
The following is a review of the Financial Markets and Products principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

CORPORATE BONDS

Topic 50

EXAM FOCUS

The term “bond” refers to a variety of assets which offer a wide range of interest rate payments from fixed cash payments, to accruals without cash, to payments in the form of additional securities. In this topic, we will provide an overview of major fixed-income instruments and their payment structures. We will also address the impact of credit risk and event risk on bond ratings and features. For the exam, be familiar with the types of bonds discussed and the methods for retiring bonds. Also, know the terminology associated with high-yield issues.

BOND INDENTURE AND ROLE OF CORPORATE TRUSTEE

LO 50.1: Describe a bond indenture and explain the role of the corporate trustee in a bond indenture.

The **bond indenture** is a document that sets forth the obligation of the issuer and the rights of the investors in the bonds (i.e., the bondholders). It is usually a detailed document filled with legal language. One of the roles of the **corporate trustee** is to interpret this language and represent the interests of the bondholders. Banks or trust companies most often serve as corporate trustees, and the position requires that they act in a fiduciary capacity on behalf of the bondholders. The trustee would authenticate the issue, which includes keeping track of the amount of bonds issued and making sure the number does not exceed the limit specified in the indenture. The trustee would monitor the corporation's activities to make sure the issuer abides by the indenture's covenants (e.g., maintaining key ratios below a given number).

All corporate bond offerings over \$5 million and sold in interstate commerce must have a corporate trustee as set forth in the **Trust Indenture Act**. The corporate trustees must be competent and financially responsible and should also not have any conflicts of interest, (e.g., being a creditor of the issuer). The indenture would specify how the trustee would make reports to bondholders and what to do if the issuer fails to pay interest or principal. As mentioned earlier, the basic goal of the trustee is to protect the rights of bondholders.

MATURITY DATE

LO 50.2: Explain a bond's maturity date and how it impacts bond retirements.

The maturity date of a bond is when the bond issuer's obligations are fulfilled. At maturity, the issuer pays the principal and any accrued interest or premium. The contract, as set forth by the indenture, may terminate prior to the maturity date if, for example, the corporation chooses to retire the bonds early. The longer the maturity of the bond, the more time a company has to retire the bond issue.

INTEREST PAYMENT CLASSIFICATIONS

LO 50.3: Describe the main types of interest payment classifications.

LO 50.4: Describe zero-coupon bonds and explain the relationship between original-issue discount and reinvestment risk.

The main types of bond interest payment classifications are: straight-coupon bonds, zero-coupon bonds, and floating-rate bonds. The interest rate on a bond is often called the **coupon**. However, bonds today technically no longer have coupons attached directly to them. Now, bonds are registered and represented by a certificate, or they are kept in book-entry form where one master or global certificate is issued and held by a central securities depository that issues receipts. This method is considered a safer way to make payments.

Straight-coupon bonds, also called fixed-rate bonds, have a fixed interest rate set for the entire life of the issue. In the United States, fixed-rate bonds typically pay interest every six months. In Europe and some other countries, bonds make annual interest rate payments. A bond issued in the United States with an 8% interest rate and a \$1,000 par value on March 1, 2009 will pay \$40 of interest each September 1 and each March 1 until its maturity date or until the bond is retired, at which time the issuer would pay both the final interest payment and the \$1,000 principal back to the bondholder.

In addition to just paying a fixed dollar interest, bonds in the United States have been issued that pay in foreign currency. Two other variations are a participating bond and an income bond. **Participating bonds** pay at least the specified interest rate but may pay more if the company's profits increase. **Income bonds** pay at most the specified interest, but they may pay less if the company's income is not sufficient. In both cases, the conditions for paying more or less than the specified coupon would be set forth in the indenture.

Floating-rate bonds are also known as variable rate bonds. The interest paid is generally linked to some widely used reference rate such as LIBOR or the Federal Funds rate.

Zero-coupon bonds pay the face value or principal at maturity. There is not a cash interest payment; instead, the bondholder earns a return by purchasing the bond at a discount to face value and receiving the full face value at maturity. Variations of the zero-coupon bond include the **deferred-interest bond** (DIB) and the **payment-in-kind bond** (PIK). The DIB will not pay cash interest for some number of years early in the life of the bond. That period is the deferred-interest period. During this period, cash interest accrues and is then paid semiannually until maturity or when redeemed. PIK bonds pay interest with additional bonds for the initial period, and then cash interest after that period ends.

Most zero-coupons issued today share a host of other features such as being convertible, callable, and putable. A zero-coupon bond's interest rate is determined by the **original-issue discount** (OID):

$$\text{original-issue discount (OID)} = \text{face value} - \text{offering price}$$

The value of the bond grows each year and thus pays implicit interest, which is a function of the OID and the term-to-maturity. In other words, the rate of return depends on the amount of the discount and the period over which it grows.

One advantage of zero-coupon bonds is zero reinvestment risk. The bondholder does not have to make an effort to reinvest cash interest payments or worry about the available rates at which to reinvest them. A disadvantage is that the bondholder must pay taxes each year on the accrued interest even though no cash is received from the bond issuer.

If the issuer goes into bankruptcy prior to the maturity of a zero-coupon bond, the bondholders are only entitled to the accrued interest up to that date and not the full face value of the bond. In other words, the zero-coupon bond creditor can only claim the original offering price plus accrued and unpaid interest up to the date of the bankruptcy filing. The bond issuer faces a huge liability with a zero-coupon bond because of the large balloon payment at maturity.

BOND TYPES

LO 50.5: Distinguish among the following security types relevant for corporate bonds: mortgage bonds, collateral trust bonds, equipment trust certificates, subordinated and convertible debenture bonds, and guaranteed bonds.

Corporate bonds can have a security, such as real property, underlying the issue. Those who own mortgage bonds have a first-mortgage lien on the properties of the issuer. This security allows the issuer to pay a lower rate of return than it would have to pay on unsecured bonds, which are known as debentures. The lien gives the bondholders the right to sell the mortgaged property to satisfy unpaid obligations to bondholders. In practice, this right is usually used for bargaining purposes only, and the bankruptcy takes the form of reorganization as opposed to liquidation.

Mortgage bonds can be issued in a series in a blanket arrangement. In this case, one group of bonds is issued under the mortgage, and then others are issued later. When earlier issues mature, additional bonds are then issued in their place.

Collateral trust bonds are backed by stocks, notes, bonds, or other similar obligations that the company owns. The underlying assets are called the collateral or personal property. The issuers are holding companies, and the collateral consists of claims on their subsidiaries.

The trustee holds the collateral for the benefit of the bondholders; however, the issuer retains voting rights for stock used as collateral, so they retain control over their subsidiaries. The indenture may have provisions covering what to do if the value of the collateral falls below the value of the loan. If the collateral falls in value, the issuer may have to contribute additional securities to back the bonds. The issuer may be able to withdraw collateral if the value rises in order to exceed the loan value. Like mortgage bonds, collateral trust bonds may be issued in series.

Equipment trust certificates (ETCs) are a variation of a mortgage bond where a particular piece of equipment underlies the bond. The usual arrangement is that the borrower does not actually purchase the equipment. Instead, the trustee purchases the equipment and leases it to the user of the equipment (the effective borrower), who pays rent on the equipment, and that rent is passed through to the holders of the ETCs. The payments to the creditors are called dividends. The trustee pays for the equipment with the money raised from the issuance of the ETCs, usually about 80% of the value of the equipment, and what is effectively a down payment from the user of the equipment. This provides more security to the creditors than that of a mortgage bond. It is especially attractive if the equipment is standardized, as in the case of railroad cars, which provides for easy sale or lease of the equipment in the case the user of the equipment defaults. ETCs are generally considered the most secure type of bond since the underlying assets are actually owned by the trustee and rented to the borrower.

As noted earlier, **debentures** are unsecured bonds (i.e., they do not have any assets underlying the issue). Most corporate bonds are debentures and usually pay a higher interest rate for that reason. However, if the company is highly rated and has not issued any secured bonds, then debentures are almost the equivalent of mortgage bonds in that they have a claim on all the assets of the issuer along with the general creditors. If the issuer has issued secured debt along with debentures, the debenture holders have a claim on the assets that are not backing the secured debt. Typically the issuer is restricted to one issue of debentures if there is already secured debt. If there is no secured debt, and the company issues debentures, there is often a negative-pledge clause that says that the debentures will be secured equally with any secured bonds that may be issued in the future.

