity should consider instituting investment related sensitivity limits. For example, the regulated entity could establish limits as a percent of capital or earnings. For further interest rate risk management details, refer to the examination module on Interest Rate Risk Management.

The presence of a few securities with high risk may, or may not, be a supervisory concern. Whether a security is an appropriate investment depends upon such factors as the regulated entity's capital level, the security's contribution to the aggregate portfolio's risk, and management's ability to understand, measure, monitor, and manage the security's inherent interest rate risk and potential effects upon liquidity. Additionally, the process and environment that led to acquiring higher-risk securities should be assessed to ascertain if the board's risk appetite has changed or if the regulated entity's risk management process is defective. The assessment should include determining if there were policy exceptions, a breakdown of an internal control process, or a failure to properly report the securities on the board's investment activity reports.

A portfolio sensitivity analysis is an effective way for management to gain an understanding of the portfolio's risks. The analysis can facilitate asset/liability management decisions and the establishment of policies or guidelines to control aggregate portfolio interest rate risk.

Asset/Liability Management Issues

The emergence of the derivatives market led to the creation of securities with complex cash flow profiles. Investment professionals, using derivatives, can customize a security's structure to the investor's risk/reward profile of choice. As a result, investors now have more investment choices. The increasing complexity of these securities, however, has complicated asset/liability risk measurement and management decisions.

A decline in interest rates can cause significant prepayments and early redemptions for regulated entities holding a large percentage of their portfolio in securities with options (*e.g.*, mortgage securities). The portfolio's yields could fall significantly, as high-yielding assets pay off and are reinvested at the lower market yields. In an attempt to replace the high yields lost, management may be tempted to invest in additional securities with more options. This strategy carries significant risks, since a subsequent rise in interest rates could extend maturities, accelerate depreciation, and depress the portfolio's economic value when interest rates change. Therefore, management's evaluation of the investment portfolio's risk should be part of an overall assessment of asset/liability management activities and interest rate risk.

3) *Credit Risk*

Credit risk is the risk that an issuer and/or guarantor will default on principal or interest payments or that a collateralized security has insufficient collateral or credit enhancements to maintain full payments of principal and interest. Exposure to credit risk can result in actual credit losses and write-downs or widening credit spreads, which reduces the security's market value. Other sources of investment-related credit risk include those pertaining to securities dealers and custodians. The performance of many securities relies on the quality of the underlying assets. While some securities are collateralized with high-quality loans or investment securities, other securities have poor or marginal quality assets. Credit risk also arises from the fact that the issuer and/or guarantor will fail to pay as agreed; the securities dealer could default prior to the settlement date; or a securities custodian's failure could prevent a regulated entity from recovering all of its assets. The two Enterprises invest in individual loans that they guarantee but have not yet securitized or that they are unable to securitize. While the Enterprises hold the loans in their investment portfolios, the examiner should use the workprogram and guidance found in the Examination Manual's Credit Risk Management module to review these assets.

<u>Credit Ratings by a Nationally Recognized Statistical Rating Organization</u>

Based on current regulations, the regulated entities may only purchase investment grade securities, which are those in one of the four highest rating categories by a Nationally Recognized Statistical Ratings Organization (NRSRO). The three most widely known NRSRO rating services are Moody's Investors Service (Moody's), Standard & Poor's (S&P), and Fitch Ratings (Fitch). The tables below show a summary of the NRSRO investment-grade and noninvestment grade ratings. In addition to the grades outlined below, the rating agencies have in-grade relative ranking methodologies. Moody's uses 1, 2, and 3 while S&P and Fitch use +/- for in-grade rankings.

Summary of Investment Grade Rating Systems

Moody's	S&P	Fitch	Description
Aaa	AAA	AAA	Extremely strong; Highest quality.
Aa	AA	AA	Very strong; high quality by all standards.
A	A	A	Upper medium grade; strong capacity to meet commitments; high credit quality.
Baa Lowest eligible grade is Baa3	BBB Lowest eligible grade is BBB-	BBB Lowest eligible grade is BBB-	Medium grade; adequate capacity to meet commitments; good credit quality.

Summary of Non-Investment Grade Rating Systems

Moody's	S&P	Fitch	Description
Ba	BB	BB	Speculative elements; faces major uncertainties, but deemed likely to meet payments when due.
B	B	B	Generally lack desirable investment characteristic. Highly speculative; currently has ability to meet commitments, but faces major uncertainties which could lead to inadequate capacity to meet its commitments.
Caa Ca C	CCC CC C	CCC CC C	Poor standing; may be in default (Moody's); currently vulnerable to non-payment; high default risk.
	D	DDD DD D	In default; Fitch ratings reflect recovery prospects.

Management should understand the NRSRO evaluation criteria for the security type under consideration and the credit rating's scope. For most securities, the assigned credit rating applies to both principal and interest. However, underwriters can structure securities with a highly-rated principal component, but with no rating for the interest component. Such securities may offer very high yields because of the uncertainty of collecting interest payments. The inconsistency of the high yields with the principal's rating should serve as a "red flag" for investors.

NRSRO ratings can be used to help make investment decisions and monitor the investment portfolio's credit risk. Ratings are a convenient means of assessing the investment portfolio's credit quality and should be periodically updated. Services are also available that alert management of NRSRO rating changes. However, exclusive reliance on ratings can be an unsafe and unsound practice because credit ratings may lag actual changes in credit quality. Furthermore, NRSRO ratings only assess credit risk and do not incorporate liquidity or price risk. There have even been instances where issuers maintained investment grade ratings until just before they defaulted. Regulated entities should base their assessment of an investment's credit risk on their own financial analysis and not rely on the ability of the NRSROs to evaluate potential risks.

Issuer/Guarantor Credit Risk

There is a fundamental difference between a bond that was assigned a strong credit rating because of the issuer and/or a third party credit enhancement and a bond given a strong rating because of subordination or excess spread/overcollateralization. The issuer or third-party credit enhancer, such as a guarantor or surety provider, may refuse or be unable to honor its obligation if the issuer defaults. Management should therefore carefully evaluate the issuer and/or third-party credit provider to assess their ability to honor their obligation. Likewise, management should understand the security's structural credit support.

Subordination allows some tranches to provide the credit enhancement for other tranches by having a lower claim on the security's cash flows.

Example: A $100 security may have an $85 senior tranche, a $12 mezzanine (second loss) tranche, and a $3 equity (first loss) tranche. The senior tranche may carry an Aaa/AAA rating because of the enhancement the other two tranches provide. In this type of structure, the senior tranche would suffer a loss only after the two subordinated tranches have undergone complete losses. The mezzanine tranche would experience losses only after the equity tranche has suffered a complete loss.

Management should ensure the credit risk monitoring procedures include reviewing the amount of protection still provided by the subordinate tranches for the regulated entity's more senior tranches.

Excess spread is derived from the difference between the underlying collateral's coupon and the security's coupon.

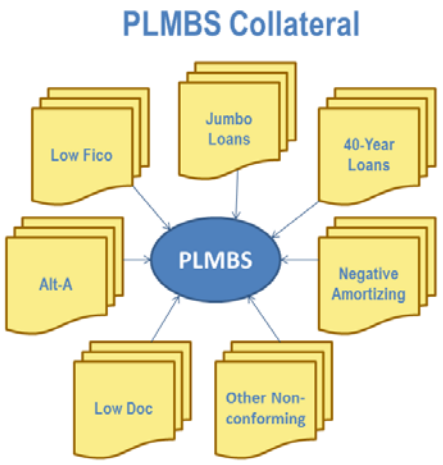
Example: A security with a 4 percent coupon could be backed by mortgages paying 7 percent interest. The 3 percent excess spread can be used to absorb collateral losses or build overcollateralization to its target level.

Excess spread also allows the security coupon payment to still be made even if some of the underlying loan payments are late or default. However, once the excess spread has been used to cover losses for that month, the remaining monthly excess spread not needed to achieve the overcollateralization target is typically allocated to a residual certificate holder.

Investors do not have a universal preference for the type of credit enhancement. However, structural subordination and excess spread/overcollateralization have become more common over time, due to the declining number of firms rated Aaa/AAA, as well as investors' desire to avoid undue concentrations in any single third-party credit enhancer. Additionally, many firms no longer offer credit enhancement services.

Private-Label Mortgage-Backed Securities (PLMBS)

PLMBS holdings are a significant source of credit risk for a number of the regulated entities. A PLMBS is a residential mortgage-backed security where the underlying loans are not guaranteed by the U.S. government or a government-sponsored agency. The collateral is often referred to as "nonconforming loans" because the loans usually do not meet all the requirements for a government or government agency guarantee. Below is a diagram that depicts some of the nonconforming type collateral used to create PLMBS.



To create PLMBS, the issuer bundles the loans, sells them into a bankruptcy-remote trust, and creates bonds backed by the underlying loans in the trust.[6] The issuer then structures the bonds by separating the underlying mortgages' risk into tranches to spread the risk among investors with assorted risk tolerances. Additionally, the structuring builds in credit support such as subordination, overcollateralization, or excess spread. This support allows the bonds to receive investment grade NRSRO ratings.

[6] Refer to the Securitization section for additional information on how PLMBS are created.

Asset-Backed Securities

Asset-backed securities (ABS) are securities backed by loans or leases such as home equity loans, auto loans, credit cards, aircraft leases, and so on and have some form of credit enhancement embedded into the structure. The Enterprises generally purchase ABS collateralized by credit card receivables, auto loans, and student loans whereas the FHLBanks are only authorized to acquire ABS collateralized by manufactured housing loans and home equity loans. Some ABS are created in a process similar to PLMBS, where the ABS issuer bundles similar loans (*e.g.*, auto loans), sells them into a bankruptcy-remote trust, and creates bonds backed by the underlying loans. ABS can also be created by bundling assets, such as credit card receivables and home equity loans, into a revolving non-amortizing structure, which typically have senior/subordinated tranches. Both structuring types build in credit support such as subordination, overcollateralization, or excess spread that allowed the bonds to receive investment grade NRSRO ratings. Prior to purchase, management should understand the ABS structure's effect on the regulated entity's investment portfolio.

Money Market Asset Counterparty Credit Risk

Credit risk posed by money market assets, such as Federal funds sold, certificates of deposit, bankers' acceptances, and commercial paper, can be managed by establishing credit lines. Counterparty credit relationships should always involve internal financial analysis, with the depth and frequency of analysis dictated by the exposure size. External ratings can be a part of the analysis, but cannot be exclusively relied upon. The line amount should be lowered as the tenor of the exposure increases, because the longer the term, the greater the credit uncertainty.

Example: A regulated entity might give a counterparty a $5 million overnight facility, but limit its 6-month line to only $3 million.

The credit limit should cover a counterparty's aggregate credit exposure, and include exposures from investments and derivative contracts.

The following table identifies the short-term ratings scale used by the largest rating agencies:

Moody's	S&P	Fitch	Interpretation
A-1	P-1	F-1	Superior ability to repay
A-2	P-2	F-2	Strong ability to repay
A-3	P-3	F-3	Acceptable ability to repay
Not prime	B	B	Speculative
	C	C	High default risk
	D	D	Default

The rating agencies do not assign short-term ratings using the same methodology as for long-term ratings. Each short-term rating category covers a range of longer-term ratings.

Example: A P-1 rating could "map" or be equivalent to a long-term rating as high as AAA or as low as A-.

Because commercial banks and securities dealers with whom a regulated entity may conduct business occasionally fail, credit risk from transactions with the banks and dealers is an important consideration. Regulated entities should establish and enforce credit limits on exposures with the counterparties. While personnel in the regulated entity's treasury unit may execute transactions within these limits, qualified, independent credit personnel should establish and authorize them.

Securities Dealer Credit Risk

Regulated entities assume credit risk when buying and selling securities to and from a dealer. Credit risk is a function of the length of the settlement period between the trade date and settlement date and the security's price sensitivity. The risk rises as both the settlement period and the security's price sensitivity increase. Securities transactions rarely settle on the trade date, particularly newly issued CMOs, which can take as long as 60 days to settle.

The risk during a purchase is that the dealer will be unable to complete the trade by delivering the security to the regulated entity. If the security's value has risen and the dealer defaults prior to settlement, the regulated entity could lose the appreciation. The credit risk exposure when selling a security is that the dealer could default before the settlement date and that the security's value could have declined between trade date and the default date. The regulated entity's opportunity loss equals the difference between the agreed-upon sale price and the security's lower value at default.

When settling securities trades, regulated entities should use a delivery versus payment (DVP) process whenever possible. In a DVP process, the regulated entity only pays for securities upon delivery.

Example: On a Treasury security transaction, the selling dealer delivers the securities per the regulated entity's delivery instructions, such as to the regulated entity's Federal Reserve Bank account. When the dealer delivers the securities, the Federal Reserve Bank simultaneously pays the dealer and charges the regulated entity's account. Similarly, during a sale, the regulated entity should deliver the security against the payment so that payment and delivery occur at the same time. The regulated entity would receive immediate credit to its Federal Reserve account as soon as it has delivered the security to the purchaser.

To control the risk of unsettled trades, regulated entities should establish an approved dealer list and consider dealer limits on the allowable volume of unsettled trades. Periodic review of dealer financial information allows the regulated entity to assess the dealer's continuing ability to

perform on securities transactions. Credit reviews are particularly important for thinly capitalized dealers.

FHLBank Adverse Classifications or Criticisms[7]

Investment quality securities held by an FHLBank normally do not exhibit weaknesses that justify an adverse classification rating. However, published credit ratings may lag demonstrated changes indicative of credit quality deterioration, and FHLBank examiners may classify or criticize a security notwithstanding an investment grade rating. For securities with split ratings, investment quality ratings by one or more rating agencies and sub-investment-grade ratings by others, examiners will generally classify such securities, particularly when the most recent rating is not investment quality.

The table below reflects the FHFA's general approach for classifying a security. To reflect asset quality properly, however, an examiner has discretion to not adversely classify a below-investment-grade security if other analysis indicates the security does not have a well-defined weakness.

Type of Security	Substandard Classification	Doubtful Classification	Loss Classification
Investment quality debt securities with temporary impairment	N/A	N/A	N/A
Investment quality debt securities with Other Than Temporary Impairment (OTTI)	N/A	N/A	Impairment
Sub-investment quality debt securities with temporary impairment	Amortized Cost	N/A	N/A
Sub-investment quality debt securities with OTTI, including defaulted debt securities	Fair Value	N/A	Impairment

Examiners should criticize or adversely classify securities using the following categories:

Substandard - Exposure classified ***Substandard*** is protected inadequately by obligor's current net worth and paying capacity or by the collateral pledged, if any. There must be a well-defined weakness or weaknesses jeopardizing the regulated entity's ability to liquidate the security. This exposure level is characterized by the distinct possibility that the regulated entity will sustain some loss if the deficiencies are not corrected.

[7] This section is not applicable to the Enterprises.

Doubtful - Exposure classified ***Doubtful*** has all the weaknesses inherent in those exposures classified ***Substandard*** with the added characteristic that the weaknesses make full collection or liquidation highly questionable and improbable, based upon currently known facts.

Loss - Exposure classified ***Loss*** is considered uncollectible and of such little value that the exposure's continuance as a bankable asset is not warranted. This classification does not mean that the exposure has absolutely no recovery or salvage value; rather, it is not practical or desirable to defer writing off this essentially worthless asset, even though partial recovery may occur in the future.

Special Mention - A ***Special Mention*** exposure has potential weaknesses that deserve management's close attention. If left uncorrected, these potential weaknesses may result in deterioration of the repayment prospects for the exposure or in the regulated entity's credit position at some future date. ***Special Mention*** is not adversely classified and does not expose a regulated entity to sufficient risk to warrant adverse classification.

4) *Operational Risk*

Operational risk is the risk of possible losses resulting from inadequate or failed internal processes, people, and systems or from external events. Operational risk includes potential losses from internal or external fraud, improper business and accounting practices, fiduciary breaches, misrepresentations, unauthorized investment activities, business disruption and system failures, and execution, delivery, and process management failures. A well-managed regulated entity will have a sound internal control system in place to mitigate investment transaction risks. Large dollar volumes of securities can be purchased or sold by telephone, fax, or email exposing the regulated entity to operational losses if the transaction process has insufficient controls. The basic control mechanisms every investment unit should have include:

a) Separation of duties;
b) Authorizing specific personnel to conduct portfolio trades;
c) Timely reconcilements;
d) Effective reporting processes;
e) Data integrity checks; and
f) Competent personnel.

<u>Separation of Duties</u>

The board and management should establish a control culture that stresses strong operating controls and an independent audit process. In particular, the persons authorized to purchase or sell securities should not have any authority or responsibility to maintain official investment accounting records or risk management reporting.

Dealer confirmations should be transmitted to operations (mid- or back-office) personnel rather than portfolio (front-office) personnel. The control structure should require portfolio personnel to report immediately all transactions to the operations area, which can compare the transaction details to the security dealer's information. Early comparison of transaction details can avoid costly settlement disputes and permit verification that all activity reported by portfolio personnel and the dealer has in fact occurred.

Example: Operations personnel should ensure the dealer's confirmation has a matching trade ticket or other originating documents previously reported by portfolio personnel. Similarly, operations personnel should verify that all internal trade tickets match an incoming deal confirmation.

Authorization of Investment Personnel

The board or management should designate personnel authorized to conduct investment transactions and place limits on the transaction size based upon the individual's role and responsibilities and the security type. Further, regulated entities should keep the authorization list current and inform securities dealers that only personnel on this list may initiate trades. Securities transactions can quickly commit a large percentage of the regulated entity's capital; therefore, the authority should be strictly limited to designated personnel.

Timely Reconcilements

Management should implement procedures to ensure timely reconcilements of investment account records and securities holdings.

Example: In addition to reconciling investment account records to the general ledger, operations personnel should also reconcile portfolio holdings to custodian safekeeping records.

This procedure ensures that an independent party confirms the existence of the assets on the regulated entity's books. Custodians for investment securities usually include a correspondent bank, a Federal Reserve Bank, or a broker/dealer.

Effective Reporting Processes

Portfolio personnel should immediately report purchase and sale transactions to operations personnel in order for them to arrange for settlement. A security settles when the buyer receives delivery from the seller and makes payment. As is stated previously, in a DVP settlement the delivery and payment occur simultaneously. The buyer provides its settlement instructions to the seller, who then delivers the securities according to those instructions. Failure to communicate transactions in a timely manner can result in expensive security "fails." A fail occurs when a security settlement does not happen on the scheduled date. Either the seller fails to deliver to the buyer or the buyer fails to receive from the seller.

"Fails-to-deliver" are expensive because the regulated entity stops accruing interest income on the settlement date. If it delivers the securities a day late, the regulated entity carries the investment as a nonearning asset for that day. A "fail-to-receive" can occur when the portfolio manager purchases a security and does not instruct operations personnel to receive the security. The dealer will attempt to deliver the security but lacking any instructions to receive it, operations personnel may refuse delivery. In a "fail-to-receive" instance, the securities dealer will likely claim compensation or interest due from the regulated entity for the dealer's loss of interest income on the transaction. The dealer, expecting to receive payment for the delivery, will have less cash than expected and may have to borrow funds in the market.

Fails are particularly expensive when they occur on a Friday, because the nonearning asset will cost the regulated entity three days of interest income. The cost of a fail and other securities operations problems underscores the importance of having well-trained securities operations personnel. A regulated entity can minimize its fails expense if management establishes and enforces prudent operating and control procedures.

When a regulated entity transacts securities, portfolio personnel should report these transactions to the regulated entity's funding position manager. Failure to inform the funding desk about a large securities sale could result in large amounts of excess cash in its Federal Reserve Bank account. Large purchases of securities could expose the regulated entity to a shortage in its Federal Reserve Bank account if the funding desk is unaware of the transaction. The regulated entity could be forced to purchase overnight Federal funds, perhaps at disadvantageous rates, or otherwise implement a provision of their liquidity contingency plan.

Data Integrity Checks

Management makes business decisions based upon an assessment of risks and rewards, which usually starts with an evaluation of financial data. Inaccurate financial data could result in inappropriate management decisions. Given the importance of data integrity, independent risk management personnel and/or internal auditors should routinely verify the accuracy of board and management reports related to investments. Mistakes in public or regulatory filings could necessitate amendments, damage the regulated entity's reputation, and could result in a violation of applicable laws, regulations, and regulatory guidance. To preserve integrity in the management information reporting process, regulated entities should require board and management reporting to be prepared by an independent risk management unit.

Competent Personnel

Investment personnel should have strong technical skills in order to understand a complex security's risks and rewards as well as to evaluate the reasonableness of the bid/offer. Purchasing a security too high or selling one too cheaply can be very expensive.

Example: A seemingly insignificant mispricing of one-half of 1 percent on a $5 million transaction would cost $25,000.

Regulated entities can protect themselves against potential pricing abuses by using reputable securities dealers and adopting a competitive bidding practice of obtaining more than one dealer bid to assure a fair price.

