Chapter 19

The Secondary Mortgage Market: Pass-Through Securities

Introduction

We begin this chapter with a brief description of the evolution of the secondary market. Particular attention is paid to the need for this kind of market and the major organizations that participate in it. We then describe the various types of mortgage-backed securities that have evolved in recent years and provide a framework for analyzing their investment characteristics. Although mortgage-related securities may be offered on many types of mortgage pools, we generally limit our discussion to residential mortgage-backed pools. The chapter concludes with a section on pricing two types of mortgage-related securities and provides an evaluation of characteristics that differentiate these more important security types. The next chapter is a continuation of this one. It provides a detailed analysis of collateralized mortgage obligations (CMOs) and derivative securities. It also contains an introduction to commercial mortgage-backed securities.

Evolution of the Secondary Mortgage Market

The **secondary mortgage market,** as we know it today, evolved as a result of a combination of the following influences:

1. A need existed for a market in which specialized mortgage originators, such as mortgage banking companies, could sell mortgages and thereby replenish funds with which new loans could be originated.
2. A need also existed for a market mechanism to facilitate a geographic flow of funds. Such a market would allow lenders located in regions where the demand for housing and mortgage financing far exceeded the availability of deposits to sell mortgages to other intermediaries in regions with a surplus of savings.

3. Beginning in the late 1960s, many innovations in securitization occurred in response to the trend toward deregulation of depository-type financial institutions. Because of this trend, savers were no longer limited to traditional methods of saving, such as savings accounts and certificates of deposit. Further, with the passage of legislation giving individual retirement accounts (IRAs) favorable tax treatment, and the aging of the U.S. population increasing the flow of funds to pension accounts, the market for investable funds became much broader. Hence, mortgage lenders, with the aid of organizations specializing in underwriting and selling securities to the public and institutional investors, were faced with the challenge of attracting savings from the public in different ways so as to replenish funds for new mortgage loans. There has been a long-standing commitment on the part of the federal government to encourage home ownership and to provide support for a strong system of housing finance.

Early Buyers of Mortgage Loans

There has always been a secondary mortgage market of some type. Prior to the mid-1950s, primary mortgage originators included mortgage companies and, to a lesser extent, thrift institutions. Investors, including large life insurance companies and eastern thrifts with a surplus of funds, purchased mortgages from mortgage companies or from thrifts in regions where housing demand was great relative to funds available for lending. By purchasing mortgages, these institutional investors helped to replenish funds necessary for the housing boom during the postwar era.

One major factor enhancing the early development of the secondary market was that the federal government, through programs initiated with the Federal Housing Administration (FHA) and later the Veterans Administration (VA), protected mortgage investors from losses by providing either default insurance (FHA) or loan guarantees (VA). One outcome of these programs was a system of minimum underwriting standards for borrower qualifications, appraisals, and building specifications. Uniform administrative procedures required by the FHA and VA were followed by mortgage companies and helped to accommodate significant volumes of FHA and VA originations and facilitated servicing activities. Given (1) the availability of default insurance and loan guarantees, (2) the development of standardized loan underwriting, processing, and servicing, and (3) the availability of hazard and title insurance, investors in mortgages could acquire a large quantity of loans and expect to receive interest and principal payments with little or no risk. Administrative problems regarding defaults, late payments, and so forth were usually handled for a fee by the servicer, making mortgage investments resemble those of a bond or fixed-income security. With funds acquired from sales of mortgages to institutional investors, originators (primarily mortgage companies) replenished funds with which they could originate new loans.

The Secondary Market after 1954

In 1954, Congress rechartered the **Federal National Mortgage Association (FNMA)**, now commonly known as Fannie Mae, assigning it three separate and distinct activities: (1) enhancement of secondary market operations in federally insured and guaranteed mortgages, (2) management of direct loans previously made and, where necessary, liquidation of properties and mortgages acquired by default, and (3) management of special-assistance programs, including support for subsidized mortgage loan programs. Each function was carried out as though it was operated as a separate corporation.