Subordinated debenture bonds have a claim that is at the bottom of the list of creditors if the issuer goes into default. They are bonds that are unsecured and have another unsecured bond with a higher claim above them. This means that the issuer has to offer a higher interest rate on the subordinated debentures.

Issuers may choose to issue **convertible debentures**, which give the bondholder the right to convert the bond into common stock. This feature will lower the interest rate paid. The cost to the issuer, however, is the possibility of increased dilution of the stock. A variation of convertible debentures is **exchangeable debentures** that are convertible into the common stock of a corporation other than that of the issuer.

Bonds issued by one company may also be guaranteed by other companies. These bonds are known as **guaranteed bonds**. A guarantee does not ensure that the issue will be free of default risk since the risk will depend on the ability of the guarantor(s) to satisfy all obligations.

METHODS FOR RETIRING BONDS

LO 50.6: Describe the mechanisms by which corporate bonds can be retired before maturity.

There are a variety of methods for retiring debt, and some are included in the bond's indenture while others are not included. The indenture would include the call and refunding provisions, sinking funds, maintenance and replacement funds, and redemption through sale of assets. The indenture would not include fixed-spread tender offers.

Call and refunding provisions are essentially call options on the bonds that the issuer owns and give the issuer the right to purchase at a fixed price either in whole or in part prior to maturity. These provisions allow a firm to call back debt that has a high coupon and reissue debt with a lower coupon. Other reasons for exercising these options are to eliminate restrictive covenants, alter capital structure, increase shareholder value, or improve financial/managerial flexibility. A **call provision** can either be a fixed-price call or a make-whole call.

- **Fixed-price call.** The firm can call back the bonds at specific prices that can vary over the life of the bonds as specified in the indenture. They generally start out high and decline toward par. Also, for most bonds, the bonds are not callable during the first few years of the issue's life.
- **Make-whole call.** In this case, market rates determine the call price, which is the present value of the bond's remaining cash flows subject to a floor price equal to par value. A discount rate based on the yield of comparable-maturity Treasury securities (usually the rate plus a premium) determines the present value and the bond's price. The redemption price is the greater of that present value or the par value plus accrued interest.

A **sinking fund provision** generally means the issuing firm retires a specified portion of the debt each year as outlined in the indenture. The bonds can either be retired by use of a lottery where the owners of the selected bonds must redeem them, or the bonds are purchased in the open market. The purchase of some sufficient amount of equipment in excess of the value of the amount of the bonds to be retired is another action that may satisfy a sinking fund provision.

The lottery approach to satisfying the sinking fund is very similar to a call provision in that the bondholders must sell back their bonds at a specified price. Unlike the call provision, there may be advantages to the bondholders. First, the retirement of bonds improves the financial health of the firm. Second, the redemption price may exceed the market price. However, the indenture may give the issuer some flexibility as to how much of the bonds to call back each period, which would give the firm some latitude to call back more bonds when the market conditions are favorable to do so. One example is an accelerated sinking-fund provision, which allows the firm to call back more bonds in early years, which the firm would do if interest rates fall in those early years.

A **maintenance and replacement fund (M&R)** has the same goal as a sinking fund provision, which is to maintain the credibility of the property backing the bonds. The provisions differ in that the M&R provision is more complex since it requires valuation formulas for the underlying assets. The main point is that the provision specifies that the fund must keep up the value of the underlying assets much like a home mortgage specifies the home buyer must keep up the value of the home. One way to satisfy the provision is

to acquire sufficient cash to maintain the health of the firm. That cash can then be used to retire debt.

Tender offers are usually a means for retiring debt for most firms. The firm openly indicates an interest in buying back a certain dollar amount of bonds or, more often, all of the bonds at a set price. The goal is to eliminate restrictive covenants or to use excess cash. If the first tender offer price does not get sufficient interest, the firm can increase its offer price. Firms can also announce that they will buy back bonds based on the price as determined by a certain market interest rate (e.g., the yield to maturity on a comparable-maturity Treasury plus a spread). This lowers interest rate risk for both the bondholders and the bond issuer.

As a final note, the issuing firm may be able to call back bonds if it is necessary to sell assets associated with the bond issue. For example, if the government requires a firm to sell property, but that property is being used as collateral for the bonds, the firm would sell the property and call back the bonds.

CREDIT RISK

LO 50.7: Differentiate between credit default risk and credit spread risk.

Credit risk includes credit default risk and credit spread risk. **Credit default risk** is the uncertainty concerning the issuer making timely payments of interest and principal as prescribed by the bond's indenture. The most widely-used indicators of this risk are bond ratings that major rating agencies assign when those agencies perform credit analysis of a firm. Fitch Ratings, Moody's, and Standard & Poor's are the main rating agencies in the United States. The agencies assign a symbol associated with the rating (e.g., AAA or Aaa for the corporate debt with the least credit default risk). The rating can be interpreted as a probability of default within some time period.

Credit spread risk focuses on the difference between a corporate bond's yield and the yield on a comparable-maturity benchmark Treasury security. This difference is known as the **credit spread**. It should be noted that other factors such as embedded options and liquidity factors can affect this spread; therefore, it is not only a function of credit risk.

The risk here is from possible changes in this spread from changes in investor risk aversion, which will change the value of the associated bond. Other factors affecting credit spreads are macroeconomic forces such as the level and slope of the Treasury yield curve, the business cycle, and issue-specific factors such as the corporation's financial position and the future prospects of the firm and its industry.

A method commonly used to evaluate credit spread risk is **spread duration**. The duration of the spread is the approximate percentage change in a bond's price for a 100 basis point change in the credit spread assuming that the Treasury rate is constant. If a bond has a spread duration of 4, for example, a 50 basis point change in the spread will change the value of the bond by 2%.

EVENT RISK

LO 50.8: Describe event risk and explain what may cause it in corporate bonds.

Event risk addresses the adverse consequences from possible events such as mergers, recapitalizations, restructurings, acquisitions, leveraged buyouts, and share repurchases, which may escape being included in the indenture. Such events can drastically change the firm's capital structure and reduce the creditworthiness of the bonds and their value. In order to protect shareholders, a company may include in the indenture a **poison put**, which can require the company to repurchase the debt at or above par value in the event of a takeover not approved by the board of directors (i.e., a hostile takeover). The purpose of this feature is to protect bondholders, but its effectiveness toward this goal can be misleading in that the acquiring firm may offer a sufficiently high price for the stock so that the hostile takeover becomes friendly. As a result, the poison puts would not be exercised.

Investors can lobby for clauses in the indenture to activate a put option for a variety of reasons including a change in the bond's rating. Some of the debt rating services issue commentary on the indenture's protective features, which could include the possibility of the firm being able to circumvent the features through careful legal moves (e.g., turning a hostile takeover into a friendly takeover). It should be noted that event risk can change on a market level. During times of increased merger activity, for example, the event risk increases for most bonds.

HIGH-YIELD BONDS

LO 50.9: Define high-yield bonds, and describe types of high-yield bond issuers and some of the payment features unique to high yield bonds.

High-yield bonds (a.k.a. junk bonds) are those bonds rated below investment grade by ratings agencies. This includes a broad range of ratings below the cutoff, (e.g., BB to default). **Businessman's risk** refers to bonds with a rating at the bottom rung of the investment-grade category (Baa and BBB) or at the top end of the speculative-grade category (Ba and BB). Over long periods of time, high-yield bonds should offer higher average returns. However, over shorter periods, the returns will be volatile where large losses are possible.

There are many types of high-yield bonds. One type includes companies who issue bonds with a non-investment grade rating. Such issuers include young and growing companies that do not have strong financial statements but who have promising prospects. Firms may issue such bonds to raise venture capital, and their prospects are tied to a particular project or story, which gives them the name "story bonds."

Established firms that have had a deteriorating financial situation may need to raise debt capital as well, and they would issue bonds that reflect their situation. Also, an established firm who already has unsecured debt issued with an investment-grade credit rating may be able to issue subordinated debt, but that debt would be non-investment grade.