Competitive shopping may not always be possible, because not all dealers will offer the same security. In such cases, portfolio personnel should attempt to determine fair values by comparing the yield offered with yields on similar securities. Portfolio personnel should be wary of comparing yields based on credit ratings, because credit ratings can lag actual credit quality changes. When evaluating a specific issuer's bonds, the appropriate comparison is to the same issuer's other securities. In addition, regulated entities should be similarly wary of making purchase decisions based on the security with the highest reported option adjusted spread (OAS) since investment firms use different OAS calculation methodologies.

Personnel policies should require employees in positions that significantly affect the books and records to take a meaningful amount of consecutive time off each year, typically two weeks. The importance of implementing this control has been confirmed by well publicized losses that occurred because individuals were able to conceal unauthorized transactions for a number of years. These unauthorized activities might have been detected earlier if the individuals had been required to be absent from their duties for a meaningful amount of time. Employees subject to this policy should not be able to effect any transactions while on leave. Exceptions to this policy should be granted only with senior management's approval in accordance with the institution's policies and procedures, and multiple exceptions for the same employee should not be allowed to occur.

Measuring Relative Value

Callable Bond Prices and Yields

For investors purchasing callable securities, yield should not be the sole measure of the security's value.

Example: Suppose a callable security yields 4.61 percent and a Treasury security with a comparable maturity yields 3.82 percent. Although the callable security's nominal yield (yield-to-maturity) is 79 basis points higher than the Treasury, the investor has to consider the option's effect on its yield before determining whether it is a better value.

Any call option an investor sells imposes a cost, since an option limits the bond's price appreciation when rates decline. A regulated entity investing in a callable bond is effectively entering into two separate transactions: the purchase of a bullet bond and the sale of a call option to the issuer. Thus, the price of a callable bond can be stated as:

PRICEcallable = PRICEbullet – PRICEcall option

The above equation illustrates two key points. First, the callable bond's price should always be less than or equal to a bullet bond's price with similar terms. Second, the callable bond's price is influenced by both the *same* factors affecting the bullet bond's price and factors affecting *only* the call option's price. An option's price is primarily influenced by the call's flexibility, which is the ease with which an issuer can exercise the option, and the likelihood that it will be exercised.

A call's flexibility is mainly affected by the option type and lockout period:

1) *Option type* - American call options are the most flexible because they can be called at any time after the lockout period, and hence are the most valuable to the issuer. Conversely, European call options are the least valuable because they can only be called at the end of the lockout period.

2) *Lockout period* - The lockout period begins on the bond's settlement date. Shorter lockout periods give the issuer the greatest call flexibility and are more valuable to the issuer. Therefore, bonds with shorter lockout periods will tend to have higher yields and lower bond prices than those with longer lockout periods.

The likelihood that a call option will be exercised is influenced by volatility and the yield curve:

1) *Volatility* – In theory, the value of any option increases with the volatility of interest rates. Volatility represents the expected amount of interest-rate fluctuation over a given period. As volatility increases, option values rise, because there is a greater chance that interest rates will decline by a margin sufficient for the issuer to replace the higher yielding debt with lower-cost debt. High volatility also means interest rates have a greater chance of rising, but the issuer has no incremental loss because they can simply choose not to exercise the option. In other words, while the issuer's potential loss is limited as volatility increases, the potential gain is not. Thus, issuers will pay more for call options through higher yields and lower bond prices when volatility is high or expected to be high during the bond's term.

2) *Yield Curve* - The yield curve shape affects the call option's price because a rising curve implies that rate increases are anticipated and the steeper the curve, the stronger the anticipation. A flat yield curve implies no expected rate changes, while a declining, or inverse curve implies long-term rates are expected to fall. The call's value will be lower for steep slopes because the chance of a profitable interest rate decline is more remote. A nearly flat or negative term structure will tend to result in a larger option value.

An investor's primary motivation for purchasing callable bonds is the incremental yield pickup over bullet securities of comparable risk and maturity. A callable bond's yield should always be greater than or equal to the yield of a similarly termed bullet because:

YIELDcallable = YIELDbullet + YIELDcall option

Option Adjusted Spreads

Many investors analyze a security with embedded options by assessing the security's yield after deducting the options' value. The resulting value measure is called an option-adjusted yield and is expressed as a spread over the Treasury curve. A security's OAS is its yield net of the options' cost, compared with a portfolio of Treasuries having the same expected cash flows. Treasuries are used because they are free of credit risk. If a security has a 25 basis points OAS, for example, its yield net of the options' cost is 25 basis points higher than the portfolio of Treasury securities.

OAS analysis estimates the compensation an investor should receive for assuming a variety of risks such as liquidity, default, and model risk, net of the cost of any embedded options. Investors should therefore expect relatively limited spreads after deducting the cost of the options on high-quality securities. OAS analysis addresses the deficiencies of the simple yield measures like yield-to-maturity and yield-to-call. However, the assumptions used to generate the OAS dictate the measure's outcome. Interest rate volatility is the critical pricing parameter, along with prepayment assumptions for assets such as MBS because the issuer has sold an option. Purchasing option embedded securities when volatility is high can be beneficial, since the issuer will have to pay the investor higher yields to motivate the investor to sell the option.

Just as a securities dealer can make a CMO tranche appear attractive by using prepayment speeds different from the market consensus, a volatility estimate that is below market consensus will result in a higher OAS. Investors who do not carefully evaluate volatility could purchase a security with a negative OAS, even though the nominal spread appears attractive. This possibility underscores the need to assess more than just simple yield measures. Investors should evaluate volatility the same way they do mortgage prepayment speeds, such as by checking market consensus among several dealers.

Securities with large OASs, particularly when there is little credit risk, may indicate the issuer is selling difficult to value options. An investment strategy that focuses purely on maximizing yield can result in a portfolio that fails to accomplish other desired investment activity objectives, such as controlling interest rate risk and producing adequate liquidity. Further, strategies that emphasize accounting yields can, if not managed properly, result in portfolios with excessive interest rate risk exposure (due to, for example, concentrations in options or long maturities) or credit risk. Higher yielding investment assets frequently have greater cash flow uncertainty and wider bid/offer spreads, reducing their potential liquidity. Management should set the investment portfolio's goals and then undertake securities transactions accordingly.

5) *Country Risk*

Country risk is a collection of risks associated with foreign investments. These risks include political, currency, economic, transfer, and sovereign risks.

Political Risk can stem from a change in the political environment, withholding tax laws, or market regulations. These factors can have an adverse impact on the value and liquidity of a foreign investment and should thus be monitored.

Currency risk is the risk that exchange rate fluctuations may affect a bond's yield as well as the value of coupons and principal paid in U.S. dollars. A number of factors may influence a country's foreign exchange rate, including its balance of payments and prospective changes in that balance; inflation and interest-rate differentials between that country and the United States; the social and political environment, particularly with regard to the impact on foreign investment; and central bank intervention in the currency markets.

Economic risk is that risk that a significant change in the economic structure or growth rate could produce a major reduction in an investment's expected return. Examples include fundamental fiscal or monetary policy changes or a significant change in a country's comparative advantage such as resource depletion, industry decline, or a demographic shift.

Transfer risk is the risk arising from a foreign government's decision to restrict capital movements, which could make it difficult to move profits, dividends, or capital out of the country. Since a government can change capital movement rules at any time, transfer risk applies to all types of investments.

Sovereign risk is the risk that a government becomes unwilling or unable to meet its loan obligations, or reneges on loans it guarantees.

The board needs to ensure that the regulated entity adequately provides for processes and procedures to identify, measure, monitor, and control country risk exposure. Assessing and measuring country risk can be performed by reviewing and assessing country risk reports to ensure that exposures are managed prudently in accordance with the internal policy and that corrective actions are taken for identified breaches.

6) *Financial Condition and Performance*

Term investments and money market assets usually serve as a source of liquidity. In particular, money market assets provide a cushion against unanticipated funding demands because of their short maturities, limited price sensitivity, and more cash flow certainty than term investments. In the case of many term investments such as MBS, the security's cash flow uncertainty is typically a function of options, which cause the timing and cash flow amounts to vary with changes in

interest and prepayment rates. The more optionality in the portfolio, the more cash flow uncertainty exists. In addition, the type of option-sensitive securities in a portfolio has an important effect on the portfolio's cash flow uncertainty. Cash flow volatility will be highest for portfolios with concentrations in callable bonds, followed by portfolios with concentrations in CMOs, PLMBS, CMBS, MBS pass-through securities, and ABS. Conversely, portfolios with limited option embedded securities will have the most cash flow certainty.

A regulated entity should expect that a callable security's issuer would exercise its option whenever it is economically efficient to do so and call the entire security. If it does not, a credit problem may exist. On the other hand, when it is not economically efficient, the issuer will likely leave the bonds outstanding. With an MBS, the investor will experience partial calls. The partial call's size depends upon factors like the difference between current mortgage rates and the underlying mortgages' rates and the seasoning of the loans. Mortgage prepayments also increase when the yield curve slope is steep because homeowners tend to replace their fixed-rate mortgages with adjustable-rate mortgages. Historically homeowners have not exercised their prepay option as efficiently as callable securities issuers. When rates rise, MBS will still experience some prepayments due to homeowners prepaying their mortgage for reasons unrelated to interest rates as well as involuntary payoffs (homeowner defaults).

A CMO is a structured security that uses mortgage pass-through securities as collateral. The predictability of a CMO's cash flow is a function of the CMO tranche's structure. Some CMO types, such as planned amortization classes (PACs), can offer reasonably predictable cash flow profiles. Others, such as support tranches, absorb more of the cash flow uncertainty to support more stable tranches. To assess risk properly, investors must assess the cash flow schedule and evaluate how changes in interest and prepayment rates will alter the estimated cash flow. ABS will tend to have more cash flow certainty because the loan assets tend to have a lower propensity to refinance as rates change.

A portfolio of non-callable securities will have no cash flow volatility, because the cash flow schedules do not change as interest rates change. Regulated entities that use their investment portfolios as a source of liquidity should consider how the different kinds of option-sensitive securities affect cash flow predictability when structuring their portfolios.

Bond dealers tend to widen the bid/offer spread on securities with highly uncertain cash flows, because they are more difficult to analyze and value, and consequently harder to sell. When a dealer buys securities for its own account, it assumes all the attendant price risk, but protects itself against price risk by widening the bid/offer spread. A wide bid/offer spread reduces the security's liquidity, because the price an investor receives to sell the security can be significantly less than the security's purchase price. Liquidity is especially important to consider for securities designated as trading and available-for-sale, since regulated entities mark-to-market both categories. Additionally, a large accumulation of illiquid securities reduces the practical liquidity of the investment portfolio. Examples of illiquid securities include MBS investments with new or unique collateral attributes and MBS with unusual structures. The fact that an issuer

has strong financials and a good credit rating simply means the bonds have little credit risk; it does not imply that the bonds carry low interest rate risk or are liquid.

Accounting Issues

ASC 320 *Investments-Debt and Equity Securities*

When regulated entities purchase investment securities, ASC 320 requires them to classify the securities as held-to-maturity (HTM), trading, or available-for-sale (AFS).

HTM - The regulated entity has the positive intent and ability to hold the security to maturity and reports the security at amortized cost.

Trading – A security that the regulated entity bought and held principally for selling it in the near term and is reported at fair value, with unrealized gains and losses included in earnings.

AFS - Securities not classified as either HTM securities or trading securities and are reported at fair value, with unrealized gains and losses excluded from earnings and reported in Accumulated Other Comprehensive Income (AOCI), which is a separate component of equity.

Regulated entities occasionally sell AFS securities either for budget reasons or to reposition the portfolio's risk profile. The AFS account provides the flexibility to buy and sell securities and to manage investment risks. It is important, however, to differentiate between an AFS and a trading portfolio. Trading investments for speculative or market-making purposes is inconsistent with the regulated entity's mission. The regulated entities use the trading designation primarily for the ability to mark trading assets to fair value to offset an associated derivative's fair value changes for instruments that do not meet ASC 815 hedge criteria.

Selecting a security's accounting classification is another strategic investment decision a regulated entity faces. Since ASC 320 requires management to classify most securities as AFS, HTM, or trading, the initial classification is an important decision. The primary reasons are the rules for reclassifying investments between categories. For example, once a security is placed in the HTM category, management cannot usually sell it without adverse consequences. Absent a "safe harbor" exception, selling HTM securities may call into question the suitability of the regulated entity's classification of all securities in the HTM category. The regulated entity could be required to reclassify all of the remaining HTM securities to AFS. The inability to sell long-maturity, price-sensitive securities can significantly weaken management's control over interest rate risk and earnings.

With an AFS portfolio, management can buy or sell securities to restructure the portfolio to make its risk profile more consistent with the regulated entity's interest rate views and asset/liability management objectives. However, the marking to market of AFS securities in AOCI and trading

securities to income requires appropriate retained earnings levels. The retained earning's adequacy analysis is particularly important for FHLBanks given the par value nature of FHLBank stock.

ASC 320-10-35 Security Impairment

ASC 320 requires an entity to determine whether a decline in fair value below the amortized cost basis is other-than-temporary for securities classified as either AFS or HTM. Providing a general allowance for unidentified impairment in a portfolio of securities is not appropriate.

For debt securities determined other than temporarily impaired, the accounting is driven by whether the entity intends to sell the debt security, determines it's more likely than not it will be required to sell the security, or does not intend to sell the security and determines it is not more likely than not it will be required to sell the security.

1) If the regulated entity intends to sell the security *or* it is "more likely than not" that it will be required to sell the security before recovering its amortized cost basis (less any current-period credit loss), it shall recognize in earnings OTTI equal to the entire difference between the security's amortized cost basis and its fair value.

2) If, however, the regulated entity does not intend to sell the security, *and* it is <u>not</u> "more likely than not" the regulated entity will be required to sell the security before recovering its amortized cost basis (less any current-period credit loss), *and* it does not expect to recover the entire amortized cost basis, the OTTI shall be separated and recognized as follows:

    a) The credit loss amount shall be recognized in earnings.
    b) The non-credit loss shall be recognized in AOCI, net of applicable taxes.

3) Determining Credit Loss: ASC 320-10-35-33D captioned under "Impairment of Individual Available for Sale and Held to Maturity Securities" states, "in determining whether a credit loss exists, an entity shall use its best estimate of the present value of cash flows expected to be collected from the debt security. One way of estimating that amount would be to consider the methodology described in Section 310-10-35 for measuring impairment on the basis of the present value of expected future cash flows. Briefly, the entity would discount the expected cash flows at the effective interest rate implicit in the security at the date of acquisition."

<u>ASC 310-20 *Receivables-Non Refundable Fees and Other Costs*</u>

When a regulated entity purchases investments, most costs and fees and discounts or premiums on loans at their time of purchase are amortized over the loan's life. Amortization is calculated based on the interest method, using a level yield (constant effective yield method).

Regarding MBS, a regulated entity is permitted to incorporate into its constant effective yield calculation the anticipated principal prepayments if the prepayments' timing and amount may be reasonably estimated. Premiums and discounts are amortized based upon the underlying mortgages' expected prepayments. At least monthly, amortizations should be adjusted to reflect actual prepayments and revised outlook, which could cause the MBSs' accounting yield to change substantially, as recognition of discounts and premiums accelerates or slows. Regulated entities may also use the contractual method for calculating amortization. This method bases the amortization of premiums and discounts upon the instrument's actual terms and does not use estimated prepayments.

Specific Risk Controls Related to the Investment Function

Risk Management Framework

The diversity and complexity of the regulated entities' investments, the investment portfolios' effect on market and credit risk, and the regulated entities' financial condition and performance underscores the importance of a mechanism to control risk. An effective risk management framework includes:

1) Board of directors and senior management oversight;
2) Processes to identify, measure, monitor, and control risks; and
3) A sound internal control system.

1) Board of Directors and Senior Management Oversight

The oversight of investment portfolio activities is an important part of managing the regulated entity's overall interest rate, liquidity, operational, and credit risk profiles. The board's role in the oversight process is to:

a) Establish the regulated entity's strategic direction and risk limits;
b) Review portfolio activity, risk profile, and performance;
c) Monitor compliance with authorized risk limits;
d) Approve investment policies; and
e) Hire capable management.

Management's role is to translate the board's risk tolerance into a set of operating policies and procedures that govern investment activities. Management develops portfolio objectives and strategies, establishes standards for investment acquisition and new product review, oversees portfolio activity, and reports the results of investing activities to the board. Additionally, management is responsible for establishing a sound system of internal controls and holding employees accountable for developing and enforcing such a framework.

2) Processes to Identify, Measure, Monitor, and Control Risks

Regulated entities should effectively identify and measure risks associated with investments. To manage the investment portfolio in a safe and sound manner, management should perform a documented pre-purchase analysis on securities to detect any characteristics that do not fit the regulated entity's objectives. A pre-purchase analysis would quantify a security's interest rate risk and identify any asymmetries, such as a security with embedded option's limited upside price potential. In addition to assessing credit and liquidity risks, investment officers should assess the potential changes in security values over a number of interest rate scenarios.

Example: The regulated entity might analyze the security's performance profile or value changes as yields increase and decrease by 50, 100, 200, and 300 basis points, and for selected non-parallel yield curve shifts.

Management should establish standards for documenting the pre-purchase analysis. Although it may not be necessary to document the performance profile of all securities, such as short-term Treasuries, management may find that documenting the analyses imposes a healthy discipline over the investment process.

Some of the more complex securities can change in character as market yields change. For example, certain mortgage securities can have the amount and timing of their expected cash flows change significantly because of their option features and structure. A security's structure refers to how cash flows from the loans underlying an ABS, such as a CMO, are distributed to security owners. While reviewing the price sensitivity of all securities, management should give particular attention to securities with option features, not only prior to purchase but also periodically thereafter.

Regulated entities control investment risks by establishing and enforcing investment policies to provide structure and organization to the regulated entity's investing activities. Regardless of whether the regulated entity has a separate investment policy or incorporates it into the risk management policy, it should address:

a) Investment objectives;
b) Minimum credit quality;
c) Permissible investment types;
d) Market risk limits;
e) Maturity limits;
f) Concentration limits and monitoring;
g) Risk reporting;
h) Approved securities dealers; and
i) Policy exceptions.

Objectives: Most regulated entities' investment objectives include achieving a desired asset/liability management profile, generating earnings, and providing liquidity.

Credit Quality: See the "Credit Risk" section above for a detailed discussion of the credit risk of portfolio assets. Minimum quality standards are a key component of any investment policy and outline the regulated entity's tolerance for credit risk in the investment portfolio.

Permissible Investments: For a list of permissible investments, see 12 CFR 1267 for the FHLBanks. For Fannie Mae and Freddie Mac, refer to the pertinent provisions of their respective charters.

Market Risk Limits: Regulated entities that limit permissible market value of equity (MVE) changes at the macro level (on and off the balance sheet), do not necessarily need individual security and portfolio sensitivity limits. However, they may find that micro limits for securities and the investment portfolio are helpful in achieving overall MVE objectives. The regulated entity should consider and quantify maximum permissible portfolio price sensitivity as a percentage of capital or earnings. Capital-based risk limits illustrate the potential threat to the regulated entity's viability, while earnings-based limits reflect potential profitability effects. In addition, the board may choose to establish limits relative to total assets, total investment securities, or other standards. Further, the FHLBanks are subject to 12 CFR 1267.3, which places restrictions on MBS's price sensitivity.

Maturity Limits: While market risk limits are the most effective way to control interest rate risk, regulated entities may find that maturity limits add discipline to the risk control process. Further, longer-term securities have greater interest rate risk, price risk, and cash flow uncertainty than shorter-term instruments. Maturity limit examples include placing restrictions on the maximum stated maturity, weighted average maturity, or duration of instruments.

Concentration Limits and Monitoring: When developing the investment policy, management should understand the ramifications of concentration sources and consider whether the board's risk tolerance calls for specific limits. Concentrations can result from:

1) *Geographic Concentrations* – To control risk exposure, the board and management should be aware of geographic concentrations, particularly in states with volatile real estate markets. The concentration should be considered at the bond level, as well as the portfolio level. If the regulated entity purchases an MBS at a premium, the MBS may perform poorly if the state has faster than anticipated prepayments. If it has purchased a MBS at a discount, slower than expected prepayments will also cause the MBS to underperform. In addition, geographic diversification is an especially important credit risk issue for mortgage securities without government agency backing and large municipal bond portfolios.

2) *Specific Originators, Credit Enhancers, Servicers, and/or Trustees* – These types of concentrations increase the regulated entity's vulnerability to unforeseen credit and liquidity risks. For example, an originator's decline in credit quality could affect its underwriting standards, which in turn could lower the credit quality of the underlying securities. Another example is that the receipt of security cash flows could be delayed if the trustee were to fail.

3) *Concentration of Mortgage Security Characteristics* - The regulated entity should consider concentrations such as lien status, coupon and/or cap rates, fixed versus variable rate, and type of floating-rate index and reset period. Second-lien mortgages tend to experience higher default rates and losses given default than first-lien mortgages. Prepayment characteristics will also differ between first- and second-lien mortgages.