Throughout this and earlier periods, interest rates on FHA and VA mortgages were *regulated* by those agencies. Instead of deregulating interest rates on FHA and VA mortgages, Congress, in its attempt to keep mortgage interest rates as low as possible to would-be home

buyers, preferred to maintain a system under which FHA-VA interest rates would remain regulated. FNMA's role would be to raise capital by issuing debt when necessary to purchase mortgages, thereby replenishing capital to originators during periods of rising interest rates. It was thought that those mortgages would be sold at a gain when interest rates declined, thereby providing FNMA with funds to retire debt that was previously issued to acquire mortgages. FNMA was thus viewed as a vehicle that would provide liquidity to the home finance system when needed, and would assume the interest rate risk associated with its role as an intermediary between mortgage originators (primary originators of FHA and VA loans) and investors in its bonds. Ostensibly, over many periodic cycles of interest rate movements, it was hoped that FNMA would, on the average, earn a spread between interest earned on mortgages and interest paid on its bonds, while providing liquidity to the home finance system.[1]

FNMA's Changing Role

As market interest rates gradually increased and FHA-VA mortgage interest rates lagged, the spread referred to above became more problematic for FNMA to maintain. These influences prompted Congress to review the operations of FNMA and culminated in the Charter Act of 1954. Among the provisions in the act, however, was an additional provision that governmental participation in the operation of the principal secondary market facility should be gradually replaced by a private enterprise. The act included a procedure whereby FNMA would, over a period of time, be transformed into a privately owned and managed organization. By converting FNMA to a private operation rather than setting up a new one, FNMA's years of experience in the secondary market could be utilized during the transition period and eventually would concentrate the whole operation in private hands.

To provide a financial base to operate FNMA, the Charter Act also authorized issuance of nonvoting preferred and common stock for the financing of secondary market operations. The preferred stock was issued to the secretary of the treasury. Sellers of mortgages to FNMA were required to purchase FNMA stock as a condition of sale, which provided additional capital for operations and resulted in widespread ownership of FNMA. Additional funding for FNMA came from its issuance of notes and debt instruments. The act provided that, if necessary, the U.S. Treasury would be permitted to acquire up to $2.25 billion of these notes. This "backstop" was intended to provide assurance of liquidity to FNMA bond and note purchasers and a price support for such securities should FNMA's profitability or inability to issue more of these obligations ever come into question. It also provided FNMA with a distinct advantage when borrowing in capital markets to finance its activities. FNMA could now borrow at lower rates of interest than it otherwise could have in the absence of the Treasury backstop.

In 2008, due to concerns about FNMA's viability in light of the subprime mortgage crisis, the Federal Housing Finance Agency (FHFA) was appointed as conservator of FNMA, thus placing FNMA under federal government control (FHLMC was likewise placed under federal government control). Additionally, the U.S. Treasury agreed to provide up to $100 billion of capital as needed to ensure that FNMA continues to provide liquidity to the housing and mortgage markets. Given the continuing economic uncertainty, more changes to FNMA in the future would not be unexpected.

The Government National Mortgage Association

The **Government National Mortgage Association (GNMA)** was organized as part of the Housing and Urban Development Act of 1968 to perform three principal functions:

[1] Obviously, the risk of such a strategy is that the *net* cost of bonds and notes used to raise funds over periods of rising and falling interest rates could exceed the *net* interest income from mortgages held in a portfolio. This could occur if, over several cycles, net purchases of mortgages exceeded net sales.

(1) management and liquidation of mortgages previously acquired by FNMA—the liquidation of the portfolio acquired from FNMA at the time of its partition comes through regular principal repayments and sales; (2) special-assistance lending in support of certain federal subsidized housing programs; GNMA, also known as "Ginnie Mae," is authorized to guarantee mortgages that are originated under various housing programs designed by FHA, to provide housing in areas where it cannot be provided by conventional market lending; and (3) provision of a guarantee for FHA-VA mortgage pools, which would provide a timely payment of principal and interest guarantee for mortgage-backed securities. Its operations are financed through funds from the U.S. Treasury and from public borrowing.

Mortgage-Backed Securities and the GNMA Payment Guarantee

The guarantee program provided for in 1968 was one of the most significant provisions in the development of the secondary mortgage market as we know it today. Essentially, GNMA was empowered to guarantee the timely payment of principal and interest on securities backed or secured by pools of mortgages insured by the FHA and the Farmers Home Administration (FmHA) or guaranteed by the VA. One of the problems in the secondary mortgage market prior to this time was that even though FHA-insured mortgages could be purchased by investors who received monthly payments of principal and interest (less servicing fees), investors often experienced delays in payments when borrower defaults occurred. In these cases, servicers would have to make a claim for any payments in arrears plus remittance of the loan balance from FHA or the guarantee from VA. Settlement of these claims could be time consuming and required additional administrative effort on the part of investors.