Fallen angels are another type of high-yield bond. They are bonds that were issued with an investment-grade rating, but then events led to the ratings agencies lowering the rating to below investment grade. If the issuers are in or near bankruptcy, they are often called “special situations,” which could either pay off if the company recovers or lead to big losses.

Restructurings and leveraged buyouts may increase the credit risk of a company to the point where the bonds become non-investment grade. The new management may pay high dividends, deplete the acquired firm’s cash, and lower the rating of the existing bonds. In this process, the firm may issue non-investment grade debt to pay off the bridge loans taken to finance the acquisition.

High-yield bonds can have several types of coupon structures. There are **reset bonds**, where designated investment banks periodically reset the coupon to reflect market rates and the creditworthiness of the issuer. There are also **deferred-coupon structures**, which include three types: (1) deferred-interest bonds, (2) step-up bonds, and (3) payment-in-kind bonds. Deferred-interest bonds sell at a deep discount and do not pay interest in the early years of the issue, say, for three to seven years. Step-up bonds pay a low coupon in the early years and then a higher coupon in later years. Payment-in-kind bonds allow the issuer to pay interest in the form of additional bonds over the initial period.

DEFAULT RATE

LO 50.10: Define and differentiate between an issuer default rate and a dollar default rate.

A default occurs if there are any missed or delayed disbursements of interest and/or principal. It has been proven that lower credit ratings indicate a higher probability of default, but there are two ways to measure default: by the raw number of issuers that defaulted or the dollar amount of issues that defaulted. For each approach in measuring default rates, there are different formulas, which can lead to researchers reporting different default rates for the same data set.

The **issuer default rate** is the number of issuers that defaulted over a year divided by the total number of issuers at the beginning of the year. It is only a proportion of the number of issuers who do fulfill their obligations and does not include a measure of the dollar amount involved.

The **dollar default rate** is the par value of all bonds that defaulted in a given calendar year divided by the total par value of all bonds outstanding during the year. Over a multi-year period, often-used measures are ratios of cumulative dollar value of all defaulted bonds divided by some weighted-average measure of all bonds issued. One such measure attempts to weight the bonds outstanding by the number of years they are in the market:

$$\frac{\text{cumulative dollar value of all defaulted bonds}}{(\text{cumulative dollar value of all issuance}) \times (\text{weighted average # of years outstanding})}$$

Another measure simply takes a raw total as shown in the following equation:

$$\frac{\text{cumulative dollar value of all defaulted bonds}}{\text{cumulative dollar value of all issuance}}$$

RECOVERY RATE

LO 50.11: Define recovery rates and describe the relationship between recovery rates and seniority.

The recovery rate is the amount received as a proportion of the total obligation after a bond defaults. Measuring this can be complicated because the value of the total obligation requires computing the present value of the remaining cash flows at the time of the default. Furthermore, some of the amount that the investor recovers may be in the form of securities (e.g., stock in the company). A study by Moody's estimated that the recovery rate for bonds has been about 38%. Bonds with higher seniority will obviously have higher recovery rates.

KEY CONCEPTS

LO 50.1

A bond indenture sets forth the obligations of the issuer. The trustee interprets the legal language of the indenture and works to make sure the issuer fulfills obligations to bondholders.

LO 50.2

The bond issuer's obligations are fulfilled on the maturity date or before. Bonds can be retired before that date.

LO 50.3

The main types of interest payment classifications are straight-coupon bonds, zero-coupon bonds, and floating-rate bonds. Straight-coupon bonds pay a fixed cash coupon periodically. Floating-rate bonds pay a cash amount that varies with market rates. Zero-coupon bonds increase in value over the life of the issue.

There are many variations of the main types of bond structures. For example, deferred-interest bonds are a mix of zero-coupon and coupon bonds in that they do not pay cash interest in early years and pay a cash coupon in later years. Some bonds have principal in one currency and pay coupons in another currency.

LO 50.4

Zero-coupon bonds have low reinvestment risk. The interest is based on the time-to-maturity at issuance and the original-issue discount, which is the difference between the face value and the offering price. In the case of bankruptcy, the bondholder has a claim only equal to the issue price plus accrued interest to that date, and not the full face value.

LO 50.5

The holder of a mortgage bond has the first lien on real property owned by the issuer.

Collateral trust bonds are backed by stocks and bonds that represent claims against the subsidiaries of the issuer. The collateral is also called personal property.

Equipment trust certificates are a form of mortgage bond where the trustee actually owns the property and rents it to the bond issuer. The property is often in the form of standardized equipment (e.g., rail cars) that is easily sold.

Debentures are unsecured debt. Owners of debentures have a claim on the company's assets not backing outstanding secured debt.

LO 50.6

Call provisions allow the firm to retire debt early at a given price. Sinking-fund provisions require the firm to buy back portions of debt each year. Call provisions are generally considered detrimental to bondholders, but sinking-fund provisions may be beneficial to bondholders.

A maintenance and replacement fund helps maintain the financial health of the firm. Cash in the fund can be used to retire debt.

Bond issuers can retire debt through a tender offer. The offer price may either be a fixed price or a price that varies with a market rate such as that on comparable Treasury securities.

LO 50.7

Credit default risk is the possibility that the issuer does not make the payments specified in the indenture. Credit spread risk is the price risk from changes in the spread of a bond's interest rate over the corresponding Treasury rate.

LO 50.8

Event risk is the possibility that a merger, restructuring, acquisition, et cetera, increases the risk of the bond by changing the ability of the firm to pay off the bonds. The indenture can try to address some of these events, but some can be omitted and lawyers can find loopholes around those included.

LO 50.9

High-yield bonds can either be issued by growing, risky firms or established firms with senior debt outstanding. High-yield bonds may also be fallen angels (i.e., one-time investment grade bonds).

High-yield bonds may have coupon structures which allow the firm to conserve cash in early years, such as: (1) deferred-interest bonds, (2) step-up bonds, and (3) payment-in-kind bonds.

LO 50.10

The issuer default rate is a proportion based on the number of issues that default as a proportion of all issues. The dollar default rate estimates the dollar amount of defaulted bonds compared to the dollar amount of the corresponding population of bonds outstanding.

LO 50.11

In the event of default, the recovery rate refers to the amount a bondholder receives as a proportion of the amount owed. Bonds with higher seniority usually have higher recovery rates.

CONCEPT CHECKERS

1. Which of the following responsibilities is least likely to be part of the role of a corporate trustee in a bond issue?
 - A. Interpret the language of the indenture.
 - B. Determine the interest rate on a reset bond.
 - C. Keep track of the amount of bonds issued by the corporation.
 - D. Monitor the corporation's activities to make sure the corporation abides by the indenture's covenants.

2. In bankruptcy, the holder of a zero-coupon bond obligation of the bankrupt corporation would have a claim equal to:
 - A. the face value of the bond.
 - B. the issuing price of the bond only.
 - C. the issuing price plus accrued interest.
 - D. nothing, since zeros are always unsecured.

3. All other things being equal, which of the following types of bond instruments would have the lowest interest rate?
 - A. Equipment trust certificates.
 - B. Mortgage bonds.
 - C. Junior debentures.
 - D. Senior debentures.

4. Which of the following methods for retiring bonds before maturity is generally considered the most detrimental for the bondholders?
 - A. Tender offers.
 - B. Call provision.
 - C. Sinking fund provision.
 - D. Maintenance and replacement funds.

5. With respect to default risk and credit spread risk, the ratings of bond-rating agencies such as Moody's provide information concerning:
 - A. default risk only.
 - B. credit spread risk only.
 - C. both default risk and credit spread risk.
 - D. neither default risk nor credit spread risk.