Risk Reporting: The review of investment activity is one of the most important aspects of management oversight. Regulated entities typically summarize investment activity at the end of the quarter, but often the reports are presented at every board meeting. The investment reports should provide data as well as explain the key risks.

Example: An investment activity report that lists each purchased or sold security's par value, issuer, yield, purchase/sale price, and any gain/loss provides important details, but it should also address the associated identified risks and how they have been managed.

A more effective presentation would also report information like price sensitivity measurements under various parallel and non-parallel interest rate scenarios and the rationale for purchases at prices significantly different from par and/or unusual structures. Another valuable report is an aggregate portfolio report that summarizes the portfolio's balances and yields, its sensitivity to yield changes, and unrealized gains/losses. For the current position, risk-focused information might include a breakdown by security type, showing market value, unrealized gain/loss, price sensitivity for selected yield changes, and yield. In addition, portfolio summaries should compare key policy constraints to portfolio performance, identifying any policy exceptions, explaining why they occurred and who approved them.

Investment performance and activity reports to management should provide more detail than board reports. Periodically, management should assess whether the current reporting framework meets their needs. For example, a policy change to purchase more complex securities may require a change to management and board reports to more accurately portray the portfolio's risks.

Securities Brokers and Dealers: The regulated entities should not be over-reliant on the securities broker's recommendations of proposed investments, investment strategies, and the timing and relative value of securities transactions. Investment managers should communicate their investment policy and expect dealers to find or structure securities meeting the regulated

entity's objectives. When appropriate, management should inquire into the broker's background to determine his or her experience and expertise.

Management should deal only with board-approved investment firms and should know the reputation of securities firms and the personnel with whom they deal. An investment portfolio manager should not engage in transactions with any securities dealer that is unwilling to provide complete and timely financial statements. Credit personnel, independent of investment management, should make an informed judgment about the dealer and its subsidiaries' or affiliates' financial wherewithal to honor its commitments. The analysis should consider capital strength and operating results disclosed in current financial data, annual reports, credit reports, or other reports. The regulated entity should also inquire into the dealer's reputation by consulting with other customers, including past or current financial institutions. Securities regulators and securities industry self-regulatory organizations, such as the Financial Industry Regulatory Authority, can verify the existence of any enforcement actions against the dealer, its affiliates, or associated personnel.

The board may want to consider prohibiting employees from engaging in personal securities transactions with the regulated entity's approved securities firms to help control conflicts of interest. Another alternative is to prohibit transactions unless the board specifically approves and periodically reviews them. The board should also consider adopting a policy concerning the receipt of gifts, gratuities, or travel expenses from approved dealer firms and their personnel. These types of prohibitions are sometimes included in the regulated entity's code of ethics or conduct rather than in the investment policy. To monitor dealer activities, the regulated entity should consider requiring investment activity reports to list the firm that executed each transaction. A high volume of transactions with one firm may indicate a failure to shop competitively to obtain the best price.

Policy Exceptions: Policy documents should be designed to impose discipline on risk-taking. Occasionally, management may determine that an investment policy exception is in the regulated entity's best interests. Policies should address whether exceptions require prior approval, and the appropriate approving level. Additionally, policies should provide for an orderly reporting process for exceptions to review policy compliance on an ongoing basis. If exceptions become too frequent, the board should evaluate whether it is time to revise the policy or insist on more rigorous compliance.

3) Independent Review

A control culture, which senior management and the board must support in policy and practice, is a key component of effective corporate governance and provides the integrity necessary to properly manage risk-taking activities.

Management and the board are responsible for establishing a suitable internal control structure, which is integral to the risk management framework. A good internal control system includes

policies and procedures, clear lines of authority, separation and rotation of duties, ethical standards, and an independent audit (including testing) of the systems for executing transactions and reporting risks.

Independent reviews are essential to the integrity, accuracy, and reasonableness of the entire risk management framework. Personnel independent of the investment securities function should periodically assess the effectiveness of the internal control system, risk reports, policies, and procedures. The assessment should verify compliance with applicable policies and procedures. The reviewers should immediately bring deficiencies in the control processes and the risk management framework to the attention of senior management and the board. Examiners should assess the timeliness and appropriateness of corrective action.

Regulatory Environment

1) Rules and Regulations of the predecessor Federal Housing Finance Board (Finance Board), which include the following parts and sections relevant to the FHLBank's investments:

12 CFR Part 917 - Powers and Responsibilities of Bank Boards of Directors and Senior Management

12 CFR Part 932 – Limits on Extensions of Unsecured Credit. In particular, Section 932.9 addresses unsecured extensions of credit and limits to various counterparties.

2) Federal Statues enforced by the Federal Housing Finance Agency (FHFA), that are relevant to the regulated entities' investments include:

The Federal Housing Enterprises Financial Safety and Soundness Act of 1992, as amended. (12 U.S.C. 4501 *et seq*.)

The Fannie Mae Charter Act (12 U.S.C. 1716 *et seq*.)

The Freddie Mac Corporation Act (12 U.S.C. 1451 *et seq*.)

The Federal Home Loan Bank Act, as amended (12 U.S.C. 1421 *et seq*.). In particular, 12 U.S.C. 1431(g), (h), and (j), and 12 U.S.C. 1436(a) and (c).

3) ***Rules and Regulations of the predecessor Office of Federal Housing Enterprise Oversight (OFHEO), which include the following parts and sections relevant to the Enterprises' investments:***

12 CFR Part 1710 - Corporate Governance

12 CFR Part 1720 – Safety and Soundness, Appendix A Policy Guidance: Minimum Safety and Soundness Requirements; Appendix B: Non-Mortgage Liquidity Investments

4) Rules and Regulations of the Federal Housing Finance Agency (FHFA), which include the following parts and sections relevant to investments:

12 CFR Part 1236 - Prudential Management and Operations Standards *(*PMOS*)* –Standard 6 (Management of Asset and Investment Portfolio Growth), Standard 4 (Management of Market Risk—Measurement Systems, Risk Limits, Stress Testing, and Monitoring and Reporting), and Standard 7 (Investments and Acquisitions of Assets). Standard 6 requires the board to ensure that the investment portfolio growth is managed prudently and within regulatory requirements. Further, the board must establish investment policies that include MBS growth limits and make certain that senior management is appropriately trained and competent to manage the investment portfolio within the policy's parameters. Standard 4 emphasizes, among other things, that a regulated entity should have a risk measurement system (a model or models) that captures all material sources of market risk, and should ensure that its models are independently validated on a regular basis. Standard 7 mandates that the regulated entity's investment policy have clear explicit guidelines that are appropriate to the institution's mission and objectives. The policy should establish investment objectives, risk tolerances, investment constraints, and procedures for selecting investments. In addition, the policy should take into account the importance of maintaining the market value of member stock commensurate with the par value of that stock so that the FHLBank is able to redeem and repurchase member stock at par value at all times.

12 CFR Part 1265 – Core Mission Activities

12 CFR Part 1267 - FHLBank Investments[8]

5) ***Advisory Bulletins of the Finance Board that provide investment related supervisory guidance:***

Advisory Bulletin 98-10, dated December 8, 1998 - Minimum FHLBank unsecured credit monitoring standards.

Advisory Bulletin 01-8, dated October 4, 2001 - Policy and procedures standards for identifying, comparing, reporting, and quantifying problem assets.

[8] On March 24, 2008, the FHFB passed a resolution that allowed the FHLBanks to purchase agency MBS up to six times its capital. The resolution expired on March 31, 2010; however, some FHLBanks may still be holding more than three times its capital because the MBS have not paid down to three times capital.

Advisory Bulletin 02-7, dated August 27, 2002 - Reporting standards for unsecured credit exposures.

Advisory Bulletin 05-8, dated August 25, 2005 – FHLBank Anti-predatory lending policies.

Advisory Bulletin 07-01 dated, April 12, 2007 – MBS with underlying nontraditional and subprime residential mortgages.

Advisory Bulletin 08-01, dated April 3, 2008 - Temporary Increase in Mortgage-Backed Securities Investment Authority.

Advisory Bulletin 08-02, dated July 1, 2008 - Application of Guidance on Nontraditional and Subprime Residential Mortgage Loans to Specific FHLBank Assets.

Advisory Bulletin 10-01, dated April 6, 2010 - Clarification of Advisory Bulletin 08-02: Application of Guidance on Nontraditional and Subprime Residential Mortgage Loans to Specific FHLBank Assets.

6) ***Examiner Guidance Bulletins that provide investment related supervisory guidance:***

Examiner Guidance Bulletin 2010-EGB-01, dated January 7, 2010 – Framework for Adversely Classifying Investment Securities and Supplemental Framework for Identifying Special Mention and Adversely Classifying Private-Label Mortgage-Backed Securities.

7) ***OFHEO and FHFA Policy Guidance that provides investment related supervisory guidance:***

PG-00-001, dated December 19, 2000 - Minimum Safety and Soundness Requirements

PG-00-002, dated December 19, 2000 – Non-Mortgage Liquidity Investments

PG-06-001, dated November 8, 2006 - Examination for Corporate Governance

PG-06-002, dated November 8, 2006 - Examination for Compensation Practices

PG-06-003, dated November 8, 2006 - Examination for Accounting Practices (*replaced and updated by unnumbered FHFA Guidance dated October 27, 2009* - Examination for Accounting Practices)

PG-08-001, dated January 10, 2008 - Examination of Mortgage Fraud Programs

PG-08-002, dated April 21, 2008 – Standards for Enterprise use of the Fair Value Option

Issues Specific to the Regulated Entities

1) Corporate Governance

Regulated entities manage investment activity risk by establishing a risk management framework composed of policies and procedures, risk measurement and reporting systems, and independent oversight and control processes. On an ongoing basis, the board and management revise this framework to keep pace with the changes taking place within the regulated entity. Policies articulate factors such as the investment portfolio's purpose, risk limits, goals, authorized activities and instruments, internal controls, and reporting. At a minimum, the board will review and approve investment policies. Regulated entities use complex models to measure risk and produce board and management reports. Typically, the regulated entities' organizational structures include an enterprise-wide risk management function that is independent of the risk-taking function. This function is responsible for measuring risk and preparing board and management reports. Another part of the framework is the internal and external audit function, which lends an independent assessment of the regulated entity's investment activities.

2) Market Risk

The investment portfolio typically has a significant effect on a regulated entity's overall interest rate risk profile. Regulated entities manage this risk by establishing risk limits, typically as a percent of capital or earnings.

Often, the regulated entities will manage interest rate risk by measuring the entire regulated entity's exposure on a macro basis, but some will separately measure and control the investment portfolio's price sensitivity. From a risk management perspective, the entire portfolio's sensitivity is more important than the individual securities' sensitivity; however, management should incorporate into the acquisition decision an assessment of the instrument's contribution to the overall portfolio's risk and return. For further interest rate risk management details, refer to the examination module on Interest Rate Risk Management.

3) Credit Risk

Regulated entities use several methods for assessing and monitoring credit risk.

Pre- and Post-Purchase Analysis – Before a purchase and periodically thereafter regulated entities conduct internal credit analyses. The analysis' depth varies based on the investment's size, structural complexity, collateral type and quality, external ratings, and other risk characteristics. Included in the analysis should be an evaluation of the structural credit support, as well as an assessment of the issuer and/or third-party credit provider to determine their ability to honor their obligation.

NRSRO Ratings - Regulated entities use NRSRO ratings to assist in making investment decisions and monitoring the investment portfolio's credit risk. The regulated entities also use NRSRO ratings to measure sovereign risk, which is the risk of a foreign government becoming unwilling or unable to meet its obligations or renege on its guarantees. Regulated entities use services that provide an alert for when NRSRO ratings change. Reports are often produced that indicate the percentage of the portfolio in each rating category.

The regulated entities should not place undue reliance on external ratings. In addition, the Dodd-Frank Wall Street Reform and Consumer Protection Act requires financial regulators (including the FHFA) to review their regulations and eliminate requirements for reliance on credit ratings.

Private-Label Mortgage-Backed Securities

PLMBS present a significant source of credit risk for the regulated entities. Relaxed loan underwriting standards, a weak economy, and the downturn in real estate markets increased the credit risk associated with PLMBS issued between approximately 2005 and 2008. During that time, the market had perceived limited credit risk from these securities. In many cases, the PLMBS initial prices and yields did not fully reflect their elevated credit risk. As market and underlying credit conditions deteriorated, credit and liquidity spreads widened and became more volatile, giving way to valuation declines and, in many cases, the volume and severity of credit rating downgrades increased. Further, credit support for senior tranches diminished and price volatility rose. Consequently, most of the regulated entities recognized OTTI charges and substantial fair value markdowns on these securities, which required the PLMBS' cost basis to be written down to fair value as a new cost basis and the amount below cost written off against current earnings[9].

To understand the inherent risk, management must comprehend not only an investment's structural characteristics, but also the composition and credit characteristics of the underlying collateral. Management needs to conduct the analysis at both the deal and pool level using information that sufficiently captures collateral characteristics. Regulated entities rely upon models and, in some cases, third parties for estimating the portfolio's inherent risk and in some cases, to price PLMBS. These models are highly sensitive to inputs and assumptions that may be subject to errors and uncertainty. Accordingly, the regulated entities need to maintain robust governance processes to ensure compliance with regulatory requirements and fair value accounting guidelines. Additional information regarding valuation models can be found in the Risk Modeling module.

Money Market Assets

Regulated entities routinely lend funds to counterparties in money market asset transactions, such as selling Federal funds, investing in certificates of deposit, bankers' acceptances, and

[9] Refer to the "Accounting" subsection of the Investment section of this module for additional guidance.

commercial paper. Money market assets enhance a regulated entity's overall liquidity posture, because their short maturities provide regular cash flow that allows for a cushion against adverse funding conditions. Regulated entities also use this cash flow to purchase additional securities, or in the case of the FHLBanks, fund advances.

4) Operational Risk

The regulated entities are exposed to numerous operational risks that must be mitigated. Although front-office operations are subject to operational risk, the back-office operations have more significant risks because the back office processes the transactions, records them in the accounting system, and performs reconciliation procedures. In conducting these functions, the back office provides the necessary checks to prevent unauthorized investment activities. Listed below are two examples of methods a regulated entity might use to manage these risks.

Operational Incident Reports – The regulated entities use the reports to identify inherent areas of risk. Once these risks are identified, a root cause analysis is performed to determine the leading indicators and define appropriate risk mitigating actions. Management, and the board when significant risks are found, is responsible for ensuring the root-cause analysis is thorough and for monitoring the corrective action until resolution is achieved.

Process Mapping – The regulated entities that map their key processes improve workflow efficiencies, reduce operational risks, lower costs, and create a better match between information systems and investment related processes.

5) Financial Condition and Performance

Regulated entities use their investment and money market asset portfolios as a source of liquidity. A common method the regulated entities use is to structure their portfolios with a "laddered" maturity distribution so that maturities occur evenly over time. A laddered portfolio provides the regulated entity with a regular source of liquidity as well as allows the regulated entity to "dollar cost average" its investment purchases. By investing a similar volume of funds at regular intervals, regulated entities reduce the risk of investing a disproportionate amount of funds at any one time. Investing too much all at once could result in future earnings problems if the purchases occurred at the low point of a yield cycle.

6) *Liquidity*

FHFA has directed the regulated entities to maintain highly liquid securities and other assets to cover their cash needs. Treasury bills and Federal Reserve deposits are superior sources of liquidity. Such forms of liquidity, however, impose a trade-off because a regulated entity can hold such investments at a negative carry. Each regulated entity needs to evaluate the tradeoff between superior liquidity and the cost of carry. Additional information on this topic can be found in the examination module on Liquidity.

Examination Guidance

The workprogram for Investment Portfolio Management is detailed below. If this module is included in the examination scope, the examiner must perform worksteps sufficient in coverage to document the basis for conclusions on the quantity of risk and quality of risk management pertaining to this area. Transaction testing is mandatory and the examiner must document sufficient worksteps from Section 4, *Testing,* to support the findings and conclusions from this examination module.

In determining the extent of review and testing to be conducted in completing each examination, the examiner should take into account applicable FHFA off-site monitoring or analysis reports, such as analyses of the quality and effectiveness of corporate governance practices, financial condition and performance, economic and housing industry conditions, internal controls, and audit coverage relating to the institution's investment activities.

NOTE: Text in (*italics*) referenced in a workstep represents illustrative guidance that serves as suggestions for specific inquiry. Examiners may also refer to the Financial Concepts Tutorial that appears as Appendix A to this module.

1) Scope of Examination Work Performed

1) Review investment related internal and external audit reports to determine the audit function's coverage and effectiveness in identifying internal control and risk management deficiencies. Assess and conclude on the responsiveness to address concerns identified by the internal and external auditors.

2) Review applicable FHFA off-site monitoring or analysis reports, and workpapers produced as part of on-going monitoring, related to investment portfolio management.

3) Review the previous report of examination and identify concerns related to the institution's investment practices. Evaluate the status of the regulated entity's efforts to address and correct previous examination findings.

4) Review investment portfolios reports that provide information such as:

   a) Security description and CUSIP number;
   b) Purchase price, date and par value;
   c) Book value, including un-accreted discount or unamortized premium;
   d) Maturity date and call options;

e) ASC 320 designation;
f) NRSRO ratings;
g) Performance reports;
h) Interest rate risk sensitivity analysis;
i) Investments purchased and sold since the last examination; and
j) Counterparty credit exposure reports.

5) Evaluate the investment business strategy for its ability to assist the board and management in accomplishing the regulated entity's mission and generating income in a safe and sound manner. Additionally, ensure that the board, management, and staff have the ability to successfully execute the strategy and are appropriately monitoring the portfolio.

6) Assess the investment department's organizational structure, controls environment, and risk management framework to ascertain if they are adequate to meet the regulated entity's needs.

7) Determine the extent and effectiveness of the investment policies and procedures.

8) Assess the regulated entity's conformance with internal policies and procedures, regulatory requirements, and, in coordination with personnel from the FHFA's Office of the Chief Accountant, generally accepted accounting principles (GAAP). Of particular importance is the regulated entity's impairment analysis (ASC 320 *Investments-Debt and Equity Securities*).

9) Review the suitability of the analysis and controls surrounding the pre- and post-purchase processes.

10) Evaluate the investment portfolio's overall quality and performance as well as its contribution to the regulated entity's interest rate risk profile.

11) Review the board minutes to assess the board's participation in the investment policymaking and strategic planning process.

Summarize the work performed in the examination of the institution's investment portfolio management practices. To the extent there were modifications to the originally planned scope based on concerns identified during the examination, document those changes and the reasons for such changes.

2) Description of Risks

1) Review the investment portfolio strategy to determine the risks and benefits. (*Does the strategy emphasize:*

   a) Maximizing yield-to-maturity?
   b) Using the portfolio to implement a desired asset/liability management position?
   c) Keeping interest rate exposures within established limits?
   d) Relative value of securities?
   e) Maximizing the portfolio's total return?
   f) Using the portfolio as a temporary asset until it can make better use of the funds?)

2) Determine if the investment business model is consistent with the regulated entity's broader strategic objectives.

3) Evaluate any significant investment strategy changes that have been implemented since the last examination or are being considered that may affect the regulated entity's risk profile. *(The examiner should consider:*

   a) New investment products.
   b) Accounting changes.
   c) Policies and key procedures.)

3) Risk Management

Risk Identification Process

1) Based on worksteps performed under **Description of Risks**, assess and conclude on the adequacy of the organization's risk identification process.

2) Review the annual risk assessment to determine if it reasonably identifies and evaluates all material investment activities' risks. Investigate any action plans arising from the assessment and check corrective actions for effectiveness. *(Determine whether the regulated entity's risk assessment:*

   a) Identifies all business lines and processes and their strategic objectives;
   b) Describes key business processes;
   c) Defines associated risks and quantifies potential effects on earnings and capital;

d) Delineates control objectives;
e) Identifies and assesses the effectiveness of mitigating controls;
f) Documents methods used for testing control effectiveness;
g) Quantifies the likelihood of control failures; and
h) Identifies control weaknesses; and describes remedial actions to address the deficiencies.)

3) Ascertain that management committees and delegated authorities appropriately identify, measure, monitor, and report the portfolio's risk trends and level of risk.

Organizational Structure

1) Determine if the board's committee structure and delegated authorities effectively assist the full board in understanding the portfolio's risks and risk levels. *(Are concerns appropriately identified and communicated to the board and management? Are explanations of how risk is mitigated appropriately described?)*

2) Identify the key investment officers and personnel and their primary responsibilities, knowledge, and technical expertise. Determine if the staffing and skill level, segregation of duties, and cross-training are sufficient to execute the investment strategies.