Many investors in mortgage packages disliked this waiting period, which resulted in unpredictable cash flows and a reduction in investment yields. By providing the buyer with a guarantee of timely payment of interest and principal, GNMA was, in essence, guaranteeing monthly payments of interest and principal from amortization. The guarantee also included repayment of outstanding loan balances, should mortgages be prepaid before maturity or should borrowers default. GNMA would make timely payments to the security purchaser, and then take responsibility for settling accounts with the servicer. This would relieve investors from administrative problems and delays in receiving mortgage payments. For this guarantee, the buyer was charged a guarantee fee, which provided GNMA with operating funds to perform this function.

As a result of this GNMA guarantee program, a virtual explosion in the secondary market occurred. This guarantee enabled originators of FHA and VA mortgages to pool or package mortgages and to *issue securities,* called *pass-through securities,* which were collateralized by the mortgages and were based on the notion of investors buying an undivided security interest in a pool of mortgages with interest and principal passed through to investors as received from borrowers. These securities would be underwritten by investment banking firms and sold to investors in markets that were not reached prior to this innovation. Funds received by originators from the sales of pass-through securities would be used to originate new mortgages.

Investors were attracted to these securities because default risk on them was minimized as a result of either FHA insurance or a VA guarantee. Securities issued against such pools were viewed by investors as virtually riskless or very similar to an investment in a government security. With the added guarantee of timely payment of interest and principal by GNMA, these securities also took on the repayment characteristics of a bond, although repayment of the outstanding principal could occur at any time. Repayment could occur when a borrower defaulted, refinanced, or repaid the outstanding loan balance.[2]

[2] Repayment could also occur if a property was sold and the loan was not assumed by the buyer, or, in the event of a hazard (fire, etc.), if proceeds from hazard insurance were used to repay the mortgage rather than to reconstruct the improvement.

The Federal Home Loan Mortgage Corporation

By the early 1970s, the mortgage-backed securities market based on pools of FHA-insured and VA home mortgages was well established under the operation of FNMA and GNMA. However, no such secondary market existed for the resale of *conventional* loans originated by thrifts. These mortgages have historically accounted for the vast majority of residential loan originations. For example, conventional mortgage originations accounted for approximately 79 percent of total residential loans, while FHA and VA mortgages accounted for only 21 percent of the total. Thrifts originated the majority of conventional loans (58%), and mortgage companies originated the majority of FHA-VA mortgages (80%). Hence, finding a way to securitize conventional loans was very important if funds were to continue to flow to originators.

Periods of intermittent interest rate volatility, particularly during the mid- and late-1960s, was also causing liquidity problems that plagued thrifts.[3] This resulted in a reduction in the flow of funds to the conventional mortgage market and prompted Congress, under Title III of the Emergency Home Finance Act of 1970, to charter the **Federal Home Loan Mortgage Corporation (FHLMC)**, more commonly known as Freddie Mac. Its primary purpose was to provide a secondary market and, hence, liquidity for conventional mortgage originators just as Fannie Mae and Ginnie Mae did for originators of FHA-VA mortgages.

Initially, Freddie Mac was authorized to purchase and make commitments to purchase first lien, fixed rate conventional residential mortgage loans and participations. This bill also allowed Fannie Mae to purchase conventional mortgages, and Freddie Mac was given the authority to purchase FHA-VA loans as well. This provision would, in essence, allow both organizations to *compete* for all mortgage loans. However, the vast majority of Freddie Mac's business was, and continues to be, conventional mortgages, and FNMA continues to be the dominant purchaser of FHA-VA mortgages, although its acquisition of conventional loans now exceeds its FHA-VA acquisition volume.

Concerns about Freddie Mac's solvency in the midst of the subprime mortgage crisis of 2008 caused the federal government to assume control of Freddie Mac, just as it did with FNMA. The Federal Housing Finance Agency (FHFA) was appointed as conservator of Freddie Mac in September of 2008. Given the continuing economic uncertainty, more changes to Freddie Mac in the future would not be unexpected.