CONCEPT CHECKER ANSWERS

1. **B** Investment banks other than the trustee set the rate on a reset bond.
2. **C** The claim equals the value at that point in time as implied by the issuing price, the original-issue discount, and accrued interest.
3. **A** ETCs, or equipment trust certificates, are generally the most secure because the underlying assets are actually owned by the trustee and rented to the borrower. Also, the assets are usually standardized for easy resale.
4. **B** The call provision gives the issuer the right to purchase the bonds at a given price, which the issuer would not do unless that price was below the market price. Sinking fund provisions can benefit bondholders because the issuer is obligated to purchase bonds, which improves the creditworthiness of the issue, and the issuer may have to do so at a price higher than the market price. There are no features in M&R funds or tender offers that would be detrimental to bondholders.
5. **A** Bond rating agencies issue ratings based on the default risk of the issue. Credit spread risk is determined by spread duration.

The following is a review of the Financial Markets and Products principles designed to address the learning objectives set forth by GARP®. This topic is also covered in:

MORTGAGES AND MORTGAGE-BACKED SECURITIES

Topic 51

EXAM FOCUS

Mortgage-backed securities (MBSs) are debt securities backed by a pool of residential loans, which serve to transform mortgages from an illiquid asset into a liquid asset. Because the underlying mortgages can be prepaid, prepayment risk is a major concern for MBS investors. Monte Carlo simulation is the most common methodology used for valuing MBSs because it is able to account for prepayment risk. Alternate interest rate paths are assumed in the model to generate an option-adjusted spread (OAS). For the exam, be able to calculate the payments for a fixed-rate, level paying mortgage. Also, be familiar with the factors that affect prepayment rates and how to measure prepayment speeds with a conditional prepayment rate (CPR). Finally, be prepared to discuss the steps involved in valuing an MBS using the Monte Carlo methodology and understand the advantages and disadvantages of using an OAS.

RESIDENTIAL MORTGAGE PRODUCTS

LO 51.1: Describe the various types of residential mortgage products.

A **mortgage** is a loan that is collateralized with a specific piece of real property. Before the 1970s, mortgages existed solely in the **primary market** where banks that issued the mortgage loans collected all interest and principal payments from the borrower. Within the past few decades, it is more common for mortgage lenders to sell the loans in the **secondary market** through a process known as **securitization**. The secondary market has allowed more banks to issue mortgage loans.

In the secondary market, mortgages are pooled together and packaged to investors in the form of a **mortgage-backed security** (MBS). The payments of an MBS can follow a **pass-through structure** where the interest and principal collected from the borrower pass through the banks and ultimately end up with the MBS investor. Because default risk is present in mortgage lending, banks will often guarantee the borrower's payments when mortgages are securitized.

Lien Status

Whether the mortgage is a first lien, a second lien, or a subsequent lien will greatly impact the lender's ability to recover the balance owed in the event of default. For example, a first lien would give the lender the first right to receive proceeds on liquidation, so from a seniority perspective, a first lien is more desirable than a second lien.

Original Loan Term

Mortgage terms of 10 to 30 years are common, with the most popular being 30 years (long term). However, medium terms in the 10- to 20-year range are starting to become more common, given the desire of many individuals to pay off their mortgages as soon as possible.

Credit Classification

Classifying loans between prime and subprime is determined mainly by credit score (i.e., Fair Isaac Corporation or FICO model).

Prime (A-grade) loans constitute most of the outstanding loans. They have low rates of delinquency and default as a result of low **loan-to-value (LTV) ratios** (i.e., far less than 95%), borrowers with stable and sufficient income (i.e., *front income ratio* of no more than 28% of monthly income to service payments relating to the home and *back income ratio* of no more than 36% for those payments plus other debt payments), and a strong history of repayments (e.g., FICO score of 660 or greater). Home payments include interest, principal, property taxes, and homeowners insurance.

Subprime (B-grade) loans have higher rates of delinquency and default compared to prime loans. They could be associated with high LTV ratios (i.e., 95% or above), borrowers with lower income levels, and borrowers with marginal or poor credit histories (e.g., FICO score below 660). High LTV ratios suggest a higher risk of default. Upon issuance, subprime loans are carefully scrutinized by the servicer to ensure timely payments.

Alternative-A loans are the loans in between prime and subprime. Although they are essentially prime loans, certain characteristics of Alternative-A loans make them riskier than prime loans. For example, the loan value may be unusually high, the LTV ratio may be high, or there may be less documentation available (e.g., income verification, down payment source).

Interest Rate Type

Fixed-rate mortgages have a set rate of interest for the term of the mortgage. Payments are constant for the term and consist of blended amounts of interest and principal.

Adjustable-rate mortgages (ARMs) have rate changes throughout the term of the mortgage. The rate is usually based on a base rate (e.g., prime rate, LIBOR) plus a spread. Rates can usually change on a monthly, semiannual, or annual basis. The risk of default is high, especially if there are large rate increases after the first year, thereby significantly increasing the total payment amount (due to the increase in interest).

Topic 51

Cross Reference to GARP Assigned Reading – Tuckman, Chapter 20

Prepayments and Prepayment Penalties

Prepayments reduce the mortgage balance and amortization period. They can occur because of the following reasons:

- Home is sold, which requires the mortgage balance to be paid off.
- Refinancing due to lower rates or more attractive loan features elsewhere.
- Partial prepayments by the borrower during the term.

To counteract the negative effects of prepayments, many loans contain prepayment penalties. They are amounts payable to the servicer for prepayments within a certain time and/or over a certain amount. Soft penalties are those that may be waived on the sale of the home; hard penalties may not be waived.

Credit Guarantees

The ability to create mortgage-backed securities requires loans that have credit guarantees.

Government loans are those that are backed by federal government agencies (e.g., Government National Mortgage Association or GNMA).

Conventional loans could be securitized by either government-sponsored enterprises (GSEs): Federal Home Loan Mortgage Corporation (FHLMC) or Federal National Mortgage Association (FNMA). For a guarantee fee, these GSEs will guarantee payment of principal and interest to the investors.

Agency (or conforming) MBSs are those that are guaranteed by any of three government-sponsored entities (GSEs): GNMA, FNMA, and FHLMC. Most of the MBSs are issued by these GSEs.

Also known as **private label** securitizations, non-agency (or non-conforming) MBSs grew along with U.S. home prices over time up to the 2007 credit crisis. The GSEs have restrictions on what mortgages they can guarantee/securitize [e.g., dollar value limit, loan-to-value (LTV) ratio limit], which opened up the private label market for those participants willing to take on the risks inherent in nonconventional loans—**jumbo loans** (mortgage principal balance over the limit) and/or loans with high LTVs. The rising prices of the underlying homes held as collateral provided some risk mitigation. Unfortunately, the falling prices of homes and the credit crisis beginning in 2007 caused a significant drop in MBS issuances in the non-agency segment because they did not have government guarantees.

With agency MBSs, the investor bears no credit risk because the GSEs have been paid a fee to guarantee the underlying mortgages. If there is a default with a mortgage, the GSE will pay the outstanding balance to the investors. With a non-agency MBS, there is some credit risk but that is mitigated through the process of subordination.

FIXED-RATE, LEVEL-PAYMENT MORTGAGES

LO 51.2: Calculate a fixed rate mortgage payment, and its principal and interest components.

A conventional mortgage is the most common residential mortgage. The loan is based on the creditworthiness of the borrower and is collateralized by the residential real estate that it is used to purchase. If a borrower's credit quality is questionable or the borrower is lacking a sufficient down payment, the mortgage lender may require mortgage insurance to guarantee the loan. Mortgage insurance is made available by both government agencies and private insurers. The cost of the insurance is borne by the borrower and effectively raises the interest rate on the mortgage loan.

There are a wide variety of mortgage designs that specify the rates, terms, amortization, and repayment methods. All of the concepts associated with risk analysis and valuation, however, can be understood through an examination of **fixed-rate, level payment, fully amortized mortgage loans**. This common type of mortgage loan requires equal payments (usually monthly) over the life of the mortgage. Each of these payments consists of an interest component and a principal component.

There are four important features of fixed-rate, level payment, fully amortized mortgage loans to remember when we move on to mortgage-backed securities (MBS):

1. The amount of the principal payment increases as time passes.
2. The amount of interest decreases as time passes.
3. The servicing fee also declines as time passes.
4. The ability of the borrower to repay results in **prepayment risk**. Prepayments and curtailments reduce the amount of interest the lender receives over the life of the mortgage and cause the principal to be repaid sooner.