3) Assess whether management is capable of prudently managing the investment portfolio. *Consider:*

a) Management's understanding of financial concepts, investment risks of both the portfolio and individual securities (pre-purchase analysis), and investment portfolio management strategies;
b) Treasury personnel's background and expertise;
c) The board's risk appetite;
d) Size and complexity of the portfolio;
e) Treasury personnel's awareness of interest rate trends;
f) Number of authorized dealers;
g) Credit risk analysis adequacy; and
h) Compliance with the regulated entity's policies.)

4) Assess whether mid-office and/or back-office personnel have the necessary knowledge and experience to ensure control over transaction risks given the portfolio's size and complexity.

5) Determine if investment purchases are coordinated between departments such as risk management, information technology, treasury and cash management, and accounting in an efficient and effective manner.

6) Assess the investment staff and management's independence from the risk management function.

Policy and Procedure Development

1) Determine if departmental policies and procedures are current, relevant, comprehensive, comply with applicable regulations, and are consistent with the regulated entity's other policies. They should address credit, market, operational and financial risks. (*Some points to consider include:*

   a) Policy and/or procedure limits on:

      i. Individual security price risk;
      ii. Aggregate portfolio price sensitivity;
      iii. Officer authorizations; and
      iv. Purchases/sales volume in a pre-defined period;

   b) Types of permitted securities;
   c) Portfolio diversification;
   d) Securities lending and repurchase agreement activity;
   e) Credit quality standards for security issuers, guarantors, and third-party credit enhancers;
   f) MBS, CMO, and ABS Investment guidance:

      i. Loan level attributes (FICO® or other commercially accepted credit scores, negative amortization, concentrations, loan-to-value, interest only, and documentation type);
      ii. Targeted subordination levels;
      iii. Tranche or class thickness; and
      iv. Maximum holdings;

   g) Authorized MBS and ABS servicers/trustees;
   h) Securities dealers;

      i. Authorized dealers;
      ii. Credit quality standards;
      iii. Settlement limits;

   i) Subprime, non-traditional, and predatory lending issues;
   j) Accounting policy conforms with GAAP;
   k) Security transactions:

      i. Execution standards (e.g., competitive bidding, documented pre-purchase analysis, conflicts of interest);

ii. Personnel authorized to conduct transactions;
iii. Off-premises trading;
iv. Possession and control of securities;
v. Internal control requirements; and
vi. Investment transaction reporting.)

2) Review the adequacy of the investment market pricing procedures. *(Consider the:*

   a) Independence of the pricing function;
   b) Pricing frequency;
   c) Volume of illiquid or non-marketable investments;
   d) Model pricing assumptions; and
   e) Securities and Exchange Commission qualitative pricing process disclosures.)

3) Review the Bank's policies and procedures and risk assessment for SBPAs. *Are the policies and procedures and risk assessment commensurate with the level and complexity of the Bank's SBPA activities?*

4) Review any restrictions imposed on SBPA activities. *Has the Bank set limits on SBPA activities in the aggregate, by SHFA, both, or other? How did the Bank determine the appropriateness of the limit(s)?*

5) Coordinate with the examiner responsible for reviewing interest rate risk management. *How does the Bank manage interest rate risk associated with VRDOs that it must purchase under an SBPA?*

6) Coordinate with the examiner responsible for reviewing liquidity risk management. *How does the Bank incorporate liquidity needs for SBPAs in its overall assessment of liquidity requirements?*

7) Review the FHLBank's pricing structure for SBPAs. *How does the Bank ensure that the fees address credit, market, and liquidity risks of SBPAs?*

8) Determine if policy/procedure changes since the prior examination allow for increased credit, market, operational, and/or liquidity risks relative to its overall risk exposures and regulatory requirements.

Risk Metrics

1) Evaluate any risk metrics established related to investments and conclude whether the metrics considered all aspects of potential risks. *(Are the limits:*

   a) Consistent with the strategy and the board's risk tolerance?

b) Reasonable in light of recent financial performance and budget expectations?)

2) Review the Bank's due diligence of SHFAs. *Does the Bank review the creditworthiness of SHFAs with which the Bank executes SBPAs? How often?*

3) Review the Bank's analysis of VRDOs. *Does the Bank in any way evaluate the performance of, and/or cash flows generated by, the mortgage loans covered by the bond indenture of the VRDOs that are, in turn, covered by the SBPAs entered into by the Bank?*

4) Review any restrictions placed on SHFA performance. *Below what credit rating for an SHFA does the Banks' SBPAs relieve the Bank from its obligations under the SBPA?*

Reporting

1) Assess the board and management investment reports. *(Consider whether the reports:*

a) Are tailored to the intended audience and level of risk;
b) Are accurate and timely;
c) Explain how risks have changed rather than simply provide data;
d) Provide both summary information and transaction detail, as appropriate; and
e) Address or include:

i. The status of investment strategic plan goals and objectives;
ii. Compliance with risk limits;
iii. Policy exceptions/waivers (A large number could indicate a weakness, especially if not pre-approved by board or a supervisory committee);
iv. Troubled, financially weakened, problem and/or adversely classified assets; and
v. Include off-balance sheet activities, as applicable.)

Internal/External Audit

1) Evaluate the adequacy of internal audit's investment scope, testing, and workpapers.

2) Evaluate the sufficiency of external audit's investment scope and testing.

3) Evaluate the acceptability of outside consultant review's objectives and scopes.

4) Review the responses to and status of internal and external audit findings and consultant recommendations.

5) Assess the effectiveness of reviews that identify the key financial reporting risks and controls and evaluate potential fraud. Review the efficiency of the procedures used to periodically attest to the control environment's adequacy.

6) Review the breadth and depth of audit testing to determine if it is consistent with the investment portfolio's complexity and risks. *(Specific scope attributes should include, but are not limited to the following:*

   a) Principal and accrued interest general ledger reconciliations;
   b) Balancing of safekeeping reports with portfolio holdings;
   c) Reconciling pledged securities with pledged securities activity reports;
   d) Accrued interest calculations and premium amortization/discount accretion;
   e) Tracing sale/purchase confirmations to the system of record;
   f) Investment authorization and compliance limits;
   g) Comparing and reconciling portfolio performance with internal benchmarks and in the case of FHLBanks, with System averages and/or a customized system peer group;
   h) Evaluating portfolio yields relative to the credit and interest rate risk taken; and
   i) The adequacy of the regulated entity's liquidity reserves relative to its risk exposures and regulatory requirements.)

Information Technology

1) Review process flow charts or narrative work flow documents to identify and assess the investment function's automated and manual systems and applicable controls for processing, verifying, and settling transactions. *(Examples of activities/controls to review include:*

   a) Reconcilements to determine whether there are significant unexplained differences, which should be discussed with management;
   b) Independent review controls;
   c) Trade confirmation process;
   d) Dependence upon and controls surrounding user-developed applications;
   e) Controls to ensure compliance policy limits;
   f) Operational area is independent of personnel making investment decisions;
   g) Controls over trading systems access, trade confirmation workflow, and process for entering trades into the system of records (Processes requiring multiple trade transaction entries to populate other systems are more error prone than when trade transaction data is only entered once (straight-through processing);
   h) Documentation audit trail;
   i) Operational losses to identify possible control weaknesses; and
   j) Trader, counterparty, regulatory, and bank-wide concentration limits, robustness of data environment, authorized users, and vendor technical support.)

Compliance

1) Determine if the regulated entity complies with pertinent regulations and regulatory guidance.

2) Evaluate the board and management's efforts to ensure compliance with policies and procedures related to the investment program.

3) Assess compliance with applicable FHFA PMOS standards, including Standard 6 (Management of Asset and Investment Portfolio Growth), Standard 4 (Management of Market Risk—Measurement Systems, Risk Limits, Stress Testing, and Monitoring and Reporting), and Standard 7 (Investments and Acquisitions of Assets).

4) Evaluate compliance with any conditions imposed as part of the approval to conduct a new business activity if applicable.

5) Review the regulated entity's ASC 320 Investments-Debt and Equity Securities analysis to ensure compliance with GAAP in consultation with personnel from the FHFA Office of the Chief Accountant.

4) Testing

1) Obtain a sample of security pre-purchase analysis and a process flow chart and/or procedures that summarize the key investment acquisition steps. Preferably the sample should include an MBS purchase. Verify that the analysis:

   a) Was conducted prior to the purchase;
   b) Was fully documented;
   c) Was tailored to the investment type and complexity;
   d) Complied with policies, procedures, and guidelines, as well as applicable regulatory requirements; and
   e) Was approved by authorized individuals.

2) Ensure the analysis includes:

   a) Competitive bids;
   b) A robust market risk assessment using reasonable modeling assumptions, potential parallel rate movements, and when appropriate, nonparallel interest rate shocks;
   c) A credit risk evaluation that takes into consideration such things as the underlying collateral, security structure, and credit enhancements; and
   d) An assessment of material differences between the preliminary and final prospectus (when applicable).

3) Evaluate credit quality for a sample of investments. *(Consider factors such as the:*

a) NRSRO rating and recent rating changes and whether the rating applies to principal, interest, or both;
b) Nature of underlying collateral;
c) Underlying collateral's current and historical performance;
d) Credit support level and type;
e) Internal credit analysis or stress testing;
f) Internal watch list or classification, if applicable; and
g) OTTI.)

4) In coordination with personnel from the FHFA Office of the Chief Accountant, review compliance with applicable accounting rules for a sample of securities.

5) Select a sample of approved counterparties and assess whether the files are current and contain satisfactory information to document an informed credit decision.

6) Select a sample of internally-classified securities and confirm the internal classification.

5) Conclusions

1) Summarize conclusions for all examination work performed, including work performed by other FHFA staff as it relates to the regulated entity's investments. Develop a memorandum articulating the risks resulting from the institution's investment activities and the regulated entity's management of those risks. The memorandum should describe the basis of conclusions reached and summarize the analysis completed. Within the memorandum, discuss the types of risk the regulated entity is exposed to as a result of its investment activities (*e.g.*, market, credit, operational); the level of risk exposure; the direction of risk (stable, decreasing, increasing); and the quality of risk management practices (strong, adequate, weak). A memorandum must be prepared irrespective of whether the examiner's assessment is positive or negative.

2) Conclude on the responsiveness to previous examination findings. Evaluate the adequacy of the regulated entity's response to previous examination findings and concerns.

3) Develop findings and prepare findings memoranda, as appropriate. Based on examination work performed, develop findings communicating concerns identified during the examination. Findings should identify the most significant risks to the institution and the potential impact to the regulated entity resulting from the concerns identified. Such documents should describe a remediation plan specifying the appropriate corrective action to address examination concerns and establish a reasonable deadline for the regulated entity to remediate the finding. Communicate preliminary findings with the EIC. Discuss findings with regulated entity personnel to ensure the analysis and findings are free of factual errors.

4) Develop a list of follow-up items to evaluate during the next annual examination. In addition to findings developed in the steps above, include concerns noted during the examination that do not rise to the level of a finding. Potential concerns include issues the regulated entity is in the process of addressing, but require follow-up work to ensure actions are completed appropriately. In addition, potential concerns should include anticipated changes to the institution's practices or anticipated external changes that could impact the institution's future management of investment practices.

Workprogram

1. Scope of Examination Work Performed

Workpapers must document the examination activities undertaken to evaluate potential risks related to investments portfolio management.

2. Description of Risks

- Identify areas of concern related to investment portfolio management
- Assess current risks and trends in the risk to the organization emanating from the regulated entity's investment portfolio management function
- Evaluate changes within the organization or industry affecting risk
- Evaluate the entity's own risk-identification practices and conclude on their adequacy

3. Risk Management

- Assess and conclude on the adequacy of the organization's risk identification process
- Assess and conclude on the overall adequacy of internal controls, including an evaluation of:
    - The regulated entity's organizational structure
    - Policy and procedure development for investment portfolio management
    - Appropriateness of risk metrics established in the investment portfolio management area
    - Reporting by management and the board
- Assess and conclude on the internal and external audit of risks
- Assess and conclude on the adequacy of information technology and controls related to investment portfolio management
- Assess and conclude on the adequacy of the organization's efforts to ensure:
    - Compliance with laws, regulations and other regulatory guidance
    - Compliance with the organization's policies and procedures

4. Testing

- Complete testing, as appropriate, to assess adherence with examination standards

5. Conclusions

- Summarize conclusions for all examination work performed related to investment portfolio management
    - Conclude on the level of risk to the organization
    - Include an assessment of the adequacy of an organization's monitoring of risk and establishment of internal controls to mitigate risk
- Conclude on responsiveness to examination findings from previous examinations
- Develop examination findings as appropriate
- Identify areas requiring follow-up examination activities or monitoring

APPENDIX A

Financial Concepts Tutorial

Knowledge of fundamental concepts of finance will help examiners to properly assess risk in a regulated entity's investment portfolio. This appendix presents the most important financial concepts relevant to fixed income securities and regulated entity investment portfolio management. It also provides background on some of the more sophisticated techniques investment managers use to assess and evaluate risk and reward.

The Fundamentals - Time Value of Money

A dollar received today is worth more than a dollar received a year from now. Since the investor can earn a return on the dollar received today, it is worth more than a dollar received in some future period.

Future value is the value of a sum of money at a specific future point in time. The future value is determined by applying an interest rate to the current amount of investable funds. For example, the future value of $100,000 in five years invested at an annual rate of 6.40 percent is calculated as follows:

$$FV = PV(1+i)^t \quad (1)$$

Where:

FV = Future Value in year t
PV = Present Value
i = Annual Interest Rate
t = Time (years)

$$FV = 100,000 \times (1 + .0640)^5 = \$136,366.64$$

Conversely, *present value* is the current value of a future cash flow. For example, if the investor will receive $136,366.64 five years from now, what is it worth today? The equation to compute a present value is:

$$PV = \frac{FV}{(1 + i)^t} \quad (2)$$

$$PV = \frac{\$136,366.64}{(1+.064)^5} = \$100,000$$

The interest rate used in the denominator to calculate the present value is called a discount rate. In the above example, we have "discounted" the future payment amount of $136,366.64 at 6.4 percent. The discount rate allows us to convert a future sum of money into a present value.

The previous examples demonstrate the linkage between present and future value. They involved calculations of the future value and present value of a single sum of money given a specific interest rate. Investors in fixed coupon securities often receive level interest payments over a given period of time. Such a payment stream is called an annuity. The concepts of present and future value for a single payment extend to a series of payments.

For example, suppose an investor expects to receive $5,000 per year for the next 10 years. This might be the future value of interest flows on a 10-year security. Assume the investor can invest these cash flows, as they are received, at a 7 percent annual rate of interest. This is called "interest on interest." The funds available at the end of ten years can be determined as follows:

$$FV_A = A\left[\frac{(1+i)^t - 1}{i}\right] \qquad (3)$$

Where:

FV_A = Future Value of an Annuity
A = Annuity amount

$$FV_A = 5{,}000\left[\frac{(1+.07)^{10} - 1}{.07}\right] = \$69{,}082.24$$

The difference between $69,082.24, the future value of the annuity, and $50,000 (10 annual payments of $5,000 each) represents the accumulated interest earnings on the cash flows, interest on interest.

Suppose the investor wants to sell this cash flow stream of 10 payments of $5,000 each. What is it worth today? The present value of that annuity stream comes from the following equation:

$$PV_A = A\left[\frac{1 - \left(\frac{1}{(1+i)^t}\right)}{i}\right] \qquad (4)$$

Where:

PV_A = Present Value of an Annuity

$$PV_A = 5{,}000\left[\frac{1 - \left(\frac{1}{(1+.07)^{10}}\right)}{.07}\right] = \$35{,}117.91$$

An investor would be willing to pay $35,118 today to receive the stream of $5,000 cash flows.

Bond Prices

The price of a bond is the present value of its future cash flows. The YTM of a bond is the discount rate that, when applied to the series of promised cash flows, results in a present value of those cash flows equal to the bond's current market price. So, the discount rate is the YTM. The YTM of a bond is a function of how risky the cash flows are. The more risky the cash flows, (credit risk or cash flow uncertainty risk because of bond structure) the higher the required YTM.

The timing and amount of cash flows or the cash flow schedule, as well as their uncertainty, is essential in understanding the risk in an individual security or portfolio. Bond valuation involves taking the present value of expected cash flows using a discount rate appropriate for the bond's risk features. For fixed coupon securities, like many U.S. Treasury instruments, there is no cash flow uncertainty. However, a mortgage security is subject to prepayment risk. Investors estimate the cash flow schedules for these assets by incorporating a prepayment rate. A prepayment rate allows the investor to estimate the cash flows against which to apply the required discount rate.

Consider a five-year Treasury security with a coupon of 5.375 percent, yielding 5.49 percent in the market. Its price would be the sum of the present values of both its coupon interest payments and the principal payment at maturity. The interest stream is an annuity whose present value comes from applying equation (4). The present value of the final maturity payment comes from applying equation (2).

If the bond has a par value of $1,000, the present value of the coupon interest payments may be calculated as follows, using Equation (4):

$$c\left[\frac{1-\left(\frac{1}{(1+i)^n}\right)}{i}\right]$$

Where:

c = semiannual coupon payment (annuity).
$1,000 x .05375/2 = $26.875
i = periodic yield, *i.e.*, 5.49%/2 =2.745%.
(Semiannual interest payments require us to divide the coupon rate by 2.)
n =number of periods, *i.e.*, 5 years x 2 = 10.

The present value of the annuity interest stream is $232.26.

$$26.875\left[\frac{1-\left(\frac{1}{(1+.02745)^{10}}\right)}{.02745}\right]=\$232.26$$

The present value of the principal at maturity, which in effect is like a zero coupon bond, is $762.77, using equation (2) as shown below:

$$\frac{FV}{(1+i)^n}$$

Where:

FV = Par *(i.e.*, Future) Value
i = periodic discount rate, = 5.49%/2 = 2.745%

$$\frac{1000}{(1+.02745)^{10}}=\$762.77$$

Thus, the price of the bond, which is the sum of the present values of the annuity stream and the maturity amount, is $995.03 ($232.26 +$762.77).

The price of $995.03 is below the bond's par value of $1,000. When a bond sells below its par value, the bond sells at a discount. Bonds selling at a discount will have a yield higher than the coupon rate. Investors are not willing to pay full price (par value) for securities that have coupon rates lower than required by the market. In this case, the yield of 5.49 percent is higher than the coupon rate of 5.375 percent.

When the yield is lower than the coupon rate, the price will be above par value. Such a bond sells at a premium. Investors must pay more than face value to buy a security that has a coupon rate that is greater than the yield required by the market. Because at maturity the issuer redeems the bonds at par value, discount securities will accrete to par while premium securities will amortize to par. Accounting Standards Codification 310-20 specifies how to amortize premiums and accrete discounts.

1) Compounding Periods

The present and future values calculated in the annuity examples were based on full-year interest accrual periods. The annuity paid its cash flow once each year. The real world is more complex. In the fixed income markets the usual interest payment period is twice a year. But, there are also instruments that pay on a different basis, so it is useful to have some method of converting rates

to the same basis so that investors can make comparisons between instrument types. Mortgage pass through securities pay monthly, and some interest rate swaps pay quarterly. Most rates are quoted on a semi-annual, or bond equivalent, basis. Investors convert yields on instruments that do not pay semi-annually to their semi-annual equivalent for comparison purposes. The equation for converting an annual rate to its semi-annual equivalent is:

$$SAY = 2\left((1 + R_a)^{\frac{1}{2}} - 1 \right) \quad (5)$$

Where:

SAY=Semi-annual equivalent yield

R_a =Annual yield

In the example above, the semi-annual equivalent of a 6.4 percent annual rate is 6.3 percent, calculated as follows:

$$SAY = 2\left((1 + .064)^{\frac{1}{2}} - 1 \right) = .063$$

The general equation for converting a rate to its semi-annual equivalent basis is:

$$SAY = 2\left(\left(1 + \frac{R}{k} \right)^{\frac{k}{2}} - 1 \right) \quad (6)$$

Where:

k=number of interest payments per year

R = the return, or yield, expressed on the stated payment basis

For example, the semi-annual equivalent yield of a 6 percent quarterly pay bond that pays 1.5 percent four times a year is calculated as follows:

$$SAY = 2\left((1 + .015)^{\frac{4}{2}} - 1 \right) = .06045$$

2) Yield-To-Maturity (YTM)

The price of a bond is simply the sum of the present values of its cash flows. The cash flows are the coupon payments and the return of principal at maturity. We could discount each of the cash flows at a rate specific to when we receive the flow, but YTM calculations use the same discount rate for all of the cash flows. Later in this appendix we will see how to determine the

theoretically appropriate discount rate for each maturity, and why investors find it valuable to do so. For now, however, the YTM is that single discount rate that equates the sum of the discounted cash flows to the price of a bond.