Operation of the Secondary Mortgage Market

To understand how the secondary mortgage market functions, remember that the primary function of this market is to provide a mechanism for replenishing funds used by mortgage originators. This, in turn, enables them to maintain a flow of new mortgage originations during periods of rising and falling interest rates. They may accomplish this by selling mortgages directly to Fannie Mae, Freddie Mac, or other private entities. Or they may form mortgage pools and issue various securities, thereby attracting funds from investors who may not otherwise make investments directly in mortgage loans. Hence, much like any corporation raising funds for doing business, the primary goal of mortgage originators in today's market is to replenish funds by reaching broader investor markets.

[3] Prior to the era of interest rate deregulation (on savings deposits), the small investor would deposit funds in a thrift or bank, which would in turn originate and retain the mortgage as an investment. During this period of regulated interest rates, savers withdrew deposits and began investing directly in financial securities. This change, as well as legislation allowing individuals to open individual retirement accounts (outside of savings institutions), forced thrifts to find a way to compete for funds that they once had been able to acquire by offering savings accounts.

Direct Sale Programs

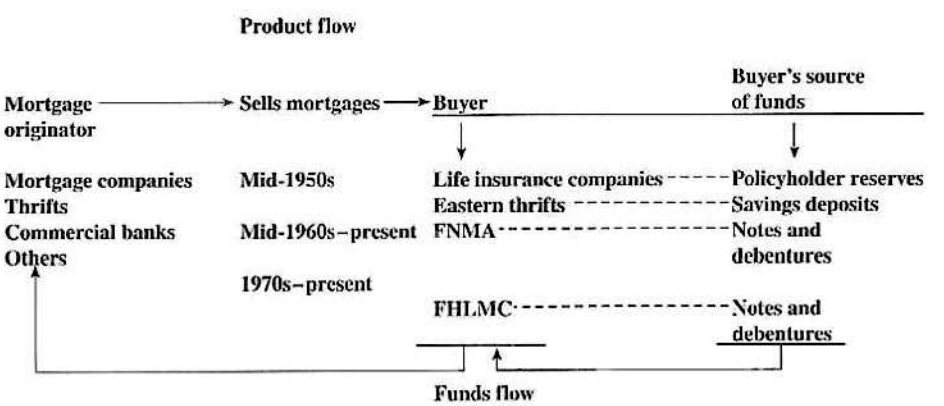
Exhibit 19–1 illustrates the direct sale approach used by mortgage originators to replenish funds. As previously indicated, prior to the mid-1950s, the secondary market was utilized by mortgage companies and some thrifts who originated FHA and VA mortgages, which were in turn sold to life insurance companies and some large eastern thrifts. These institutions utilized funds obtained from policyholder reserves and savings deposits, respectively, to acquire mortgage packages. This market changed during the mid-1950s as FNMA became the predominant purchaser of FHA-VA mortgages from mortgage bankers. The FHLMC entered the market by 1970, offering savings and loan associations the opportunity to sell conventional and FHA-VA mortgages.

FNMA's current commitment program is divided into two parts: mandatory and optional. Under the mandatory commitment option, Fannie Mae is obligated to purchase a certain amount of mortgages at a certain price at a certain time, and mortgage originators are *obligated* to deliver the mortgages. Originators pay a commitment fee to Fannie Mae for the privilege of selling mortgages under the commitment program. Under the optional delivery program, originators pay Fannie Mae a fee (the amount is higher than the corresponding commitment fee under the mandatory commitment program) for the *option* to deliver their mortgages to Fannie Mae. Under the mandatory commitment program, mortgage originators will benefit if market interest rates rise, but they could lose if market interest rates fall because they could have received a higher price elsewhere. On the other hand, the optional delivery commitment program gives the mortgage originator the "right but not the obligation" to sell the mortgages to Fannie Mae. Hence, if interest rates increase, originators can sell mortgages to Fannie Mae, but if rates fall, they retain the option to sell mortgages to another party for a better price (or even to renegotiate a price with Fannie Mae). With the advent of these commitment programs, mortgage originators were able to continue to shift most interest rate risk to Fannie Mae; however, this can now only be done for a fee. The program became so successful for Fannie Mae that Freddie Mac instituted a similar program in 1970.