Example: Calculating a mortgage payment

Consider a 30-year, \$500,000 level payment, fully amortized mortgage with a fixed rate of 12%. Calculate the monthly payment and prepare an amortization schedule for the first three months.

Topic 51**Cross Reference to GARP Assigned Reading – Tuckman, Chapter 20****Answer:**

The monthly payment is \$5,143.06:

$$N = 360; I/Y = 1.0 \text{ (12/12)}; PV = -500,000; FV = 0; CPT \rightarrow PMT = 5,143.06$$

With reference to the partial amortization schedule in the figure below, the portion of the first payment that represents interest is \$5,000.00 ($0.01 \times \$500,000$). The remainder of the payment, \$143.06 ($\$5,143.06 - \$5,000.00$), goes toward the reduction of principal. The portion of the second payment that represents interest is \$4,998.57 ($0.01 \times \$499,856.94$). The remaining \$144.49 ($\$5,143.06 - \$4,998.57$) goes toward the further reduction of principal.

Monthly Amortization Schedule for a 30-Year, \$500,000 Mortgage Loan at 12%

<i>Payment Number</i>	<i>Initial Principal</i>	<i>Monthly Payment</i>	<i>Interest Component</i>	<i>Reduction of Principal</i>	<i>Outstanding Principal</i>
1	\$500,000.00	\$5,143.06	\$5,000.00	\$143.06	\$499,856.94
2	499,856.94	5,143.06	4,998.57	144.49	499,712.45
3	499,712.45	5,143.06	4,997.12	145.94	499,566.51

Notice that the monthly interest charge is based on the beginning-of-period outstanding principal. As time passes, the proportion of the monthly payment that represents interest decreases, and, because the payment is level, the proportion that goes toward the repayment of principal increases. This process continues until the outstanding principal reaches zero and the loan is paid in full.

The incremental reduction of outstanding principal is referred to as scheduled amortization (or scheduled principal repayment). The previous figure is a portion of what is commonly called an **amortization schedule**. Amortization schedules are easily constructed using an electronic spreadsheet.

The collection of payments and all of the other administrative activities associated with mortgage loans are paid for via a servicing fee, also known as the servicing spread, because it is usually built into the mortgage rate.

For example, if the mortgage rate is 10.5% and the servicing fee is 35 basis points, the provider of the mortgage funds will receive 10.15%. This amount is called the net interest or net coupon. The dollar amount of the servicing fee is based on the outstanding loan balance; thus, it declines as the mortgage is amortized. Keep in mind that the reduction in principal associated with each payment is based on the mortgage rate and is unaffected by the servicing fee.

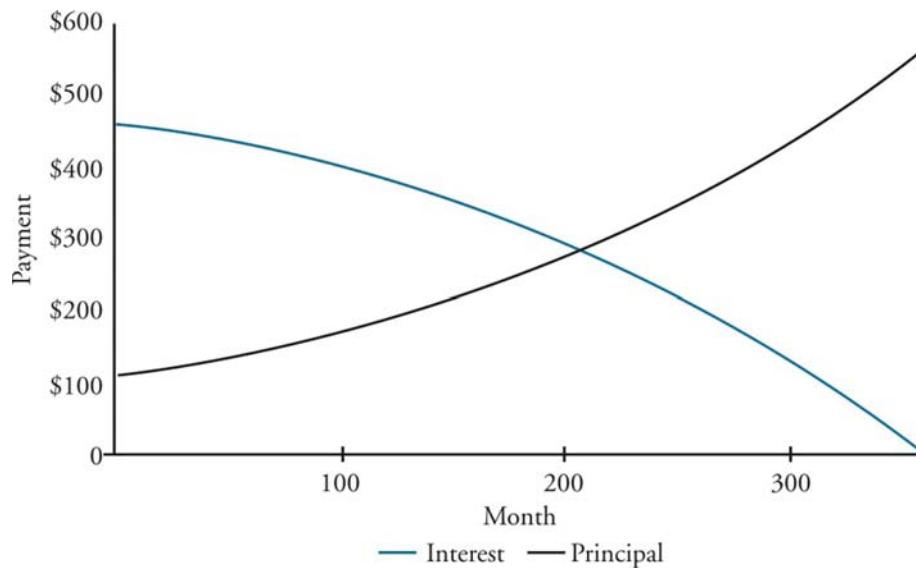
Allocation Between Principal and Interest

Fully amortizing fixed-rate mortgage:

- The mortgage payment consists primarily of interest in the early years.
- Interest is calculated on a declining principal balance so the interest payable will gradually decrease over time. As a result, more of the fixed mortgage payment will be applied toward reducing the principal amount.
- The crossover point is the point in the mortgage where principal and interest allocation amounts are the same. After that point, relatively more amounts will be allocated to principal.
- Mortgages with shorter amortization periods result in less interest paid and more of the payment applied toward reducing the principal balance sooner. In other words, equity buildup occurs at a quicker rate when the amortization period is shorter.

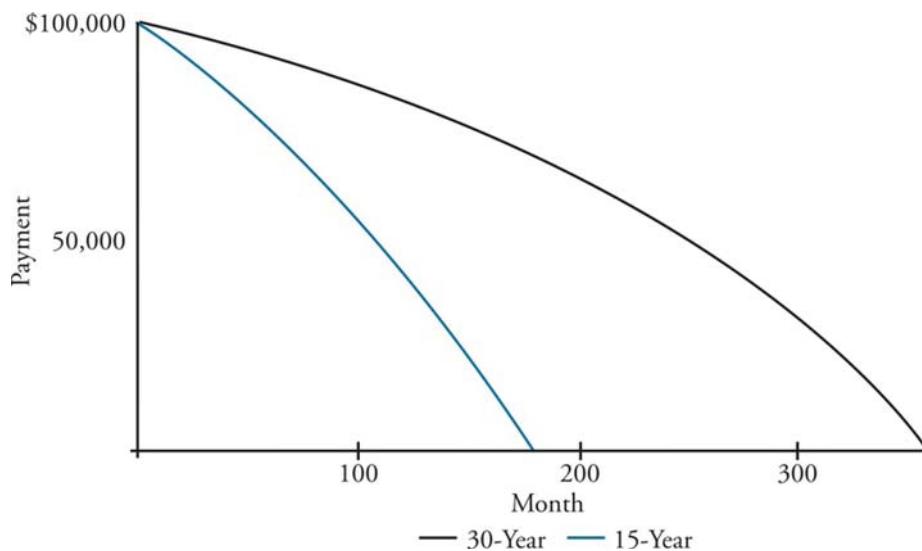
Figure 1 illustrates the relationship of interest and principal over the term of the loan.

Figure 1: Interest and Principal Over Time



As indicated previously, the reason principal payments will increase over time is due to the reduction in the outstanding loan balance. Figure 2 illustrates the relationship between loan balance and time for a \$100,000 loan.

Figure 2: Loan Balance Over Time



PREPAYMENT

LO 51.3: Describe the mortgage prepayment option and the factors that influence prepayments.

In the previous example, it was assumed that the borrower paid the exact amount of the monthly payment, and the interest and principal followed the amortization schedule. However, it is possible for a borrower to pay an amount in excess of the required payment or even to pay off the loan entirely. The option to prepay a mortgage is essentially a call option for the borrower. The borrower is in a position that is very similar to the issuer of a callable bond. A prepayment will effectively free the borrower of the mortgage obligation.

Mortgage Prepayment Option

Mortgage prepayments come in two forms: (1) increasing the frequency or amount of payments (where permitted) and (2) repaying/refinancing the entire outstanding balance. Prepayments are much more likely to occur when market interest rates fall and borrowers wish to refinance their existing mortgages at a new and lower rate. For the lender, prepayments represent a loss for two reasons: (1) they stop receiving interest income at the high rate and (2) they have to reinvest the proceeds received from prepayment at the prevailing lower market rates. Therefore, the pricing of the initial mortgage rate should be somewhat higher to take into account the possibility of prepayment. With agency MBSs, prepayments and defaults have the same impact on investors. Prepayments result in the investors actually receiving cash from the borrowers, whereas with defaults, the borrower does not pay the outstanding mortgage balances, but the GSE does, thereby causing a prepayment.