The equation for a bond price is:

$$P = \frac{C_1}{(1+y)} + \frac{C_2}{(1+y)^2} + \ldots + \frac{C_n + Par}{(1+y)^n} \qquad (7)$$

Where:

P=Bond price
C_i = cash flow in period i, in this case the semiannual coupon payment
Par = Par Value
Y = yield to maturity/2
n = number of periods to maturity (2 times the number of years to maturity for a semi-annual pay bond)

The YTM is the discount rate, y, that satisfies equation (7). It gives a present value of cash flows equal to the bond's market price. In this case, the YTM is also the semi-annual, or bond equivalent, yield, because we receive payments twice per year. The bond-equivalent yield (BEY) is the standard for yield comparisons in the fixed income market.

Table 1

(1) Period	(2) Cash Flow	(3) Discount Factor	(4) Present value of Cash Flow
1	26.88	0.973	26.16
2	26.88	0.947	25.46
3	26.88	0.922	24.78
4	26.88	0.897	24.12
5	26.88	0.873	23.47
6	26.88	0.850	22.84
7	26.88	0.827	22.23
8	26.88	0.805	21.64
9	26.88	0.784	21.06
10	1026.88	0.763	783.27
			995.03

Table 1 illustrates the calculation of the price of the $1,000 par value five-year Treasury security we reviewed earlier. Rather than using the present value equations for an annuity and a single cash flow to calculate the price, as before, we are now going to view each cash flow separately. To calculate a bond price using equation (7), we need a schedule of the bond's cash flows. In

Table 1, column one shows the period in which the cash flow is received. Period 1 is six months from today, period 2 is one year from today, and so on out to five years. Here, we have assumed a new issue bond with its coupon due a full six months from now. Column 2 schedules the cash flows. The Treasury security pays $26.875 for each six-month period. In period 10, the investor receives the interest payment ($26.875) plus the return of principal ($1,000). Column 3 provides the discount factor. The discount factor is the result of applying the present value equation given in equation (2), $PV = \frac{FV}{(1+i)^t}$. It is the amount we need to invest today in order to receive $1.00 in period t. The values decline as we go down the column because the amount we invest will take longer to compound to get to $1.00. Column 4 details the present value of each scheduled cash flow. It results from multiplying the cash flow in column 2 by the discount factor in column 3. As before, we see the price of the bond is $995.03.

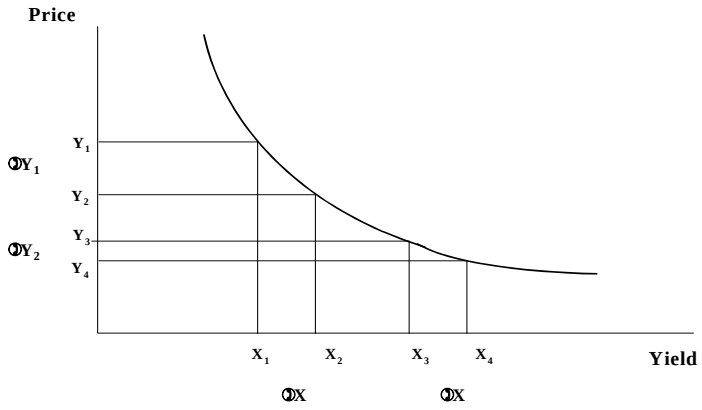
3) Bond Price Sensitivity

While the valuation of a financial instrument is an important concept in investment management, quantifying the sensitivity of that valuation to changes in market conditions such as interest rates and volatility is at the core of investment portfolio risk management.

A basic property of non-callable bonds is that the price of the bond has an inverse relationship to its yield. This is because the price of a bond is the present value of its cash flows. As market yields increase, the present value of future cash flows decreases. The price of the bond will decrease since its promised cash flows become less valuable; the coupon rate on the bond is lower than the market's required yield. The most important determinant of price sensitivity is maturity. A less understood factor, however, is the level of interest rates.

Graphically, (see Figure 1) the shape of the price/yield relationship for an option free bond is

Figure 1



curved, or "convex." It is not linear. This property of fixed income securities is beneficial. When yields decline (increase) the price of the bond will not only increase (decrease), but will do so at an increasing (decreasing) rate. This property of non-callable bonds is known as positive convexity, which this appendix will cover in detail later. Because of positive convexity, price sensitivity for bonds, given a particular yield change, are greater at lower interest rates than they are at higher interest rates. This is evident by looking at the slope of the price/yield curve in Figure 1. The relationship between price and yield is a curve, and not a line, because equation (7), the bond price formula, is not a linear equation.

At low rate levels, a given change in yields causes a bigger change in price than at higher rate levels. The fact that the graph is a curve, and not a line, means that yield changes (along the X axis) produce different changes in price (along the Y axis) all along the curve. In Figure 1 the difference between the two yields X2 and X1, (X2-X1), is the same as the difference between X4 and X3, (X4-X3), but the associated price changes are not the same. The price change at lower rates (Y1-Y2) is greater than at higher rates (Y3-Y4).

Bond Price Sensitivity: Duration & Convexity

Many financial professionals use duration and convexity to measure the sensitivity of a bond's (or portfolio's) value to parallel changes in yield. Thus, these terms are measures of risk. There are a number of different "duration" measures. "Modified" duration directly estimates the price sensitivity of a security. Related terms include Macaulay[10] duration and effective duration. Although all attempt to measure price sensitivity, in practice they have different uses.

Macaulay duration is useful in immunization, a process in which a risk manager constructs a portfolio whose value will at least equal a specified liability amount, regardless of whether rates rise or fall. To obtain such a portfolio, the manager acquires a portfolio with a Macaulay duration equal to the investment horizon (the liability maturity) and an initial present value of the bond portfolio equal to the present value of the future liabilities. If interest rates rise, the investor's total return from interest will increase, offsetting the decline in portfolio values. If interest rates fall, the rise in portfolio values offsets the decline in the return from interest payments.

Portfolio managers use modified duration, an extension of Macaulay duration, to measure a bond's price sensitivity to small parallel movements in interest rates. For securities that have fixed cash flows, such as Treasuries, modified duration can provide a very good estimate of price sensitivity, especially for small yield changes.

To illustrate the calculation of Macaulay and modified duration, consider the previous example of a five-year Treasury note with a coupon of 5.375 percent, priced to yield 5.49 percent. First, the relevant equations:

[10] Macaulay F., *Some Theoretical Problems Suggested by Movements of Interest Rates, Bond Yields and Stock Prices in the United States since 1856* (New York: National Bureau of Economic Research, 1938).

Macaulay Duration (in periods):

$$D = 1\left(\frac{\frac{C_1}{(1+y)}}{P}\right) + 2\left(\frac{\frac{C_2}{(1+y)^2}}{P}\right) + \ldots + n\left(\frac{\frac{C_n + Par}{(1+y)^n}}{P}\right) \quad (8)$$

Macaulay Duration **(in years):**

$$D_y = \frac{D}{k} \quad (9)$$

Where:

D =Macaulay duration in periods
D_y=Macaulay duration in years
k =number of interest periods per year
And other variables are the same at the yield to maturity calculation in equation (7)

Perhaps an easier way to see what the duration calculation does is to consider an alternative representation of Macaulay's duration:

$$D = \frac{(1)PVCF_1 + (2)PVCF_2 + .. + (n)PVCF_n}{PVTCF} \quad (10)$$

where:

$PVCF_t$ = Present value of cash flow in period t discounted at the periodic yield;
PVTCF = Present value of total cash flow, the price;
k = number of periods per year. k=2 for Treasury securities that pay semiannually.
n = number of periods until maturity. With semiannual compounding, a five-year Treasury security has n=10 periods; and
t = period in which the investor receives the cash flow.

The denominator of the equation is the bond's price, including accrued interest. In the numerator, the duration calculation considers the present value of each cash flow, and multiplies it by the period in which it occurs.

Modified Duration:

$$D_{\text{mod}} = \frac{D_y}{1 + \left(\frac{yield}{k} \right)} \qquad (11)$$

Where: D_{mod} = Modified Duration

The percentage price change for a security, using duration, is:

Percentage price change = - D_{mod} x yield change x 100 (12)

For example, if a bond has a modified duration of 2.0, a 100 basis point change in rates would cause a percentage price change of: 2.0 x .01 x 100 = 2 percent. Modified duration simply measures percentage price sensitivity.

To calculate duration, we need a schedule of the bond's cash flows. In Table 2, column one shows the period in which the cash flow is received. Period 1 is six months from today, period 2 is one year from today, and so on out to five years. Column 2 schedules the cash flows. The Treasury security pays $26.875 for each six-month period. In period 10 the investor receives the interest payment ($26.875) plus the return of principal ($1,000). Column 3 provides the discount factor. The discount factor is what a dollar is worth, based upon our assumed discount rate of 5.49 percent, at each future point. These factors decline over time, because a dollar becomes worth less the further in the future we receive it. This results from applying the present value equation given in Equation (2). $PV = FV/(1+i)^t$. In this case, the FV is always $1, because we're calculating the present value of a dollar at some future period. Column 4 details the present value of each scheduled cash flow. It results from multiplying the cash flow in column 2 by the discount factor in column 3. Column 5 represents the present value of each cash flow, multiplied by the period in which it occurs. For example, in period 1 the present value of the cash flow is $26.157, and is multiplied by 1 to get $26.16 in column 5. In period 2, the present value of $25.458 multiplied by 2 gives $50.92 in column 5.

Table 2

(1) Period (t)	(2) CF	(3) Discount Factor	(4) $PVCF_t$	(5) t X ($PVCF_t$)
1	26.875	.9733	$26.157	$26.16
2	26.875	.9473	$25.458	$50.92
3	26.875	.9220	$24.778	$74.33
4	26.875	.8973	$24.116	$96.46
5	26.875	.8734	$23.472	$117.36
6	26.875	.8500	$22.845	$137.07
7	26.875	.8273	$22.234	$155.64
8	26.875	.8052	$21.640	$173.12
9	26.875	.7837	$21.062	$189.56
10	1,026.875	.7628	$783.268	$7,832.68
			$995.031	$8,853.30

Table 2 simply replicates what occurs when applying equation (10). The sum of the present values of the cash flows in column 4 is $995.03. This is the bond's price, which is the same value we got when we valued the bond as an interest annuity stream and a principal cash flow at maturity using Equations 2 and 4. Macaulay duration is calculated as the sum of column 5 divided by the bond's price. The resulting duration of 8.898 is measured in periods. To get duration in years, divide duration (in periods) by the number of periods in a year (2), and get Macaulay duration of 4.449 years (equation 9). To get modified duration, we apply equation (11).

$$D = \frac{8,853 \quad .30}{995 \quad .031} = 8.898$$

$$D_y = \frac{8.898}{2} = 4.449$$

$$D_{\text{mod}} = \frac{4.449}{1.0275} = 4.33$$

Modified duration, which estimates the amount that a bond's price will change, assumes that changes in yield do not change cash flows. In our example, the bond has a modified duration of 4.33 years. Thus, the bond's price is estimated to increase/decrease 4.33 percent if market interest rates fall/rise 100 basis points. Note in equation (12) that there is a negative sign in front of the modified duration term. This illustrates that when interest rates rise (the yield change is positive), the change in price is negative. If interest rates fall (the yield change is negative), the change in price is positive. There are some securities, such as interest-only securities stripped

from mortgage pass-through securities, whose prices rise when rates rise. Such securities have negative durations.

Modified duration calculates an estimate for percentage changes in price, but portfolio managers are also interested in absolute dollar price changes. Dollar duration provides the estimated dollar price change, and is calculated by multiplying the modified duration of a bond by its price.

Dollar Duration = - Modified duration x price (13)

For example, the modified duration of a 5 percent coupon, ten year bond trading at 89.98 and yielding 6.37 percent is 7.62 years. Its dollar duration for a 100 basis point change in rates is 6.86, (7.62 x .9). This means that a $100 par value bond would have an estimated dollar price change of $6.86 for a 100 basis point change in rates. The price of the bond at a 6.27 yield, ten basis points lower, is 90.67. Since the yield change is only 10 basis points, not 100 basis points, the estimate of the price change using dollar duration is $0.69 (-7.62 x .90 x -0.1). The actual price change is also $0.69. Over small yield changes, such as the 10 basis points here, duration (and dollar duration) provide very good approximations of price sensitivity.

The duration of any zero coupon cash flow for a given maturity will always be longer than that of a regular interest-bearing bond. The reason for this is that a higher proportion of the total cash flow for an interest-bearing bond occurs sooner than for a zero coupon bond. The earlier the cash flow occurs, the lower the risk, since risk increases with maturity.

Lower coupon securities have higher durations, or more price sensitivity, than higher coupon securities. A zero coupon security is more price-sensitive than any other security with its maturity. Reviewing equation (10), the zero coupon bond has only one cash flow.

$$D = \frac{(1)PVCF_1 + (2)PVCF_2 + .. + (n)PVCF_n}{PVTCF}$$

In the equation, all terms in the numerator are zero, except the last one.

$$D = \frac{(n)PVCF_n}{PVTCF}$$

The last term in the numerator is $(n)PVCF_n$. Since a zero coupon bond has only one cash flow, $PVCF_n$ is PVTCF. Therefore, the term in the numerator cancels the term in the denominator, except for n.

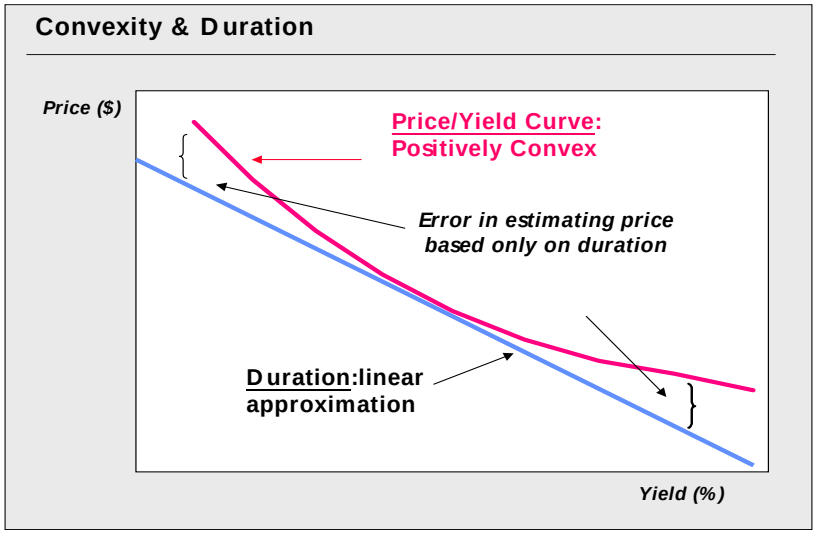
$$D = n$$

Thus, the Macaulay duration of a zero coupon security is its maturity. The modified duration is slightly less, after applying equation (11).

Equation (10) also provides a convenient way of seeing why longer maturity assets have more price sensitivity than do shorter maturity assets. Since the denominator of the equation is just the price, it is the terms in the numerator that determine duration. Since the present value of each cash flow is multiplied by the period in which it occurs, the longer the maturity, the greater the duration measure, because each cash flow present value is multiplied by a bigger term for n, and consequently the greater the price sensitivity.

Recall the price/yield curve for option-free securities:

Figure 2



For progressively larger changes in interest rates, the duration estimate of the actual price movement will be increasingly in error. Using our five-year Treasury example, Table 3 quantifies the duration error for a 100, 200, and 300 basis point change in interest rates. It compares the price change estimated by duration with the actual percentage price change. Notice that the greater the change in rates from our starting level of 5.49 percent, the greater the error in the duration estimate. For example, when rates rise 300 basis points to 8.49 percent, duration estimates that the price will decline 12.99 percent while the actual price decline is only 12.04 percent. The error using duration is thus 0.95 percent at 300 basis points. At a 100 basis point change the difference between the actual price change and the duration estimate is only 0.11 percent.

Note that the duration price estimate always is less than the actual price, since the straight line tangent to the curve in Figure 2 lies below the curve at all points except at the current price (tangency point). Finally, note that the actual price change when yields fall is greater than the price change when rates rise. For example, when yields drop 100 basis points, the price increases 4.44 percent. The price falls 4.22 percent when yields increase 100 basis points. This is positive convexity.

Table 3

Actual Price	$1,134.85	$1,085.80	$1,039.24	$995.03	$953.03	$913.13	$875.20
% Price Change	14.05%	9.12%	4.44%		-4.22%	-8.23%	-12.04%
Est. Price	$ 1,124.28	$ 1,081.20	$ 1,038.11		$ 951.95	$ 908.86	$ 865.78
Est. Price Chg	12.99%	8.66%	4.33%		-4.33%	-8.66%	-12.99%
Duration Error	1.06%	0.46%	0.11%		0.11%	0.43%	0.95%

The calculation of duration assumes that when yields change, the cash flows of a bond will not change. This is an unrealistic assumption for bonds with options, such as callable bonds or mortgage-backed securities. In the case of a callable bond, a decline in the market yield near or below the coupon rate will limit the price appreciation. Investors will be reluctant to pay more than par for a bond that the issuer can redeem, at par, prior to maturity. If the bond is called, investors who pay more than par (or the call price) will have a capital loss. Therefore, Macaulay and modified duration, which assume that cash flows do not change, are not effective methods of quantifying the price sensitivity of bonds with embedded options.

Investors use a different measure, called effective duration (also known as option adjusted duration), to address the likelihood that cash flows will change as rates change. Equation (14) below shows the calculation for effective duration.

(14)

$$D_{eff} = \frac{P_d - P_u}{2P(\Delta y)}$$

Where:

P_d = Price when rates go down P_u = Price when rates go up
P = Initial price (Δy) = yield change (in basis points)

The important difference between effective duration and other duration measures is that the price of the bond, in both up and down rate shifts, is determined based upon cash flows expected to occur in that new rate environment. Many analysts compute the price for the security in up and down interest rate scenarios using a constant option adjusted spread (OAS). OAS analysis is discussed later in this appendix.

For a CMO, for example, a rate decline of 100 basis points would trigger a new prepayment rate, which would generate a new cash flow schedule. A rise in rates might trigger a slower prepayment rate.

Effective duration essentially takes an average of price changes when rates rise and fall. This "average" can mask the true amount of risk when a security has very different price changes when rates rise and fall. For example, consider a security priced at 100 (par), whose value

becomes 102 when rates fall 100 basis points and 85 when rates rise 100 basis points. The security clearly has an asymmetric risk profile; it loses much more than it gains when rates change 100 basis points.

Using equation (12) the effective duration of the security would be 8.5:

$$D_{eff} = \frac{102 - 85}{2 \times 100 \times .01} = 8.5$$

While effective duration does consider how rate changes affect cash flows, it can give a resulting risk measure that bears little relationship to how the security will perform, especially when the interest rate move is large. The example above shows that the bond's price will rise 2 percent or fall 15 percent if rates change by 100 basis points. Effective duration thus has little meaning for a bond with such an asymmetric risk profile for a yield change this significant. Effective duration is therefore much more effective over smaller yield changes, such as 25 basis points.

This example underscores the important point that investors should understand the projected price change of a security in both rising and falling rates, rather than rely on a summary measure like effective duration.

The term "effective duration" used here is the one given in various books written by Frank Fabozzi, as well as other authors. Some market participants, however, use "effective duration" in different ways. Examiners should recognize that this term may have a meaning that varies among different users.

Examiners can use the following table to gain a general insight into the price sensitivity of securities in a regulated entity's investment portfolio:

4) Security	**Estimated Price Sensitivity (100 basis point yield change)**
2 Year Treasury	1.95%
4 Year Treasury	3.49%
5 Year Treasury	4.27%
7 Year Treasury	5.66%
10 Year Treasury	7.44%
30 Year Treasury	14.18%
15 Year Ginnie Mae	3.59%
15 Year Fannie Mae	3.50%
30 Year Freddie Mac	4.31%
30 Year Ginnie Mae	4.80%

The sensitivities above arise from using modified and effective duration, as appropriate.

The modified duration of a portfolio of securities is the weighted average of the modified durations of the bonds in the portfolio, where the weight of each security is the proportion of the portfolio each security represents. If the portfolio has a modified duration of 5.5, it means that a 100 basis point change in rates will cause the portfolio value to change by approximately 5.5 percent. Such a portfolio would be quite price sensitive, given that its sensitivity exceeds that of a 30-year Ginnie Mae security.

The duration estimate assumes a parallel shift in the yield curve; the required YTM on each bond in the portfolio will change by the same amount. Since parallel shifts happen rarely, the duration estimate of the value change of a portfolio will likely be in error because of this unrealistic assumption.

Duration measures provide a first approximation of price volatility for a bond. Duration always underestimates the actual price of an option-free security, because duration is a straight-line (linear) estimate of the price/yield function, which is a curve. Investors can gain better price estimates by using a combination of duration and convexity.

Convexity

The term "convexity" refers to the curvature of the price/yield relationship evident in Figures 1 and 2. While duration provides a first approximation to price volatility, convexity provides a second approximation. Duration combined with convexity provides a better approximation of bond price volatility than using duration alone.