The Development of Mortgage-Related Security Pools

As discussed previously, in addition to direct sales of mortgages from originators to investors, many large mortgage originators found that they could place mortgages in pools and sell securities of various types, using the mortgages in these pools as collateral. With the aid of investment bankers, large originators could issue securities in small denominations that would be purchased by many more investors. Firms with smaller mortgage origination volumes could continue to sell mortgages directly to FNMA and FHLMC, who in turn

EXHIBIT 19–1
Funds Flow Analysis (Direct Purchase Programs)



would create large pools of their own and issue securities. Creation of mortgage pools for securitization has clearly changed the previous pattern of thrifts *originating and holding* mortgages in their own portfolios and mortgage companies originating and selling mortgages directly to life insurance companies or large thrifts in regions where a surplus of savings existed. As we will see, many originators are no longer willing to take the interest rate risk associated with originating loans with funds obtained from deposits and have found a way, through securitization, to raise funds and shift interest rate risk to various classes of investors who are willing to take that risk.

Many types of mortgage-related securities have been developed in recent years. The number and types of securities are continuing to increase as mortgage originators, investment bankers, and the three federally related institutions discussed thus far (FNMA, FHLMC, and GNMA) continue to innovate and reach investor markets that provide the ultimate sources for many of the funds used in new mortgage originations. In this chapter and the next, we will deal in depth with the major types of mortgage-backed securities currently in use:

1. Mortgage-backed bonds (MBBs).
2. Mortgage pass-through securities (MPTs).
3. Mortgage pay-through bonds (MPTBs).
4. Collateralized mortgage obligations (CMOs).

Mortgage-Backed Bonds

One approach to mortgage securitization that has been used by private mortgage originators such as mortgage companies, commercial banks, and savings and loans to replenish funds for new originators has been to issue **mortgage-backed bonds (MBBs).** When issuing MBBs, the issuer establishes a pool of mortgages—this pool usually includes residential mortgages, but commercial mortgages and other mortgage-related securities may also be used—and issues bonds to investors. The issuer retains ownership of the mortgages, but they are pledged as security and are usually placed in trust with a third-party trustee. This trustee makes certain that the provisions of the bond issue are adhered to on behalf of the security owners. Like corporate bonds, MBBs are usually issued with fixed-coupon rates and specific maturities.

To assure investors that the income from mortgages will be sufficient to pay interest on the bonds and to repay principal on the maturity date, the issuer usually "overcollateralizes" the bond issue. This is done by placing mortgages in the pool with outstanding loan balances in excess of the dollar amount of the securities issued. Historically, issuers have pledged from 125 percent to 240 percent in mortgage collateral in excess of the par value of securities issued. This practice is followed because some borrowers may default or fall behind in payments on mortgage loans in the pool. In this case, the overcollateralization ensures that interest payments promised to security holders will continue even though some mortgages may be in default. Further, some loans may be prepaid either before the maturity date of the mortgage or before the bond maturity date. Because mortgage-backed bonds are issued for a specified number of years, overcollateralization ensures that, as mortgages are prepaid, others will still be in the pool to replace them. Another reason for overcollateralization is that bond issues usually provide that the trustee "mark all mortgage collateral to the market." This is done periodically to make sure that the market values of mortgages used for overcollateralization are maintained at the level agreed upon at the time of issue (e.g., 125% or 240%) or at other levels agreed upon throughout the life of the bond issue. Should the market value of the mortgages in trust fall below the agreed-upon level of

overcollateralization or be reduced because of an excessive number of defaults or prepayment on mortgages in the pool, the issuer must *replenish* the pool with additional mortgages of the same quality. If the issuer does not replenish or does not abide by the provisions of the security issue, the trustee may sell all collateral in the trust to protect the security owners.

Mortgage-backed bonds, like all mortgage-related securities, are usually underwritten by investment banking companies, given an investment rating by an independent bond-rating agency,[4] and sold through an underwriting syndicate.[5] The investment rating depends on (1) the quality of the mortgages in the underlying pool, which is a reflection of the types of mortgages and their loan-to-value ratios, and whether they are insured or guaranteed against default, either fully or partially; (2) the extent of geographic diversification in the mortgage security; (3) the interest rates on mortgages in the pool; (4) the likelihood that mortgages will be prepaid before maturity; (5) the extent of overcollateralization; and (6) in the case of commercial mortgages, the appraised value and debt coverage ratio.