Other Factors That Influence Prepayments

Seasonality. The summertime is a popular time for individuals to move (and mortgages must be paid out prior to the sale of a home), so it is the period of time with the greatest prepayment risk. Given some time lags, the prepayments often start to appear in the late summer and early fall.

Age of mortgage pool. Refinancing often involves penalties and administrative charges, so borrowers tend not to do so until several years into the mortgage. Also, it takes some time for borrowers to build up equity and savings to make prepayments and/or attempt to refinance. As a result, the lower the age of the mortgage pool, the less likely the risk of prepayment.

Personal. Marital breakdown, loss of employment, family emergencies, and destruction of property are commonly cited reasons for prepayments based on personal reasons. It is difficult to assess this type of prepayment risk.

Housing prices. Property value increases may spur an increase in prepayments caused by borrowers wanting to take out some of the increased equity for personal use. Property value decreases reduce the value of collateral, reduce the ability to refinance, and, therefore, decrease the risk of prepayment. The increasingly popular use of home equity lines of credit where the mortgage balance is revolving (i.e., mortgage balance can be drawn up to a certain limit and paid down to zero at any time) reduces refinancing and prepayment risk due to the nature of the loan.

Refinancing burnout. To the extent that there has been a significant amount of prepayment or refinancing activity in the mortgage pool in the past, the risk of prepayment in the future decreases. That is because presumably the only borrowers remaining in the pool are those who were unable to refinance earlier (e.g., due to poor credit history or insufficient property value), and those who did refinance have been removed from the pool already. Also, those who made only large prepayments (instead of fully refinancing) in the past would have exhausted their savings to make the prepayment and would require quite some time to do so again in the future.

SECURITIZATION

LO 51.4: Summarize the securitization process of mortgage backed securities (MBS), particularly formation of mortgage pools including specific pools and TBAs.

LO 51.5: Calculate weighted average coupon, weighted average maturity, and conditional prepayment rate (CPR) for a mortgage pool.

To reduce the risk from holding a potentially undiversified portfolio of mortgage loans, a number of financial institutions (i.e., originators) will work together to pool residential mortgage loans with similar characteristics into a more diversified portfolio. They will then sell the loans to a separate entity, called a special purpose vehicle (SPV), in exchange for

Topic 51**Cross Reference to GARP Assigned Reading – Tuckman, Chapter 20**

cash. An issuer will purchase those mortgage assets in the SPV and then use the SPV to issue MBSs to investors; the securities are backed by the mortgage loans as collateral.

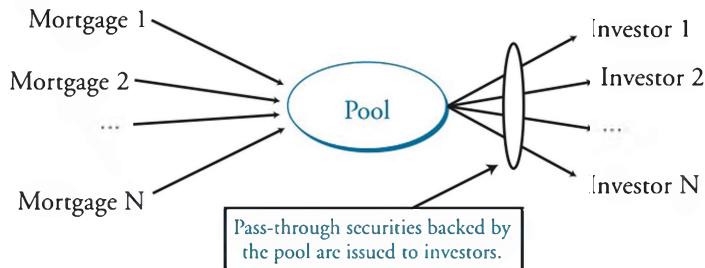
As of now, the securitization process has become a crucial part of the U.S. credit system. Financial institutions expect to originate mortgage loans and sell them through securitization. The lack of a securitization market for mortgages would lead to the downfall of mortgage lending because financial institutions would not want to retain the risks.

PASS-THROUGH SECURITIES

A **mortgage pass-through security** represents a claim against a pool of mortgages. Any number of mortgages may be used to form the pool and any mortgage included in the pool is referred to as a **securitized mortgage**. The mortgages in the pool have different maturities and different mortgage rates. The **weighted average maturity** (WAM) of the pool is equal to the weighted average of all mortgage ages in the pool, each weighted by the relative outstanding mortgage balance to the value of the entire pool. The **weighted average coupon** (WAC) of the pool is the weighted average of the mortgage rates in the pool. The investment characteristics of a mortgage pass-through are a function of its cash flow features and the strength of its government guarantee.

As illustrated in Figure 3, pass-through security investors receive the monthly cash flows generated by the underlying pool of mortgages, less any servicing and guarantee/insurance fees. The fees account for the fact that **pass-through rates** (i.e., the coupon rate on the pass-through) are less than the average coupon rate of the underlying mortgages in the pool.

Figure 3: Mortgage Pass-through Cash Flow



Because pass-through securities may be traded in the secondary market, they effectively convert illiquid mortgages into liquid securities (as mentioned, this process is called **securitization**). More than one class of pass-through securities may be issued against a single mortgage pool.

The timing of the cash flows to pass-through security holders does not exactly coincide with the cash flows generated by the pool. This is due to the delay between the time the mortgage service provider receives the mortgage payments and the time the cash flows are “passed through” to the security holders.

The most important characteristic of pass-through securities is their prepayment risk; because the mortgages used as collateral for the pass-through can be prepaid, the pass-throughs themselves have significant prepayment risk.

Measuring Prepayment Speeds

Prepayments cause the timing and amount of cash flows from mortgage loans and MBSs to be uncertain; they speed up principal repayments and reduce the amount of interest paid over the life of the mortgage. Thus, it is necessary to make specific assumptions about the rate at which prepayment of the pooled mortgages occurs when valuing pass-through securities. Two industry conventions have been adopted as benchmarks for prepayment rates: the **conditional prepayment rate (CPR)** and the **Public Securities Association (PSA) prepayment benchmark**.

The *CPR* is the annual rate at which a mortgage pool balance is assumed to be prepaid during the life of the pool. A mortgage pool's CPR is a function of past prepayment rates and expected future economic conditions.

We can convert the CPR into a monthly prepayment rate called the **single monthly mortality rate (SMM)** (also referred to as constant maturity mortality) using the following formula:

$$\text{SMM} = 1 - (1 - \text{CPR})^{1/12}$$

If given the SMM rate, you can annualize the rate to solve for the CPR using the following formula:

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

An SMM of 10% implies that 10% of a pool's beginning-of-month outstanding balance, less scheduled payments, will be prepaid during the month.

The *PSA prepayment benchmark* assumes that the monthly prepayment rate for a mortgage pool increases as it ages or becomes seasoned. The PSA benchmark is expressed as a monthly series of CPRs.

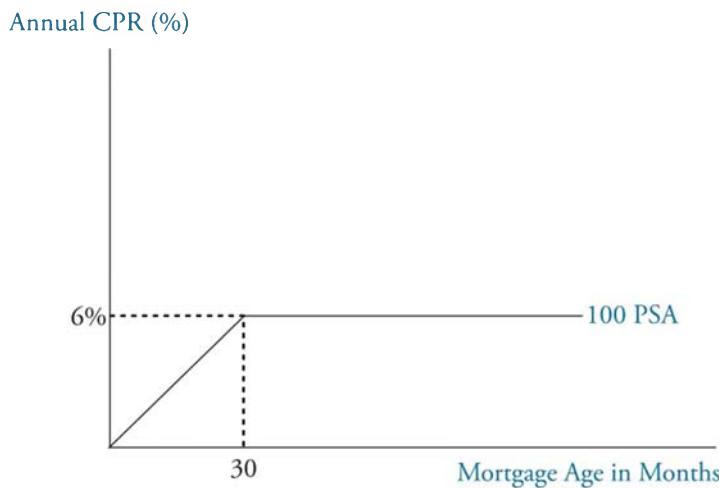
The PSA standard benchmark is referred to as 100% PSA (or just 100 PSA). 100 PSA (see Figure 4) assumes the following graduated CPRs for 30-year mortgages:

- CPR = 0.2% for the first month after origination, increasing by 0.2% per month up to 30 months. For example, the CPR in month 14 is $14(0.2\%) = 2.8\%$.
- CPR = 6% for months 30 to 360.

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Cross Reference to GARP Assigned Reading – Tuckman, Chapter 20

Figure 4: 100 PSA



Remember that the CPRs are expressed as annual rates.

A particular pool of mortgages may exhibit prepayment rates faster or slower than 100% PSA, depending on the current level of interest rates and the coupon rate of the issue. A 50% PSA refers to one-half of the CPR prescribed by 100% PSA, and 200% PSA refers to two times the CPR called for by 100% PSA.