Equation

$$\text{Convexity (in years)} = \frac{1(2)PVCF_1 + 2(3)PVCF_2 + \ldots + n(n+1)PVCF_n}{(1+\frac{yield}{k})^2 \times k^2 \times PVTCF} \quad (15)$$

$$\text{Percentage price change due to convexity} = .5 \times \text{Convexity} \times (\text{Yield change})^2 \quad (16)$$

Continuing with the example of a five-year Treasury security, Table 4 illustrates the application of equation (15) and the convexity calculation.

Table 4

(1) Period (t)	(2) t x (t+1)	(3) CF	(4) Discount Factor	(5) PVCF	(6) t X PVCF
1	2	$26.88	0.9733	$26.16	$52.31
2	6	$26.88	0.9473	$25.46	$152.75
3	12	$26.88	0.9220	$24.78	$297.34
4	20	$26.88	0.8973	$24.12	$482.32
5	30	$26.88	0.8734	$23.47	$704.15
6	42	$26.88	0.8500	$22.84	$959.47
7	56	$26.88	0.8273	$22.23	$1,245.12
8	72	$26.88	0.8052	$21.64	$1,558.10
9	90	$26.88	0.7837	$21.06	$1,895.59
10	110	$1,026.88	0.7628	$783.27	$86,159.53
			Price	$995.03	$93,506.68
			Convexity		22.255
			Impact of convexity		0.0011

The numerator of equation (15) is the sum of column 6 in Table 4. The denominator is as follows: $(1+(.0549/2))^2$ x 2^2 x 995.03 = 4,201.62. Therefore, convexity = 93,506.69 / 4,201.63 = 22.25.

Applying equation (16), the impact of convexity for a 100 basis point change in rates is: 0.5 x 22.25 x $(.01)^2$ = .0011, or 11 basis points.

Table 5 shows that supplementing duration with convexity provides a better estimate of the actual price change than does duration alone. Even for a change in yields of 300 basis points, the combination of using duration and convexity estimates comes very close to the actual price change on the security.

Table 5

Basis Point Change	**-300**	**-200**	**-100**	**0**	**100**	**200**	**300**
Yield	2.49%	3.49%	4.49%	5.49%	6.49%	7.49%	8.49%
Price	$1,134.85	$1,085.80	$1,039.24	$995.03	$953.03	$913.13	$875.20
% Change	**14.05%**	9.12%	4.44%		-4.22%	-8.23%	-12.04%
Duration Impact	**12.99%**	8.66%	4.33%		-4.33%	-8.66%	-12.99%
Convexity Impact	**1.00%**	0.45%	0.11%		0.11%	0.45%	1.00%
Duration & Convexity	**13.99%**	9.11%	4.44%		-4.22%	-8.22%	-11.99%
Total Difference	**0.06%**	0.02%	0.00%		0.00%	-0.02%	-0.05%

For a 300 basis point yield change, the duration estimate misses by more than 1 percent when rates fall (14.05 percent - 12.99 percent). Including convexity reduces the error to only six basis points (14.05 percent - 13.99 percent).

Forward and Spot Rates

Suppose an investor has funds to invest, and has a two-year investment horizon. The investor could simply purchase a two-year security. Alternatively, however, the investor could purchase a one-year security and, upon its maturity, roll it over for one year. Alternatively, the investor could purchase a three-year security and sell it after one year. There are a number of combinations that yield a two-year horizon. How does the investor decide what strategy is best?

If the investor knew where rates would be one year from now, the choice would be easy. The investor would purchase the securities that provided the greatest total return, considering coupon income, interest on interest, and any gain/loss incurred from selling securities early. While investors cannot know beforehand what the best strategy will be, they can examine the yield curve to determine what the yield curve implies for future rates. They can then use that information to make a more informed investment decision.

Assume that the investor with the two-year horizon sees that the yields for one-year and two-year securities are 6 percent and 6.5 percent respectively. Intuitively, and ignoring interest on interest, the investor with $100 to invest could earn $6 for one-year ($100 x .06), and $13 for two years ($100 x 6.5 x 2). With this information, one can see that the yield curve implies a rate of 7 percent for one-year securities, one year from now. The investor that buys a one-year security at 6 percent, and then rolls it over at that implied rate of 7 percent, would collect $13 in coupon income. That's the same amount the investor could get by purchasing the two-year security yielding 6.5 percent.

The yield curve implies a 7 percent rate for one-year securities, one year from now. The 7 percent rate is called an implied forward rate. It is implied because you cannot directly observe it in the yield curve. You need to calculate it. It is the rate that must exist in order to make the investor indifferent between the two strategies, since they both pay $13.

The investor can use this information to help make the investment decision. If the investor believes one-year rates will be greater than 7 percent a year from now, the appropriate strategy for a two-year horizon would be to buy a one-year security, and then roll it over into another one-year security. If the investor is correct, and one-year rates are higher than 7 percent, the strategy will generate more total dollars of income than would simply buying the two-year security. If the investor is incorrect, then the strategy will produce less income than simply purchasing the two-year security. The key point is that, by analyzing forward rates, the investor can compare his/her own forecast of rates to what the yield curve implies. Forward rates thus help investors make more fully informed investment decisions.

Consider the following yield curve for zero coupon securities:

Maturity	1 Year	2 Years	3 Years	5 Years	10 Years
Yield	6.42%	6.35%	6.32%	6.22%	6.04%

Note: Since short-term rates are higher than long-term rates this yield curve is inverted.

Suppose the investor wanted to determine what the yield curve implies for three-year rates, two years from now. For example, the investor may have a block of securities maturing two years from now and therefore wants to know what the "market" expects three-year yields to be at that point. The three-year rate, in two years, must satisfy the following equation:

$(1+.0622)^5 = (1.0635)^2 \ (1+{}_2f_3)^3$

Here, ${}_2f_3$ means the three-year rate, two years from now. More generally, ${}_nf_t$ means the rate for t years, n years from now.

Solving this equation for the forward rate gives a yield of 6.13 percent. Therefore, the yield curve implies that three-year yields will be 6.13 percent, two years from now. Note that the yield curve is slightly inverted, with short yields greater than long yields. As expected, an inverted curve signals the market's expectation that yields will fall: the 6.13 percent forward rate is lower than the current yield of 6.32 percent for three-year securities.

The solution to the above equation yields the more general equation for computing implied forward rates:

$$ {}_n f_t = \left[\frac{(1 + z_{n+t})^{n+t}}{(1 + z_n)^n} \right]^{\frac{1}{t}} - 1 \qquad (17)$$

Where:

${}_n/_t$ = The forward rate *n* periods from now, for *t* periods.
z_n = Semiannual spot (*i.e.*, zero coupon) rate for *n* periods.
z_{n+t} = Semiannual spot rate for *n*+*t* periods.

Investors may wonder how effectively forward rates predict future yield levels. Empirical studies have shown that forward rates generally are poor at predicting near-term changes in yields. However, the question is not whether they accurately forecast the future, but rather how the investor can use these implied yields to determine the most effective investment decision or portfolio strategy. It is precisely because forward rates are not good at predicting future rates that they are so useful. By comparing the investor's own forecast of how yields will change with what the yield curve implies, the investor can make the most informed investment decision.

1) Spot Rates

Many investors confuse spot and forward rates. A forward rate is a rate expected to occur at some future date. It is implied by the yield curve. In the example above, 6.13 percent is the rate implied by the current yield curve for three-year securities, two years from now. A spot rate, by contrast, is a zero coupon rate. It is a rate today for a zero coupon security. A zero coupon security has only one cash flow; the investor collects the face amount at maturity.

Consider again the five-year Treasury security we have used in this appendix. It pays 10 coupon payments of $26.875, and a final principal cash flow of $1,000. The YTM calculation discounted each of these cash flows at a single rate, the bond's YTM of 5.49 percent. But, why should investors discount a cash flow that occurs in six months at the same rate as a cash flow that occurs in five years? Theoretically, each cash flow should have its own discount rate.

An investor can replicate the cash flow of the five-year Treasury security without actually buying the security. To do so, the investor would purchase 10 individual zero coupon bonds whose maturities correspond to the interest payment dates on the Treasury. Each zero coupon bond would have a face value of $26.875, the amount of interest payments the investor would receive on a five-year Treasury. The investor would also have to purchase a zero coupon bond that paid $1,000 at the end of five years. The cost of this package of zero coupon bonds that replicates the cash flows of the five-year Treasury security must equal the cost of the Treasury security; otherwise, there would be an arbitrage opportunity.

Investors can think of any security as a package of zero coupon bonds. We can replicate the cash flow schedule of other kinds of securities, such as a mortgage security. We would simply buy a series of zero coupon bonds, each having a face value equal to the cash flow we expect to receive on the mortgage security for the applicable payment date. The advantage of using zero coupon yields to discount the cash flows is that the investor can assign to each cash flow the discount rate appropriate for that cash flow.

Treasury bill yields represent spot rates, because T-bills are zero coupon securities. Investors can readily observe spot rates out to one year, the maturity of the longest Treasury bill. After one year, however, investors cannot observe spot rates. Although "stripped" Treasury zero coupon securities do exist beyond one year, they tend to have much lower liquidity than coupon securities. Therefore, to construct a "spot rate curve" or zero coupon curve, investors derive zero coupon rates using a process called "bootstrapping the yield curve," using coupon-bearing Treasury issues. This process starts with known spot rates, such as Treasury bill yields, and incrementally derives "theoretical" spot rates across the maturity spectrum. These spot rates are theoretical because we derived them; the securities do not exist.

For example, consider a 1.5-year Treasury security with a 6.25 percent coupon, priced at par. A $1,000 par value security will make a coupon payment of $31.25 every six months. Assume that the six-month and one-year T-bill yields, or the spot rates, are 5.8 percent and 5.9 percent

respectively. To derive the 1.5-year spot rate, we solve for the rate that, when combined with known spot rates, gives a present value equal to the current price of the 1.5-year Treasury. In other words, what discount rate, applied to the 1.5-year payment, after discounting the six-month and 12-month cash flows at T-bill spot rates, will give a present value of the 6.25 percent coupon bond equal to its current price of par?

$$\left[\frac{31.25}{1+\left(\frac{.058}{2}\right)^{1}}\right]+\left[\frac{31.25}{1+\left(\frac{.059}{2}\right)^{2}}\right]+\left[\frac{1031.25}{1+\left(\frac{s}{2}\right)^{3}}\right]=\$1{,}000$$

Solving the equation for the spot rate, s, gives 6.26 percent. Therefore, 6.26 percent is the 1.5-year spot (or zero coupon) rate. Note that this is not the same discount rate as the 6.25 percent YTM on the Treasury security. In upward sloping yield curves, spot rates are greater than the yields to maturity. Continuing in the same manner ("bootstrapping"), we take a two-year Treasury security. We have the six-month and 12-month spot rates, as well as the 18-month spot rate we just derived. To solve for the two-year spot rate, we solve for the rate that gives a present value of the two-year security's cash flows, discounted at our spot rates, equal to its current price. This process continues sequentially until we have all the points on the yield curve.

The spot curve provides the theoretical discount rate for each maturity point. Once we have this curve, we can evaluate the relative value of different securities more effectively, especially for bonds with irregular cash flows. Consider the following two securities:

	Coupon	**YTM**	**Maturity**
Treasury	6.25%	7.00%	10 Years
Corporate	0.00%	8.50%	10 Years

Both of these securities have 10-year maturities. Traditionally, an investor would say that the corporate provides a 150-basis-point spread over the Treasury. However, the corporate bond is a zero coupon bond. It has only one cash flow. The Treasury, on the other hand, will pay a regular coupon over its life. Since the cash flow schedules of the two securities are so different, the bonds are not comparable. Therefore, for purposes of determining relative value, it is not appropriate to calculate the spread simply by subtracting the yield of the Treasury from the yield of the corporate.

As discussed previously, we can replicate the cash flow of any security by purchasing zero coupon Treasury securities. In this case, because the corporate itself is a zero coupon security, the task is easy. If the corporate bond has a face value of $1,000, an investor can replicate it by purchasing a zero coupon Treasury security paying $1,000 in 10 years. Suppose a 10-year zero coupon Treasury yields 7.5 percent. In that case, it is easy to see that the real spread on the corporate is 100 basis points, not 150 basis points.

In general, the theoretically appropriate way to assess the relative value of a security is to compare it with a package of zero coupon Treasury securities that replicate its cash flow. If one discounts each cash flow of a credit risky security by the relevant spot rates, such as the zero coupon Treasury rates, the resulting present value of the security will be greater than its current price. This makes sense, since discounting cash flows from a credit risky instrument at the low risk-free rate will produce a value much higher than the security's market price.

Suppose we then add a constant spread to each of the spot rates. If this constant spread results in a present value equal to the observed price of the security, then that spread is the theoretical spread. It is called a static, or "zero volatility," spread. Calculating the static spread is a trial and error process. "Zero volatility" simply means that any options embedded in the security are not exercised, including the option to default. In other words, the cash flow of the security will not change. When applied to bonds with no embedded options except the option to default, this static (or zero volatility) spread is the spread the investor realizes over the entire Treasury spot rate curve if the bond is held until maturity and the bond does not default.

2) Asset Pricing: YTM, Spot Rates, and Forward Rates

There are three ways to value a security, and each gives the same price. The conventional yield-to-maturity (YTM) discounts each cash flow at a single discount rate, its YTM. Alternatively, the investor can discount each cash flow at the spot rate or the zero coupon rate appropriate for each payment date. Arbitrage relationships ensure that discounting by spot rates gives the same price as discounting by the YTM. Finally, investors can discount cash flows at a series of forward rates, where the forward rates are determined from spot rates. For example, on a two-year security paying a $25 coupon, with a par value of $1,000, the calculation would be:

$$\text{Price}=\left[\frac{25}{1+\frac{s}{2}}\right]+\left[\frac{25}{\left(1+\frac{s}{2}\right)\left(1+\frac{1f_1}{2}\right)}\right]+\left[\frac{25}{\left(1+\frac{s}{2}\right)\left(1+\frac{1f_1}{2}\right)\left(1+\frac{2f_1}{2}\right)}\right]+\left[\frac{1{,}025}{\left(1+\frac{s}{2}\right)\left(1+\frac{1f_1}{2}\right)\left(1+\frac{2f_1}{2}\right)\left(1+\frac{3f_1}{2}\right)}\right]$$

The discounting process here uses a series of six-month period forward rates. Since forward rates are derived from spot rates, discounting by either method provides the same present value, price.

3) Deficiencies in Traditional Yield-to-Maturity Calculation

The traditional YTM calculation involves discounting security cash flows at a single discount rate, notwithstanding the fact that there is a unique rate for each maturity point. As an example,

for a ten-year security, the last cash flow, in year 10, is discounted at the same rate as the payment due in six months. The traditional YTM calculation thus is an average discount rate; it ignores the term structure of interest rates. The term structure of rates is important in assessing the risks and rewards of securities, such as mortgage securities, with uneven cash flows. This is why we considered spot rates.

The YTM calculation does not consider an investor's reinvestment of coupon interest. The actual yield realized on an investment depends upon the returns the investor earns on interest payments -- interest on interest. Therefore, the realized yield on the investment equals the YTM only if the investor reinvests all coupon interest payments at that YTM. This happens only for zero coupon securities, which accrete to par value at the YTM. If interest rates rise subsequent to purchasing a coupon bond, the investor may reinvest cash flows at a rate higher than the YTM, which then results in a realized yield greater than the YTM. Alternatively, reinvesting at yields lower than the YTM will cause a realized yield less than the YTM. The YTM calculation also assumes that the investor holds the security to maturity. This assumption is often unrealistic.

The traditional YTM calculation also does not consider interest rate volatility, which is particularly important for securities with options. The YTM calculation essentially assumes that interest rates remain unchanged over the life of the security.

Option-Adjusted Spread Analysis

How does an investor compare two securities when one, or both, have uncertain cash flows because of options? Traditionally, the investor would compare the yields to maturity of the two securities. However, as discussed previously, the best way to discount cash flows is not using a single rate such as in the YTM calculation, but rather using different spot or zero coupon rates for each time period's cash flows.

Even if an investor discounts cash flows at spot rates, however, what cash flow schedule should be used? An investor who buys a security with embedded options has sold those options. If the security is callable, the investor has sold the issuer the right to repay the debt prior to maturity. Many securities are path-dependent. The cash flows the investor receives in any one period depend not only on the current level of interest rates but also on how interest rates have evolved to that point. For example, a mortgage security's prepayment rates depend not only on the current rate level but also on how many refinancing opportunities homeowners have previously had. The mortgage investor has sold the homeowner the right to prepay the mortgage and thus reduce the principal balance of the security. Investors receive higher yields for selling these options. However, the key question for investors is whether the higher yield fully compensates them for the prepayment risk they have taken.

How does the investor answer that question? By evaluating the security over a sufficiently large number of possible scenarios so that the investor considers the impact of the options. After all, if

not for the options, the cash flows would not change and an investor could simply use the static spread discussed previously. The value of the options depends upon what interest rates do. If interest rates fall, the option the issuer owns permitting it to call the debt (or the homeowner to refinance the debt) becomes more valuable. The investor, who is on the other side of the transaction, has sold the options and therefore loses value when option values increase. The price of the security compresses and will not trade significantly over par value. This is negative convexity.

Suppose we could generate 5,000 possible paths that interest rates might take over the life of the security we wish to analyze. These paths would provide a summary of almost all possible scenarios. Some of these paths would be favorable, while others would be unfavorable. The process of generating interest rate paths could have constraints, such as precluding extremely high or low rate levels, and provide for mean reversion (the higher rates go, the more likely it will be that they then would fall). Given a prepayment model, we could then estimate the cash flows that would occur for each possible rate path. Once we have all 5,000 cash flow schedules, we can discount these cash flows just as we would any other security, using spot rates appropriate for each path. If we discount each cash flow at the spot rates for each of 5,000 rate paths, we generate 5,000 possible values for the security under analysis. These values can then be averaged and compared to the price of the security. Using spot rates, however, will give an average present value greater than the current price observed in the market. This is so because Treasury spot rates are the lowest discount rates; they reflect no cash flow uncertainty and no credit risk. Securities with options have cash flow uncertainty, however, for which investors demand compensation in the form of higher yields. So, we would add some fixed spread to the spot rates in each of the 5,000 rate paths to compute the present values in each path.

Suppose the fixed spread we pick is 50 basis points. We then compare the average present value of 5,000 scenarios to the current price of the security. If the average present value does not equal the observed market price, we know that 50 basis points is not the correct spread. We then select a different spread and try again. When the average present value of the 5,000 different scenarios equals the security's price, the fixed spread we have added to the spot rates is the security's option-adjusted spread (OAS). The OAS is the constant spread that, when added to each spot rate in each rate scenario, gives an average present value equal to the security's market price.

$$\text{Market Price} = \left[\frac{PV\ (path\ 1) + PV\ (path\ 2) + \ldots PV\ (path\ 5{,}000\ )}{5{,}000} \right]$$

By using 5,000 scenarios, or some other suitably large number, we have tried to consider all the possible paths interest rates can take. By evaluating a security over these scenarios, we are attempting to fully explore the impact the option has on the security value.

Because an OAS analysis considers a large number of potential rate paths, it can be an effective way to determine the relative value of securities. However, like other risk and return measures, it too has its limitations. They include:

1) **Modeling error.** Different firms can evaluate the same security and compute different, and sometimes dramatically different, OAS estimates. The causes of the difference could be different prepayment estimates, different means of developing rate paths, or other factors. Consider an investor evaluating two securities. Firm A may show the securities having OASs of 30 and 50 basis points respectively, while firm B may show the same securities having OASs of 40 and 20 basis points. Not only do the two firms show different OASs for the securities but the firms do not agree on which security has the higher OAS.

2) **Interpretation problems.** The OAS represents a summary estimate of the spread the investor might receive over the Treasury spot curve. It is not a guaranteed spread. To see this most clearly, assume that one of the 5,000 scenarios modeled in the OAS analysis actually occurs. In this particular scenario, where rates have risen, the present value of the cash flows or price, using the spot rates for that path, is considerably lower than the current price. For example, on a mortgage security, the cash flows remain outstanding longer than expected. If the investor knew that this scenario would occur, he/she would not be willing to pay the current market price. To reconcile to the current higher market price, given this perfect knowledge of how rates will evolve, the investor would have to add a spread lower than the OAS. Perhaps the investor would even subtract a spread from each Treasury spot rate on that rate path. In other words, to get a present value for that path to equal its current market price, given a specific cash flow associated with higher interest rates, we would have to add a spread less than the OAS. It may even be necessary to use rates lower than the spot rates to get the present value to equal the current market price. In such a case, the OAS would be negative. So, even if the OAS analysis includes the actual future evolution of interest rates, the investor that relies on the OAS alone has not been able to use the information to make an effective investment choice.

3) **Failure to consider all relevant information.** If the OAS modeling process evaluates 5,000 different rate paths, it will generate 5,000 present values. The distribution of those prices provides valuable information to the investor. The investor may discover, for example, that there are some scenarios that lead to unacceptably low present values. Such possibilities may exceed the investor's risk tolerance. The more widely dispersed the present values are, the more risk the security has. The more concentrated the present values are, the higher the structural quality of the security and the lower the risk. Despite this valuable information, however, investors rarely review the distribution of present values across the rate paths.