Example: Computing the SMM

Compute the CPR and SMM for the 5th and 25th months, assuming 100 PSA and 150 PSA.

Answer:

Assuming 100 PSA:

$$\begin{aligned} \text{CPR(month 5)} &= 5 \times 0.2\% = 1\% \\ 100 \text{ PSA} &= 1 \times 0.01 = 0.01 \\ \text{SMM} &= 1 - (1 - 0.01)^{1/12} = 0.000837 \end{aligned}$$

$$\begin{aligned} \text{CPR (month 25)} &= 25 \times 0.2\% = 5\% \\ 100 \text{ PSA} &= 1 \times 0.05 = 0.05 \\ \text{SMM} &= 1 - (1 - 0.05)^{1/12} = 0.004265 \end{aligned}$$

Assuming 150 PSA:

$$\text{CPR}(\text{month } 5) = 5 \times 0.2\% = 1\%$$

$$150 \text{ PSA} = 1.5 \times 0.01 = 0.015$$

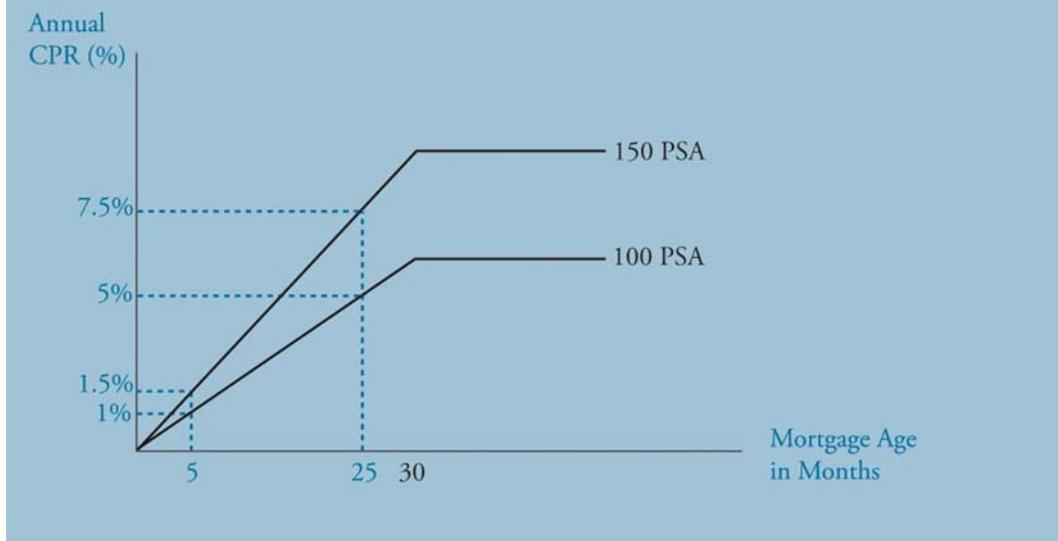
$$\text{SMM} = 1 - (1 - 0.015)^{1/12} = 0.001259$$

$$\text{CPR} (\text{month } 25) = 25 \times 0.2\% = 5\%$$

$$150 \text{ PSA} = 1.5 \times 0.05 = 0.075$$

$$\text{SMM} = 1 - (1 - 0.075)^{1/12} = 0.006476$$

Figure 5: Prepayment Speeds for 5th and 25th Months at 100 and 150 PSA



It is important for you to recognize that the nonlinear relationship between CPR and SMM implies that the SMM for 150% PSA does *not* equal 1.5 times the SMM for 100% PSA. Also, keep in mind that the PSA standard benchmark is nothing more than a market convention. It is not a model for predicting prepayment rates for MBS. In fact, empirical studies have shown that actual CPRs differ substantially from those assumed by the PSA benchmark.

Trading Pass-Through Securities

Trade settlements occur every month on a predetermined basis; delivery dates during a month are specified. In addition, prices are usually quoted for three settlement months, however, trades could be done for a longer period into the future.

Fixed rate pass-through securities (i.e., agency mortgage pools) trade in one of the following ways:

- Specified pools.
- To Be Announced (TBA).

Topic 51**Cross Reference to GARP Assigned Reading – Tuckman, Chapter 20**

The specified pools market identifies the number and balances of the pools prior to a trade. As a result, the characteristics of a given pool will influence the price of a trade. For example, high loan-balance pools, which make better use of prepayment options, trade for relatively lower prices.

The TBA market, which is more liquid than specified pools, involves identifying the security and establishing the price in a forward market. However, there is a pool allocation process whereby the actual pools are not revealed to the seller until immediately before settlement. The characteristics of the pools that can be used for TBA trades are regulated to ensure reasonable consistency.

DOLLAR ROLL TRANSACTION

LO 51.6: Describe a dollar roll transaction and how to value a dollar roll.

MBS trading requires the same securities to be priced for different settlement dates. A **dollar roll transaction** occurs when an MBS market maker buys positions for one settlement month and, at the same time, sells those same positions for another month.

How to Value a Dollar Roll

The process involves assessing the income and the expenses related over the holding period. Income is determined by coupon payments, reinvested interest, and principal payments. Expenses are determined by financing costs [i.e., repurchase (repo) market]. One could purchase the security in the earlier (front) month, hold it, and then dispose of it in the later (back) month at settlement.

The back month price of a dollar roll should take both income and expenses into account so the net cash flows are equivalent to simply purchasing the security in the back month for settlement at that time. However, empirical evidence suggests that the most likely outcome is that a price drop between the two settlement dates makes purchasing the security in the back month more attractive. In other words, purchasing a position for back month settlement results in financing at an implied repo rate lower than that of the repurchase market.

Factors that impact dollar roll valuations:

- The security's coupon, age, and WAC.
- Holding period (period between the two settlement dates).
- Assumed prepayment speed.
- Funding cost in the repo market.

Factors Causing a Dollar Roll to Trade Special

When the price difference/drop is large enough to result in financing at less than the implied cost of funds, then the dollar roll is trading *special*. It could be caused by:

- A decrease in the back month price (due to an increased number of sale/settlement transactions on the back month date by originators).

- An increase in the front month price (due to an increased demand in the front month for deal collateral).
- Shortages of certain securities in the market that require the dealer to suddenly purchase the security for delivery in the front month, thereby increasing the front month price.

OTHER PRODUCTS

Collateralized Mortgage Obligations

All investors have varying degrees of concern about exposure to prepayment risk. Some are primarily concerned with extension risk (the increase in the expected life of a mortgage pool due to rising interest rates and lower prepayment rates), while others want to minimize exposure to contraction risk (the decrease in the expected life of a mortgage pool due to falling interest rates and higher prepayment rates). Fortunately, all of the pass-through securities issued on a pool of mortgages do not have to be the same. The ability to partition and distribute the cash flows generated by a mortgage pool into different risk packages has led to the creation of **collateralized mortgage obligations** (CMOs).

CMOs are securities issued against pass-through securities (securities secured by other securities) for which the cash flows have been reallocated to different bond classes called *tranches*. Each tranche has a different claim against the cash flows of the mortgage pass-throughs or pool from which it was derived. Each CMO tranche represents a different mixture of contraction and extension risk. Hence, CMO securities can be more closely matched to the unique asset/liability needs of institutional investors and investment managers.

Planned Amortization Class Tranches

The most common type of CMO today is the **planned amortization class** (PAC). A PAC is a tranche that is amortized based on a sinking fund schedule that is established within a range of prepayment speeds called the *initial PAC collar* or *initial PAC bond*.

What makes a PAC bond work is that it is packaged with a *support*, or *companion*, tranche created from the original mortgage pool. Support tranches are included in a structure with PAC tranches specifically to provide prepayment protection for the PAC tranches (each tranche is, of course, priced according to the timing risk of the cash flows). If prepayment rates are faster than the upper repayment rate, the PAC tranche receives principal according to the PAC schedule, and the support tranche absorbs (i.e., receives) the excess. If prepayment speeds are below the lower repayment rate, the funds needed to keep the PAC on schedule come from the cash flows scheduled for the support tranche(s). It should be pointed out that the extent of prepayment risk protection provided by a support tranche increases as its par value increases relative to its associated PAC tranche.