As a result, investors should never rely on an OAS analysis alone when making investment decisions. Investors should use OAS analysis as one component of a complete relative value analysis, keeping in mind the limitations noted above. A complete relative analysis should consider, in addition to OAS, scenario and total return analyses, an assessment of duration and convexity, and a specific review of cash flows across different rate scenarios.

Prepayment Speeds

With a bullet security, the cash flow schedule -- which details the timing and amount of all principal and interest payments -- is known with certainty. When a security contains options such as a mortgage security, however, there can be an infinite number of possible cash flow schedules. To assess value, investors need to evaluate a security over a number of different interest rate environments, each of which will have its own cash flow schedule.

A mortgage borrower, for example, makes monthly payments of both interest and principal. The borrower, however, has the option to make extra principal payments, or pay off the mortgage completely. These unscheduled principal payments are called prepayments and are an example of how those who own options can exercise them against those who have sold options.

A measure of monthly prepayments is Single Monthly Mortality (SMM), and the equation for calculating it is:

$$SMM = \frac{P_p}{(B_i - P_s)} \tag{18}$$

Where: SMM = Single Monthly Mortality
P_p = Prepaid Principal
B_i = Balance at the beginning of the period
P_s = Scheduled Principal Payment

For example, if the principal balance at the beginning of the month is \$100, the scheduled principal payment is \$0.40 and the prepaid principal is \$0.60, then the SMM is calculated as follows:

$$SMM = \frac{.6}{(100 - .4)} = .6024\%$$

Notice that the quantity in the denominator is the pool balance after the scheduled principal payment.

SMM is the basic unit of prepayment, but prepayment rates are more commonly discussed in annual terms. The annualized version of SMM is the Constant Prepayment Rate (CPR). The equation for calculating CPR is:

$$CPR = 1 - (1 - SMM)^{12} \quad (19)$$

In the example above, the CPR for a pool that experiences a SMM of .6024% for twelve continuous months is:

$$CPR = 1 - (1 - .006024)^{12} = 6.99\%$$

The outstanding balance of a pool after a period of time is a function of both scheduled principal payments and prepayments. An assessment of prepayment speeds is critical to understanding the risk and reward profile of mortgage-backed securities. It is the prepayment speed that allows the investor to generate the cash flow schedule, which then permits calculation of the security's yield. Table 6 shows the balances of a pool of 6.5 percent newly originated 30-year mortgage loans prepaying 6, 12, and 18 percent CPR at various years after origination, and illustrates the dramatic effect prepayments can have on an investment.

Table 6

YEAR	6% CPR	12% CPR	18% CPR
Start	100	100	100
1	93	87	81
2	86	76	66
3	80	66	53
4	74	57	43
5	69	49	35
6	63	43	28
7	59	37	23
8	54	32	18
9	50	27	15
10	46	24	12
WAL	10.7	6.7	4.7

At 6 percent CPR, 59 percent of the pool remains outstanding after 7 years. At 18 percent CPR, however, only 23 percent of the pool remains outstanding after the same 7 year period.

1) In the early 1980s, the Public Securities Association (PSA) tried to define a "normal" prepayment rate, which they defined as the rate of prepayment in an unchanging interest rate environment. After studying the data, they developed a model, known as the PSA model. that projects that in an unchanging environment prepayment rates will increase gradually for 30 months and then level off at a constant rate. The gradual increase in prepayments is

known as "seasoning" and is the result of a number of factors. The principal reason that borrowers prepay in a stable environment is because they relocate, and once they relocate they tend to stay in the new location for at least a little while. Also, borrowers incur fixed costs from taking out a mortgage, and they try to spread out those costs over the longest possible time period.

2) The standard PSA model projects that in the first month after origination, a pool that meets their steady state definition would prepay at a rate of 0.2 percent CPR. The prepayment rate would then increase by 0.2 percent CPR each month from months 2-30. So, after 2 months the prepayment rate would be 0.4 percent CPR. After 3 months the rate would be 0.6 percent, and so on out to 30 months. After 30 months, and for the remaining life of the pool, the prepayment rate would be 6 percent CPR. Prepayment rates in different environments are then expressed as a percentage of the PSA model. For example, a pool that prepays at 0.8 percent CPR after 2 months, is prepaying at 200 percent of the PSA model, or simply 200 PSA. A pool that prepays at a rate of 9 percent CPR after 30 months is prepaying at a rate of 150 PSA (.06 x 1.5 = .09). But, it is not accurate to say that 6 percent CPR = 100 percent PSA, or 12 percent CPR = 200 percent PSA, because those statements are only true after 30 months.

3) For fixed rate mortgages the PSA model gives a reasonable approximation of the seasoning phenomenon, which makes it a convenient tool in describing prepayment speeds. For example, it's easier to say "100 PSA" than "this pool is 10 months old and prepaying at 2 percent CPR".

Because of the ramping process of the PSA model, it is possible to achieve very high PSA speeds that do not involve significant amounts of actual cash prepayments. For example, in month 1, if the security pays at 2 percent CPR, this would translate into 1,000 percent PSA, because the standard PSA model assumes only a 0.2 percent CPR in the first month.

4) For adjustable rate mortgages the seasoning period is not so pronounced. Therefore, for ARMs, investors express prepayments in CPR terms rather than PSA terms.

OVERVIEW OF MAJOR TYPES OF INVESTMENT SECURITIES

1) Mortgage-backed Securities (MBS)

Introduction

Financial management of a regulated entity has become significantly more complex with the expansion of authority to invest in MBS and derivative financial products. The key characteristic that distinguishes MBS from advances or other debt securities is the degree of uncertainty associated with the expected cash flows, due primarily to the option granted to the mortgagee to prepay part or all of the mortgage at any time without penalty. Thus, the

predictability of the cash flow stream and yield from these investments, an increasingly larger percentage of total regulated entity assets, is less certain than is typical of other investments.

Risks Associated with MBS

The prepayment option either increases or decreases the average life of a particular MBS. When interest rates fall, prepayments accelerate and investors receive cash flows earlier, resulting in a shorter average life. Conversely, when interest rates rise, prepayments slow and investors receive cash flows later, resulting in a longer average life. Because prepayments typically accelerate as interest rates decline, and slow as rates rise, any change in the security's average life works against the investor.

This extension or contraction risk can affect total investment return primarily in three ways: (1) market value; (2) reinvestment income; and (3) interest income (accounting yield). Further, investors also have to manage the traditional credit, liquidity, and geographic concentration risks.

1. Market Value. When interest rates decline, the average lives of MBS shorten, reducing the price appreciation associated with falling interest rates. When interest rates rise, average lives of MBS lengthen, increasing the price depreciation associated with rising interest rates. The net result is that prices go down faster when interest rates are rising, and prices go up slower when interest rates are falling. This phenomenon of inopportune price performance is called "negative convexity."

2. Reinvestment Income. The same inopportune timing of cash flows reduces reinvestment income. When interest rates fall, more cash flow must be reinvested at lower rates. When interest rates rise, less cash flow is reinvested at higher rates.

3. Interest Income/Accounting Yield. If the security was purchased at a premium or discount, extension/contraction risk can affect income by altering the accounting yield. Faster prepayments reduce the yield of premium-priced MBS and increase the yield of discount-priced MBS. Conversely, slower prepayments increase the yield of premium-priced MBS and decrease the yield of discount-priced MBS.

Credit Risk: The underlying mortgages collateralize the MBS, reducing credit risk, but do not eliminate credit risk. Credit risk is real, and is a function of the underwriting standards applied to the underlying mortgages.

Liquidity Risk: The liquidity for some mortgage related securities, such as private-labeled or unusually structured MBS and collateralized mortgage obligations (CMOs) may be limited under certain market conditions. Purchasing exotic or unusual structured tranches, complete tranches, or a significant percentage of an entire issue can cause liquidity or marketability concerns because an investor may incur significant losses because the investor has to sell in a very thin market. However, since the regulated entities have the ability and intent to hold CMOs to

maturity, liquidity concerns may not be as important. However, as the mark-to-market accounting treatment becomes more prevalent, the impact of liquidity on the regulated entities' income or financial condition may be just as real.

Concentration Risk: Geographic concentration in the underlying collateral may result in abnormal or unexpected prepayment behaviors that would adversely affect the credit quality or returns on a MBS.

Measuring Prepayment Speeds

MBS prepayment speeds are often expressed as an index number or "PSA." As explained earlier in this appendix, PSA stands for Public Securities Association, the organization that approved the mathematics behind the standard. PSA can range from a minimum of 60 PSA, which would indicate that only 3.6 percent of the mortgages in a pool were expected to repay in a year's time, to 1666 PSA, which would indicate that 100 percent of the mortgages were expected to be repaid within a year.

The most important factor in determining the likelihood of prepayments is the difference between the interest rates on pooled mortgages and the prevailing mortgage interest rate. The lower the current mortgage rates are relative to the interest rates on the pooled mortgages, the greater the likelihood that refinancing will occur. Other factors affecting prepayments include seasoning, burnout and seasonality.[11] In addition, the demographics of an area, the state of local economies and the assumability of the underlying mortgages also affect prepayment characteristics.

Cash Flow Yield

The various structures, prepayment rates, and other assumptions allow investors to estimate the amount and timing of the cash flows. These can be discounted and summed to provide an estimate of market price and a basis to compare yield to Treasury securities of expected comparable maturity.

The problem with this pricing methodology is that it assumes that all cash flows should be discounted at the same rate, and it does not consider that interest rate volatility can affect the timing of the cash flows of a MBS that will affect yield and price.

Option Pricing Models and Option Adjusted Spread Simulation Analysis

Option pricing models attempt to estimate the theoretical price of an option, most often in terms of implied interest rate volatility for comparison to expected interest rate volatility. There are six

[11]Burnout refers to prepayment behavior after a sustained interest rate movement. Burnout occurs when interest rate-sensitive mortgagors exit the pool, leaving only those less inclined to refinance. Prepayment speeds therefore decrease even though interest rate levels continue to provide an incentive to refinance.

factors to consider in an option's price: (1) current price of the underlying security; (2) strike price; (3) time to expiration; (4) the short-term risk-free interest rate over the life of the option; (5) coupon rate; and (6) expected interest rate volatility over the investment horizon.

Option adjusted spread (OAS) is a pricing methodology that estimates a spread over comparable maturity Treasuries that includes premiums for default, liquidity, and option risk. OAS is based on spot rates and implied forward rates, probability distributions for short-term Treasury spot rates (based on the current spot rate curve and historical interest rate behavior) and a "Monte-Carlo" simulation of a large number of interest rate paths, from which an average present value is calculated.

Most regulated entities have the capability of performing OAS analysis and have incorporated it into their investment decision making. Examiners should understand the possible complications associated with the estimation process for computing an OAS and should check the reasonableness of the regulated entities' assumptions and results.

Examiners should carefully review prepayment speed assumptions (and whether assumptions are based on seasoned, moderately seasoned, or unseasoned performance) and whether assumptions are from authoritative sources.[12] Other considerations include the appropriateness of the volatility assumptions used to determine the value of the explicit interest rate caps and floors embedded in the CMO floaters and Ginnie Mae adjustable rate issuances.

Accounting for Mortgage-Backed Securities

Accounting Standards Codification (ASC) 310-20 requires that most costs and fees on loans and any discount or premium on loans at their time of purchase be amortized over the life of the loan. Amortization is calculated based on the interest method, using a level yield (*i.e.*, constant effective yield method).

Regarding MBS, ASC 310-20 permits an enterprise that "holds a large number of similar loans for which prepayments are probable and the timing and amount of prepayments may be reasonably estimated" to consider "estimates of future principal prepayments in its calculation of constant effective yield." Premiums and discounts are amortized based upon the expected prepayments of the underlying mortgages. At least annually, amortizations are adjusted and reflect actual prepayment experience. These adjustments may cause a substantial change in the accounting yield on MBS, as recognition of discounts and premiums accelerates or slows.

2) United States Treasuries and Agencies

The regulated entities are authorized to invest in marketable direct obligations issued or guaranteed by the United States and marketable direct obligations of U.S. Government

[12]Private-label MBS do have not have a published prepayment speed consensus. Prepayment speed assumptions are typically based on a factor or multiplier of a similar coupon agency security prepayment speed.

Sponsored Agencies and Instrumentalities (GSAs) for which the credit of such entities is pledged for repayment of both principal and interest.

Risks Associated with Treasuries and Agencies

Treasury securities are considered default free. Although securities issued by Government Sponsored Agencies are not explicitly guaranteed by the U.S. Government, the agency issuances are considered almost default free. Credit risk associated with these investments is considered minimal.

However, the GSAs have become more innovative and their issuances have become more complex. The agency issuances range from simple fixed-rate, fixed-maturity bonds to bonds with embedded call or put options, with the maturity or principal repayment based on other indexes. Therefore, in addition to interest rate risks, agency issuances contain option, basis, and liquidity risks.

3) Money Market Investments

The regulated entities maintain a portfolio of money market investments for liquidity purposes. This investment portfolio is largely comprised of Federal funds sold and commercial paper (CP). The other investments in this portfolio include: (1) repurchase agreements (repo); (2) U.S. dollar deposits; and (3) Bankers' acceptances and bank and thrift notes.

Risks Associated with Money Market Investments

With the exception of repos, the regulated entities' money market investments are nearly always unsecured. Evaluating the regulated entity's management and control of its unsecured credit exposure is the primary objective in reviewing this investment sub-portfolio.

4) Standby Bond Purchase Agreements

Standby bond purchase agreements (SBPAs) are over-the-counter contracts that are designed to ensure a liquid market for variable-rate demand obligations (VRDOs), *i.e.*, as they relate to FHFA-regulated entities, variable rate bonds that are issued by state housing finance agencies (SHFAs). In the most basic sense, there are two principal parties to the SBPA: the VRDO issuer (for example, an SHFA) and a liquidity provider (for example, one of the regulated entities). At the time this module was written, eight FHLBanks had received approval to enter into SBPAs as liquidity provider with SHFAs. They are the Federal Home Loan Banks of Dallas, Des Moines, Seattle, New York, Boston, Cincinnati, Chicago, and Topeka. Both Fannie Mae and Freddie Mac charters allow participation in SBPAs as multifamily housing liquidity facilities. Since the result of a liquidity provider fulfilling its contingent obligation under an SBPA is the acquisition of a VRDO, an examiner should consider a regulated entity's participation in SBPA activities when assessing potential investment portfolio risks. Examiners should also consider in their

prioritization of resources that the level of SBPA activity at the regulated entities is declining owing to structural changes in the way SHFAs fund themselves given experiences they encountered during and after the onset of the financial market crisis in 2007-2009

Under the terms of an SBPA, the liquidity provider agrees to purchase VRDOs when certain conditions as defined in the SBPA are met, typically including a condition requiring that the SHFA remain investment grade. The term of the agreement, traditionally several years, and per annum fee are established by the SBPA. An investor in a VRDO has the option – a put option – to sell the bond to another investor through a remarketing agent at interest rate reset dates. The investors are typically money market mutual funds, which are subject to requirements that their investments be readily marketable. (The Securities and Exchange Commission's Rule 2a-7 under the Investment Company Act establishes a condition regarding the credit risk aspects of marketability, namely that a money market mutual fund may invest in a security only if it has no less than a double-A rating and the fund's board of directors otherwise determines the investment presents minimal credit risk. *See* 17 CFR 270.2a-7.) The liquidity provider's responsibilities under an SBPA facilitate marketability of the VRDOs. If the "put" is exercised and the remarketing agent is unable to sell the VRDO to another investor, the remarketing agent chooses not to take the bond into its own inventory, and SBPA conditions are met, the liquidity provider is obligated to buy the bond. The terms of the SBPA may require the SHFA to pay the liquidity provider a higher interest rate on the VRDO. The liquidity provider reserves the right to subsequently sell any bonds it purchases subject to the terms of the SBPA. If the VRDO is not successfully remarketed within a certain period of time after the liquidity provider acquires the bond, term-out provisions in an SBPA require the SHFA to redeem the bonds on an accelerated repayment schedule.

Instances in which liquidity providers must purchase VRDOs due to failed remarketing are rare. For example, except during the period of severe liquidity stress in the financial markets in the later part of 2008 (September to December 2008), the FHLBanks have never had to purchase SHFA-issued bonds as liquidity provider under SBPAs. Even during this time of liquidity stress in the financial markets, the volume of FHLBank purchases as liquidity provider was low – 18 percent on average – relative to the amount of SBPAs outstanding at the FHLBanks. (By comparison, during this period, purchases of SHFA-issued VRDOs by all SBPA providers overall was approximately 30 percent.) Furthermore, all bonds that the FHLBanks purchased were subsequently remarketed, with the majority remarketed in less than one month. Fannie Mae and Freddie Mac also experienced a low volume of VRDO purchases, even during the financial market crisis. Fannie Mae purchased VRDOs totaling just 1.4 percent of potential SBPAs obligations outstanding, with all remarketed in a month. The maximum draw on Freddie Mac's multifamily liquidity facility during the financial market crisis was just a small fraction (0.3 percent) of the total outstanding.

To perform an examination of SBPA activities, an examiner should request and review applicable policies and procedures, relevant policy committee minutes, a sample of recently-executed SBPAs, applicable counterparty (i.e., SHFA) credit analyses, financial statements of the

applicable SHFA(s), Official Statements pertaining to VRDO offerings (these are similar to offering circulars or prospectuses), applicable risk assessments and internal audits, and a ledger of outstanding SBPAs including amounts and terms. Examiners should also interview management and staff that are involved with the activity to assess their knowledge of the activity, policy requirements, relevant systems, and risks.

An examination of SBPA activities should include an evaluation of governance, credit risk, liquidity risk, operational risk, market risk and pricing, with a particular emphasis on liquidity risk, credit risk, and pricing. Conversely, an examination of SBPA activity may not need to focus extensively on market risk.

Risks Associated with Standby Bond Purchase Agreements

Governance

Governance of SBPA activities should be informed by a current risk assessment that is commensurate with the scope and complexity of the activities. Risk management policies should include limits (for example, volume and counterparty limits) that make sense to the regulated entity's operations. Executive management and, as appropriate, the board of directors should receive periodic reports regarding SBPA activities, including volume, performance, profitability, and risks.

Liquidity Risk

As indicated above, instances in which liquidity providers in SBPAs are called upon to purchase VRDOs have been rare. However, the regulated entities must ensure that they maintain sufficient liquidity to honor their commitments, albeit contingent commitments, under SBPAs. In determining the amount of liquidity necessary to honor its SBPA commitments, a regulated entity should assess the likelihood of remarketing agents being unable to remarket VRDOs when necessary and any consequent need for the regulated entity to acquire the bonds. The regulated entity should also ensure it maintains liquidity in keeping with FHFA guidance and regulations, as applicable. Fannie Mae and Freddie Mac liquidity metrics assume a worst case purchase of all or substantially all VRDOs backed by SBPAs.

Credit Risk

A regulated entity's assessment of credit risk associated with SBPAs is critical. The credit analysis should be comprehensive, independent, and timely. Interestingly, the examiner should know that SBPAs are designed to provide liquidity support rather than credit support to VRDOs. SBPAs should contain provisions that allow the liquidity provider relief from needing to take ownership of the VRDOs when the SHFA's creditworthiness deteriorates, which generally would lead to a lower rating on the VRDOs, all else equal. For example, the SBPA may provide such relief when the SHFA's credit rating drops below investment grade. However, because the

typical investors in VRDOs are mutual funds that are limited to investing in bonds rated double-A or better, a "run" on the bonds may occur if investors believe that the VRDO ratings will drop below double-A. If the SBPA only provides relief when the SHFA's rating drops below investment grade, the chance of the liquidity provider needing to assume ownership of the VRDOs is much greater (since there may be few, if any, other interested investors).

The regulated entity's credit analysis should include an evaluation of the SHFA's creditworthiness and the evaluation should not exclusively rely on credit ratings. The evaluation should include a review of the SHFA's balance sheet, income statement, and cash flows. In addition, the credit analysis should assess the structure of the trust indentures from which the VRDOs are issued, including the types of assets in the trusts, as well as the regulated entity's obligations according to the terms of the SBPA. The analysis should also consider, as appropriate, the fact that if the liquidity provider purchases a VRDO, the terms of the SBPA may require the SHFA to pay higher interest-rate coupons and higher principal, which would drain the liquidity of the SHFA more quickly. The types of assets in the trust may include single-family mortgage loans, multi-family mortgage loans, private-label or Agency mortgage-backed securities, or, potentially, other types of assets. Less risky assets in the trust generally reduce the likelihood of investor disinterest in the attendant VRDOs when credit conditions in the financial markets deteriorate. The regulated entity should have an understanding of the performance of the assets within the trust.