There is an *inverse* relationship between the prepayment risk of PAC tranches and the prepayment risk associated with the support tranches. In other words, *the certainty of PAC bond cash flow comes at the expense of increased risk to the support tranches*.

To understand the relatively high prepayment risk for support tranches, consider the situation in which prepayments are slower than planned. Because the PAC tranches have

Topic 51**Cross Reference to GARP Assigned Reading – Tuckman, Chapter 20**

priority claim against the cash flows, principal payments to the support tranches must be deferred until the PAC repayment schedule is satisfied. Thus, the average life of the support tranche is extended. Similarly, when actual prepayments come at a rate that is faster than expected, the support tranches must absorb the amount that is in excess of that required to maintain the repayment schedule for the PAC. In this case, the average life of the support tranche is contracted. If these excesses continue to occur, the support tranches will eventually be paid off and the principal will then go to the PAC holders. When this happens, the PAC is referred to as a *broken* or *busted* PAC, and any further prepayments go directly to the PAC tranche. Essentially, the PAC tranche becomes an ordinary sequential-pay structure.

Notice that the prepayment risk protection provided by the support tranches causes their average lives to extend and contract. This relationship is such that as the prepayment risk protection for a PAC tranche increases, its average life variability decreases, and the average life variability of the support tranche increases.

Strips

A distinguishing characteristic of a traditional pass-through security is that the interest and principal payments generated by the underlying mortgage pool are allocated to the bondholders on a pro rata basis. This means that each pass-through certificate holder receives the same amount of interest and the same amount of principal. *Stripped MBSs* differ in that principal and interest are not allocated on a pro rata basis. The unequal allocation of principal and interest results in a price/yield relationship that is different from that of the underlying pass-through.

The two most common types of stripped MBSs are **principal-only strips** (PO strips) and **interest-only strips** (IO strips). PO strips are a class of securities that receive only the principal payment portion of each mortgage payment, while IO strips are a class that receive only the interest component of each payment.

PO strips are sold at a considerable discount to par. The PO cash flow stream starts out small and increases with the passage of time as the principal component of the mortgage payments grows. The investment performance of a PO is extremely sensitive to prepayment rates. Higher prepayment rates result in a faster-than-expected return of principal and, thus, a higher yield. Since prepayment rates increase as mortgage rates decline, PO prices increase when interest rates fall. The entire par value of a PO is ultimately paid to the PO investor. The only question is whether realized prepayment rates will cause it to be paid sooner or later than expected.

In contrast to PO strips, an IO strip cash flow starts out big and gets smaller over time. Thus, IOs have shorter effective lives than POs.

The major risk associated with IO strips is that the value of the cash flow investors receive over the life of the mortgage pool may be less than initially expected and possibly less than the amount originally invested. Why? The amount of interest produced by the pool depends on its beginning-of-month balance. If market rates fall, the mortgage pool will be paid off sooner than expected, leaving IO investors with no interest cash flow. Therefore, IO investors want prepayments to be slow.

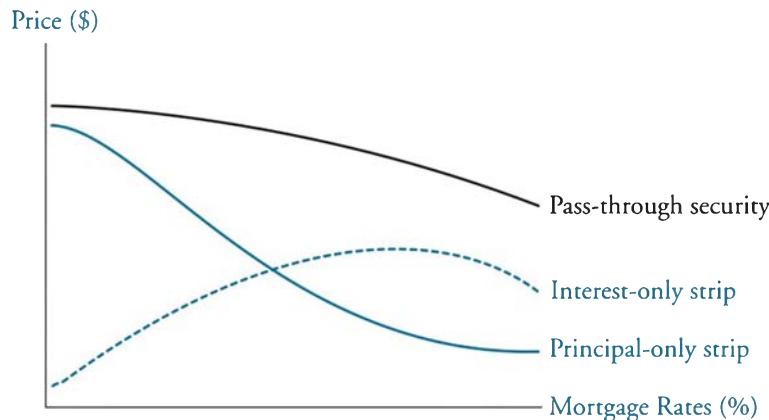
An interesting property of an IO is that its price has a tendency to move in the same direction as market rates. When market rates decline below the contract rate and prepayment rates increase, the diminished cash flow usually causes the IO price to decline, despite the fact that the cash flows are discounted at a lower rate. As interest rates rise above the contract rate, the expected cash flows improve. Even though the higher rate must be used to discount these improved cash flows, there is usually a range above the contract rate for which the price increases.

Both IOs and POs exhibit greater *price volatility* than the pass-through from which they were derived. This occurs because IO and PO returns are negatively correlated (their prices respond in opposite directions to changes in interest rates), but the combined price volatility of the two strips equals the price volatility of the pass-through.

The price/yield relationships for IO and PO securities are shown in Figure 6. Notice the following:

- The underlying pass-through security exhibits significant negative convexity.
- The PO exhibits some negative convexity at low rates.
- The IO price is positively related to mortgage rates at low current rates.
- The PO and IO prices are more volatile than the underlying pass-through.

Figure 6: Investment Characteristics of IOs and POs



PREPAYMENT MODELING

LO 51.7: Explain prepayment modeling and its four components: refinancing, turnover, defaults, and curtailments.

Borrowers may prepay their mortgages due to the sale or destruction of the property or a desire to refinance at lower prevailing rates. In addition, prepayments may occur because the borrower has defaulted on the mortgage and the lender is forced to sell the property to cover the mortgage. Finally, many mortgages have partial prepayment privileges (curtailments) that may be used, especially when the borrower has excess cash available to do so.

Topic 51**Cross Reference to GARP Assigned Reading – Tuckman, Chapter 20**

Refinancing a mortgage involves using the proceeds of a new mortgage to pay off the principal from an existing mortgage. If a homeowner is holding a high interest rate mortgage and the current mortgage rates fall, the incentive to refinance is large (given that rates decline enough to cover the transaction costs of refinancing). Historically, if mortgage rates fall by more than 2%, refinancing activity increases dramatically. This is known as the *media effect* because large declines in rates will likely gain the attention of the media.

Extracting home equity is another motive for refinancing a mortgage. Given a substantial increase in property value, a borrower may take out a new mortgage with a higher balance that not only pays off the existing mortgage but also has extra cash for other purposes. Extracting home equity is also known as *cash-out refinancing*.

Incentive functions are used to model refinancing activity and are based on the term structure of mortgage rates. Past rates, also called *lagged rates*, can be included in the model to help explain refinancing behavior. Incentive functions essentially forecast the present value of any dollar gains given that a borrower will refinance.

The path that mortgage rates follow on their way to the current level affects prepayments through *refinancing burnout*. To better understand this phenomenon, consider a mortgage pool that was formed when rates were 12%, then interest rates dropped to 9%, rose to 12%, and then dropped again to 9%. Many homeowners will have refinanced when interest rates dipped the first time. On the second occurrence of 9% interest rates, most homeowners in the pool who were able to refinance would have already done so.

It is typically the case that the mortgage is due once the property is sold. This is referred to as *due on sale*. Because most borrowers sell their homes without regard for the path of mortgage rates, MBS investors will be subjected to a degree of *housing turnover* that does not correlate with the behavior of rates. One factor that slows the degree of housing turnover is known as the *lock-in effect*. This essentially means that borrowers may wish to avoid the costs of a new mortgage, which likely consists of a higher mortgage rate.

Modeling turnover typically starts with a base rate and then adjusts for seasonality (turnover is higher in the summer and lower in the winter). The turnover model may also include a *seasoning ramp*, which is partially based on improvements to creditworthiness over time, and, thus, the homeowner's increased ability to prepay the mortgage. As a group, housing turnover only accounts for 10% of overall prepayments.

When a borrower **defaults**, mortgage guarantors pay the interest and principal outstanding. These payments act as a source of prepayment. Modeling prepayments from default requires an analysis of loan-to-value (LTV) ratios and FICO scores, as well as an overall analysis of the housing market.

Partial payments by the borrower are referred to as **curtailments**. These partial payments tend to occur when a mortgage is older or has a relatively low balance. Thus, prepayment modeling due to curtailment typically takes into account the age of the mortgage.