Pricing

Proper pricing for SBPAs is critical to ensuring that regulated entities are properly compensated for SBPA risk. SBPA pricing is generally understood as the annual fees the regulated entities charge for the commitment to purchase the VRDOs when conditions specified in the SBPA are met. Commitments with longer terms, with less creditworthy SHFAs, and/or associated with higher-risk assets in the trust indentures from which attendant VRDOs are issued command higher fees. FHLBanks have historically been "price-takers" when setting fees in that they set their fees based on an assessment of fees charged by other market participants for similar structures. They may also set the fees lower than market if they perceive a benefit to the housing communities in their district. Fannie Mae has not agreed to any SBPA commitments for several years. Freddie Mac still offers a liquidity facility for multifamily housing authorities. The facility is priced to cover all costs, with the terms limited to five years regardless of the life of the underlying bonds. Fannie Mae and Freddie Mac each participated in the U.S. Treasury Department's Temporary Credit and Liquidity Program (TCLP), announced in October 2009, through which they executed facilities similar to SBPAs, with fees set based on program formulas. (This program and a related New Issue Bond Purchase Program were designed to stabilize the SHFA funding environment during the financial crisis, given problems with the structure of VRDO financing at some SHFAs and local housing finance agencies.) Regardless of the pricing approach the regulated entity uses, supporting analysis should be documented and adequately demonstrate how SBPA pricing compensates for associated risks.

Operational Risk

The regulated entity's risk assessment process should capture operational risks associated with SBPA activities. The level and type of operational risk associated with purchasing bonds under SBPAs are similar to the operational risk of purchasing bonds as investments. Information systems and technology should be commensurate with the complexity of the SBPA operations. Systems should ensure timely communication with remarketing agents when the likelihood of the regulated entity acquiring VRDOs under the terms of the SBPA is elevated. (This can help ensure that the regulated entity is prepared to accept the bond into inventory when notified by the remarketing agent.) In addition, the regulated entity should ensure that SBPA contract execution and renewal, if any, receives adequate review by legal counsel.

Market Risk

SBPAs are off-balance sheet contracts and do not expose a regulated entity to interest rate risk unless it must fulfill its commitment under the SBPA to purchase a VRDO. If the regulated entity must purchases a VRDO, interest rate risk arises from any difference in interest rate sensitivity between payments required under the terms of the SBPA and the funding used to support the bond purchase. VRDOs that a liquidity provider may acquire through its SBPA obligation are variable rate and, moreover, the terms of the SBPA generally include above-market "penalty" rates to be paid to the liquidity provider if it needs to hold the bond for more than a short period of time. The examiner should assess the regulated entity's plans for addressing interest rate risk of holding VRDOs acquired through its fulfillment of SBPA obligations in the same manner he or she would assess market risk in other investment activities.

Measures of Security Price Sensitivity

The investment portfolio often represents a significant source of interest rate risk to a regulated entity. Managing this interest rate risk has become a significant challenge for management, given the growing complexity of security structures, the measurement of interest rate risk using the economic perspective ("market value of equity"), and the trend toward market value accounting. To control interest rate risk effectively, management should understand the sensitivity of portfolio values to interest rate changes.

Investors commonly measure price sensitivity of option-free securities by referring to a security's duration. Duration is a technical term that simply is an estimate of the price sensitivity of a security for a 100 basis point change in rates. For callable and prepayable securities, investors assess risk by considering effective duration.

The value of an investment, like that of any financial asset, is the present value of its expected future cash flows. To get a present value, an investor needs to "discount" future cash flows using an appropriate interest rate. Discounting a future cash flow gives the current, or "present," value of that future cash flow. The security's yield in the market is the rate used to discount the

cash flows. In order to value a security and measure its interest rate risk, an investor must determine:

- The amount of future cash flows,
- The timing of future cash flows,
- The appropriate discount rate, and
- How the above factors might change as interest rates change.

Option-Free Securities: Many securities, such as U.S. Treasury notes and bonds and bullet agency issues, pay an established schedule of fixed coupon payments and have a set maturity date. They contain no put or call options. With such securities, the amount and timing of the cash flows is known with certainty, though default risk exists for all but U.S. Treasury securities. Changes in interest rates will not cause any change in either the amount or timing of cash flows the investor will receive. For example, a U.S. Treasury bond pays the investor a fixed coupon payment every six months throughout its life plus principal at maturity. Rate changes do, however, change the value of those future cash flows. The price of a Treasury security is simply the present value of these future cash flows, using the market yield as the rate to discount the future cash flows to their present value. As market yields change, the value of the promised cash flows changes, and thus the price of the security changes.

Duration estimates the approximate price sensitivity of option-free securities. Duration (or, more correctly, modified duration) calculations include a bond's characteristics, such as the coupon rate, maturity, current price, and market yield, in developing a price sensitivity estimate.

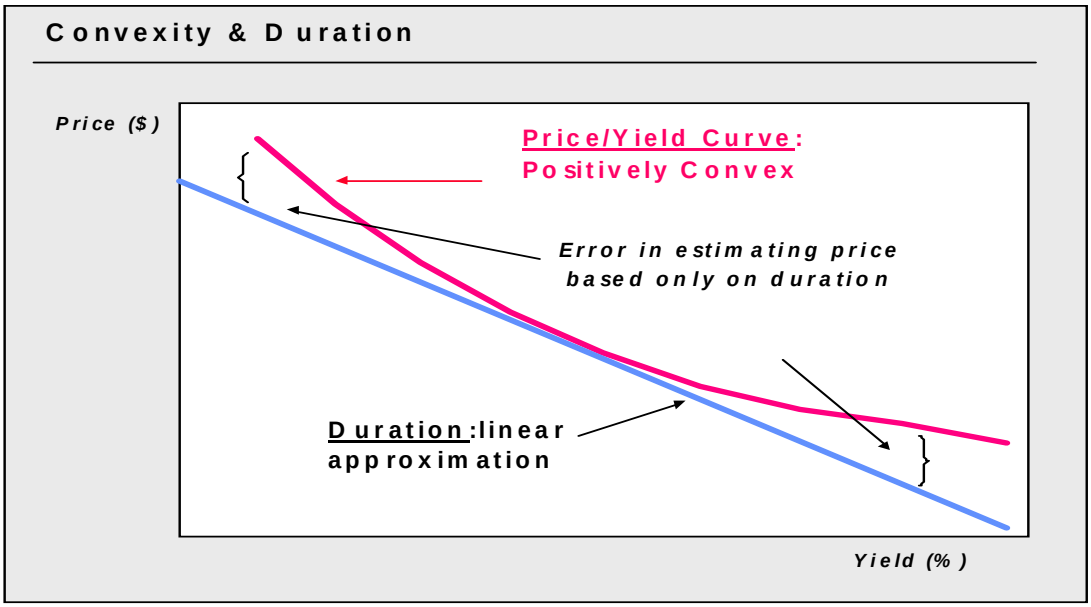
Modified duration (the terms duration and modified duration are usually used interchangeably) is a number that represents the percentage price change of a security for a 100 basis point change in yield. For example, if a security (or portfolio) has a duration of 2, the investor can estimate that the bond's price (or portfolio value) will rise or fall by approximately 2 percent for each 100 basis point change in interest rates. Therefore, if rates changed 100 basis points, a bond priced originally at par (100) would fall to 98 if rates rose and rise to 102 if rates fell. Because duration is a linear, or straight line measure of risk, a 200 basis point change in rates would cause the price to change by approximately 4 percent, or 2 percent for each 100 basis point yield change from its current level. Similarly, a 50 basis point change in rates would cause the price to change by approximately 1 percent.

When interest rates fall, prices for option-free securities rise by a greater amount than duration would estimate. When rates rise, bond prices fall by less than duration would estimate. Moreover, prices rise by more than they fall for a similar rate change. Investors use the term positive convexity to describe this favorable price movement.

A price/yield curve plots the price of a security for many different yield levels. Figure A illustrates a price/yield curve and shows that the relationship between price and yield is a curve. Duration estimates of price changes assume that the price/yield relationship is a straight line.

Because of the curved price/yield relationship, estimates of price changes using duration are accurate only for small yield changes.

Figure A



The graph shows that the actual price of an option-free bond will be greater than the price estimated by duration, except where the line meets the curve, which is the current price of the security. The line provides the price estimate at each yield point using duration. Note also that at lower rate levels, prices rise at an increasing rate as rates fall. At higher yield levels, prices fall at a decreasing rate as rates rise.

Securities with Options: The calculation of duration assumes that the cash flow schedule of a security does not change when interest rates change. When a security contains options, however, the security's cash flow schedule is no longer certain. For callable bonds, the investor will not know with certainty the redemption date or the total amount of interest income the investment will provide. As a result, duration's estimate of the price sensitivity of a security with options may not be useful or accurate.

Investors typically perform scenario analysis in order to evaluate the risks of bonds with prepayment options. In scenario analysis, investors estimate various possible cash flow schedules by evaluating the bonds in different interest rate environments. For mortgage securities, investors use prepayment rates appropriate for each interest rate scenario to generate cash flow schedules.

When investors measure the price sensitivity of securities with options, they often refer to their effective duration. This method refines duration by allowing the cash flow schedules to change

as interest rates change. The prices for both rising and falling rates are determined using the cash flow schedules that would be expected to occur at the new rate levels. Effective duration then averages the percentage price change in the rising and falling rate scenarios.

For example, if a security priced at 100 would rise to 103 if rates fall 100 basis points and fall to 95 if rates rise 100 basis points, the effective duration would be 4 percent. This 4 percent is computed as the average of the price changes of 3 percent and 5 percent. The prices, 103 and 95, are determined by projecting new cash flow schedules at the new rate levels. For securities without options, effective duration and duration give similar results.

Securities with call options lose more value when rates rise than they gain when rates fall. Investors call this profile negative convexity, as opposed to positive convexity of option-free securities. However, negative convexity has a more pronounced impact on securities with options than positive convexity has on option-free securities due to price compression in a falling rate environment.

Figure B

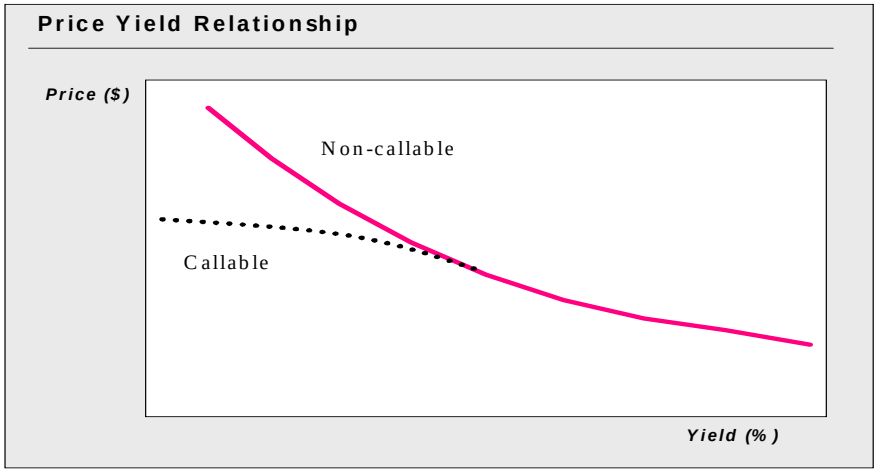


Figure B repeats the price/yield profile of an option-free (non-callable) security shown in Figure A, but also illustrates the price compression that occurs for a callable bond at lower yield levels. Note that at higher rate levels (seen on the horizontal axis further and further to the right), the price/yield profile of the callable security looks like that of a non-callable bond in Figure A. At high yield levels, the issuer's option to call the bonds has almost no value. Therefore, this portion of the price/yield curve resembles a non-callable security. At low yields, however, the dotted portion of the Figure shows price compression. Investors will assess callable securities as having maturities equal to the call date, not the stated final maturity. As a result, the prices will

compress to reflect the shorter maturity. Prices may continue to increase as rates fall, but at a slower rate.

The following table illustrates convexity:

	Bond #1	**Bond #2**
Current Price	100	100
Price Up 100 bps	96	95
Price Down 100 bps	105	101
% Price Change: +100 bp	-4%	-5%
% Price Change: - 100 bp	+5%	+1%
Effective Duration	4.5%	3%
Convexity	Positive	Negative

Bond #1 has positive convexity, because it gains more (5 percent) when rates fall than it loses (4 percent) when rates rise. Note that the impact of positive convexity is relatively modest, but it works for the investor. The percentage price change in each environment is approximately the same (4% vs. 5%). Bond #2 is negatively convex because it loses more (5 percent) when rates rise than it gains (1 percent) when rates fall. Bond #1 has an effective duration of 4.5 percent, which is the average of the 4 percent loss and the 5 percent gain. Bond #2 has an effective duration of 3 percent, the average of the 1 percent gain and the 5 percent loss. Note the more pronounced impact negative convexity can have on a security, compared to the relatively minor impact of positive convexity. Note also that bond #2's effective duration of 3 percent bears little relationship to either the 1 percent gain when rates fall or the 5 percent loss when rates rise. Effective duration can mislead the investor about the price risk profile of a security with options because it can average a relatively large loss with a relatively small gain. Therefore, investors should always review and understand the impact of negative convexity on a callable security (and a portfolio containing callable securities) by assessing price performance for both a rise and a fall in interest rates.

Final Maturity - since bond prices become more sensitive as maturity lengthens, final maturity can provide a very conservative means of controlling price sensitivity of many securities. Prepayable securities have periodic cash flows that can overstate the degree of price sensitivity implied by their final maturity. A 30-year mortgage security, for example, will not have the same risk as a 30-year Treasury security. More of the mortgage security's cash flow will occur sooner because it pays monthly principal and interest payments. A Treasury security does not pay any principal until maturity. The earlier return of cash flow (monthly principal and interest payments) makes a 30-year mortgage security less price sensitive than a 30 year Treasury bond.

Final maturity does not account for coupon differences in securities. A zero coupon security, for example, has more price sensitivity than a coupon-bearing security of the same maturity. A 10-year zero coupon security has much more price sensitivity than a 30-year pass-through mortgage

security, and nearly as much price sensitivity as a 15-year coupon security. Regulated entities using final maturity to limit portfolio interest rate risks should recognize this limitation.

Average life -- some regulated entities use average life as a means of measuring the interest rate sensitivity of individual securities and portfolios. A security's average life measures how long an average dollar of principal is outstanding.

Consider a $1,000 par value security having the following cash flow schedule:

Year	Principal Cash Flow (PCF) Schedule	Year x PCF
1	275	275
2	250	500
3	200	600
4	150	600
5	125	625
Total	1,000	2,600

A cash flow schedule typically includes both principal and interest. However, average life calculations do not consider interest. In this example, which might represent the profile of a CMO tranche, the investor collects the $1,000 par value over a five-year period. The security's average life is 2.6 years, which is calculated by dividing the weighted principal cash flow in column 3 (year the cash flow is received times the principal cash flow) of $2,600 by the $1,000 par value.

Average life can also provide misleading risk information when a security has an uneven ("barbell") cash flow schedule, as shown below:

Year	Principal Cash Flow (PCF) Schedule	Year x PCF
1	500	500
2	0	0
3	0	0
4	0	0
5	500	2,500
Total	1,000	3,000

The average life of this cash flow schedule is 3.0 years. However, after the $500 payment at the end of the first period, the security's average life will increase to 4.0 years. Therefore, the original average life of three years understates the risk profile of the security. The average life increase occurs because, after one year, the investment becomes a bullet (single-payment) security with a four-year maturity. Its average life is four years, suggesting increased sensitivity,

albeit on a risk position only half of the original exposure. This example highlights how the principal payment rules of a structured security such as a CMO can create more, or less, risky securities.

This example also underscores the importance of understanding and evaluating cash flow schedules when purchasing securities. It is not sufficient, when evaluating structured securities like CMOs, to review only the average life and price sensitivity measures. Regulated entities should also ask for projected cash flows for different rate environments. The above security has a short average life at inception, but will not deliver any principal cash flow from year two through year four. Securities with irregular principal cash flows, such as higher risk CMO tranches, should provide higher yields than securities with similar average lives to compensate investors for the irregular cash flow profile.

For securities with options, average life changes as interest rates change. For example, a CMO may have a 2.6 year average life in the current interest rate environment. If rates rise 300 basis points, however, the average life may extend to six years. Average life is only a static, point-in-time estimate of price sensitivity. It will tend to understate price depreciation when rates rise, because it will ignore any lengthening of maturity (the maturity effect). Average life will overstate price appreciation when rates fall, because it assumes that the principal amount of the security will remain outstanding even though rates have fallen; it thus ignores customers' prepayment options.

Average life (unlike duration measures) considers principal only; it does not consider the interest cash flows. Regulated entities using average life to limit portfolio risk should recognize the limitations of this risk measure and consider guidelines that control the variability of the average life of a security as rates change. For example, a regulated entity might establish a guideline that limits, given a 300 basis point change in interest rates, an investment's extension of average life to three years and contraction of average life to four years. Consider the following scenario analysis:

	Base Case Current Rates	**Rates Up 300 bps**	**Rates Fall 300 bps**	**Extends**	**Contracts**
PSA Speed	225	125	800		
Average Life	3.5 yrs	5.5 yrs	1.7 yrs	2.0 yrs	1.8 yrs

A scenario analysis evaluates an investment in different interest rate environments. Here, it shows the investment in the base case (unchanged rates), as well as 300 basis points higher and lower. The analysis indicates that the bond's average life will extend by 2 years (from 3.5 years to 5.5 years) or contract by 1.8 years (from 3.5 years to 1.7 years). Both of these average life changes are within the guidelines, which limit extension and contraction to 3 and 4 years respectively.

When assessing the average life of mortgage securities, especially structured mortgage securities such as CMOs, regulated entities should evaluate carefully the manner in which prepayment speeds are used to calculate the average life. Many analytical services use a single prepayment speed for the entire life of the underlying collateral. The scenario analysis above used a single speed of 225 percent PSA in the base (unchanged interest rates) case. This means that the prepayment estimate is 225 percent of the standard PSA model.

If the security under consideration is priced at a premium or if the investor has a short-term investment horizon, a single prepayment speed may not give an accurate assessment of the security's risk. A "prepayment vector" is a series of prepayment rates that an analyst expects will occur over a defined period. For example, mortgage securities have well known seasonality trends, with prepayment rates higher in the spring and summer than in the fall and winter. When evaluating structured securities like CMO tranches, the long-term prepayment rate may have little analytical relevance. If the investor expects to receive cash flows over a short period of time, the only prepayment speeds that matter are those that the investor expects to occur while the security remains outstanding.

The following table compares a single prepayment speed to a vector of prepayment speeds:

	Month 1	**Month 2**	**Months 3-12**	**After 1 Year**
Single Speed	18% CPR	18% CPR	18% CPR	18% CPR
Prepay Vectors	40% CPR	30% CPR	25% CPR	16% CPR

Consider a CMO tranche that has a significant exposure to rising prepayments. This means that the tranche might completely pay off over a short period of time, and might occur because the tranche provides protection to other tranches; it absorbs cash flow when rates fall and pays off early. It provides cash flow protection when rates rise by not receiving any principal. Because of its structure, the tranche may receive a disproportionate amount of all the cash flows generated by the underlying collateral. Regulated entities sometimes experience negative returns because they fail to consider the impact of very rapid prepayment speeds over short time periods. A negative return occurs when a security does not remain outstanding long enough to generate enough coupon income to offset the premium paid for it.

For example, a regulated entity might pay a price of 103 for a $1 million (par value) CMO tranche that has a coupon of 8 percent. The 3 percent premium means the regulated entity will pay $1,030,000 for the security ($1 million x 1.03 = $1,030,000). The regulated entity will collect only $1 million in principal on the security (the par value), so the regulated entity will amortize, or write off as an expense the $30,000 premium over the life of the security. The regulated entity might estimate an average life of two years, based upon a specified long-term prepayment speed (18 percent CPR). If no prepayments occur, the security will generate $80,000 per year in interest income. If the security pays monthly, the regulated entity will

accrue $6,666.67 in interest income per month ($1,000,000 x .08/12), again assuming no principal payments. However, if the CMO tranche pays off entirely in the following month, the regulated entity will have to charge off the $30,000 premium immediately. Having collected only one month's interest income, or $6,666.67, the regulated entity has a negative yield.

In order to minimize the possibility of such unexpected and unpleasant surprises, regulated entities should evaluate structured mortgage securities using prepayment vectors, or individual prepayment speeds for each month the regulated entity expects to hold the security. The more sensitive a CMO tranche is to prepayments, and the greater the price paid over par, the more important it is to analyze a security using prepayment vectors as opposed to a single prepay speed. The cash flows estimated for the security (and hence its average life) should result from applying prepayment rates expected over the period when the security may be outstanding.

In the foregoing example, the long-term estimate of 18 percent CPR could prove valid. However, if very high prepayment speeds in the short term retire the security, causing a negative yield, the accuracy of the long-term speed is irrelevant.