Obviously, for mortgage pools containing FHA-VA mortgages or conventional mortgages with private mortgage insurance, the risk of default losses would be lower than if such mortgages were not insured or guaranteed. In some cases, however, the issuer may include some additional types of credit enhancement from a third party as additional security against default losses to bondholders. This enhancement could be a letter of credit from a bank, based on the issuer's credit standing and deposit requirements maintained at the bank issuing the letter, or some types of surety in the form of an insurance or other agreement negotiated with a creditworthy third party for a fee. When credit enhancements are used, the investor must also evaluate the ability of the third party to perform on the guarantee or to evaluate the terms and conditions of letters of credit when provided by the issuer or third parties. The quality of the enhancement will generally affect the amount of overcollateralization required or the coupon rate offered on the bonds.

In summary, the quality and types of mortgages in the pool are the primary determinants of whether the cash flows used to pay interest on the bonds and to eventually retire them will be adequate. These characteristics will affect the ability of the issuer to meet the requirements of the bond issue and, hence, affect the risk to investors. This risk will determine the yields required by investors on such bonds and, hence, the price that the issuer will receive for them. This pricing issue is considered next.

Pricing Mortgage-Backed Bonds

To illustrate how mortgage-backed bonds are priced by issuers when negotiating with underwriters, we assume that $200 million of MBBs will be issued against a $300 million pool of mortgages, in denominations of $10,000 for a period of 10 years. The bonds will carry a coupon, or interest rate, of 8 percent, payable annually,[6] based on the quality of the mortgage security in trust, the overcollateralization, and the creditworthiness of the issuer (and/or credit enhancement provided by the issuer). We assume that the securities receive a rating of Aaa or AAA.[7] To determine the *price* at which the security will be offered on the *date of issue*, we must discount the present value of the future interest payments and return of principal at the market rate of return demanded by investors (who will purchase them from underwriters). This rate is obviously a reflection of the riskiness of the bond relative to other securities and the yields on comparable securities in the marketplace.

[4] Such agencies might be Moody's or Standard & Poor's Corporation.

[5] Prominent underwriters of mortgage-related securities have included Lehman Brothers, Morgan Stanley, and Goldman Sachs & Co.

[6] Most bonds pay interest semiannually. We are simplifying the analysis here.

[7] This is the highest rating obtainable. An explanation of the meaning and determination of ratings can be obtained from Moody's or Standard & Poor's.

In our example, the price of the security is determined by finding the present value of a stream of $800 interest payments (made annually for 10 years, plus the return of $10,000 in principal at the end of the 10th year). Assuming that the issuer, in concert with the underwriters, agrees that the rate of return that will be required to sell the bonds is 9 percent, then the price will be established as follows:

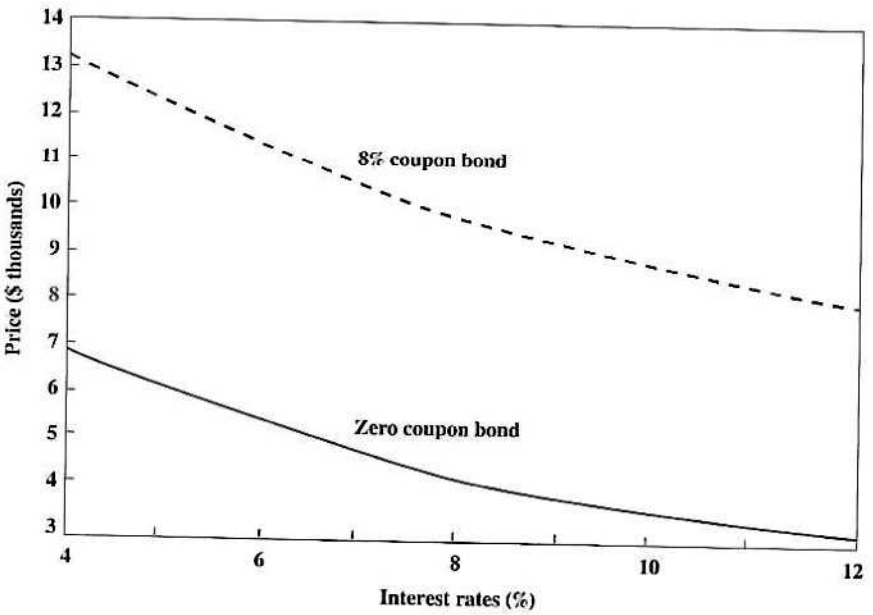
Solution:

$i = 9\%$
$n = 10$
$PMT = \$800$
$FV = \$10{,}000$
Solve for $PV = \$9{,}358$

Function:
PV (i, n, PMT, FV)

Hence, the bond would be priced at a discount of $642, or at 93.58 percent of par value ($10,000), resulting in a yield to maturity of 9 percent.[8] The issuer would receive $187,160,000 from the underwriter,[9] less an underwriting fee, in exchange for the securities. On the other hand, if the yield was deemed to be 7 percent, then the present value of the bonds would be $10,702 or they would sell at a premium of $702 and the issuer would receive $214,400,000. Hence, the price of the issue will depend on the relationship between the coupon rate on the bond and prevailing required rates of return. When market rates exceed the coupon rate, the price of the bond will be lower, and vice versa. Exhibit 19–2 shows the relationship between price and the market yield or rate of return at the time that the 8 percent MBB is issued. Note the inverse relationship between prices and demanded rates of return.

EXHIBIT 19–2
Prices for an 8 Percent Coupon versus a Zero Coupon MBB at Varying Interest Rates



[8] *Yield to maturity* is a term used by bond investors that is identical to the internal rate of return. It is calculated upon whether the coupon (interest) payments are made semiannually, quarterly, and so on.

[9] We assume that the underwriter makes a firm commitment to purchase the entire offering from the originator for an agreed-upon price. The underwriter then forms a syndicate with other underwriters, who then take the risk of reselling securities to the public and institutional investors through a network of securities dealers.

Subsequent Prices

The bonds referred to will be traded after they are issued, and although the prices at which they trade will no longer affect funds received by the issuer, these prices are important to investors as well as to issuers who plan to make additional security offerings. For example, if we assume that two years after issue the required rate of return is again 9 percent, then the bond price would be

Solution:	Function:
	PV (I, n, PMT, FV)
$I = 9\%$	
$n = 8$	
$PMT = \$800$	
$FV = \$10{,}000$	
Solve for $PV = \$9{,}447$	

Hence, we can see that the price of the security would now be 94.47 percent of par value. The discount is lower than at the time of issue because the remaining number of years to maturity is now 8 instead of 10. Alternatively, if the demanded return was 7 percent after two years, then the premium would be \$10,597, or a price 105.97 percent of par. Hence, the extent of premium and discount when the maturity period is 10 years is different from the pattern illustrated when the remaining maturity is 8 years. However, regardless of the remaining maturity period, when the market rate of return is 8 percent, or equal to the coupon rate, the security will always sell at par value. The student should verify this.

Zero Coupon Mortgage-Backed Bonds

In some cases, bonds issued against mortgages will carry zero coupons or will not pay any interest. These MBBs accrue interest until the principal amount is returned at maturity. To illustrate, we assume the bond in our previous example is to be issued with a zero coupon, but interest is to be accrued at 8 percent until maturity. At maturity, the *par value* of the security will be redeemed for \$10,000. If, however, at the time of issue, the rate of return demanded by investors in these securities is 8 percent, then the security will be *priced* as follows:

Solution:	Function:
	PV (I, n, PMT, FV)
$I = 8\%$	
$n = 10$	
$PMT = \$0$	
$FV = \$10{,}000$	
Solve for $PV = \$4{,}632$	

Based on this result, the security would be priced to sell at \$4,632, or 46.32 percent of par value at maturity (\$10,000). Should market rates of interest be 7.5 percent at the time of issue, the security would be priced at \$4,852, or 48.52 percent of par. Exhibit 19–2 also shows the relationship between prices and various market rates of return for a zero coupon MBB with a 10-year maturity period at the time of issue. When compared with the 8 percent coupon bond, the price sensitivity of a zero coupon bond, as a percentage of par value, is far greater than that of the more standard bonds that pay interest currently. For example, if the required return were 4 percent, the 8 percent interest-bearing coupon

bond would sell at 130 percent of par, while the zero coupon bond would sell at about 68 percent of par. The greater price sensitivity for zero coupon bonds relative to interest-bearing bonds occurs because all income is deferred until maturity with the zero coupon bond. Therefore, its present value will always be more sensitive to changes in interest rates than that of investments returning some cash flows during the investment period.

Marking the Mortgage Portfolio to Market

As mentioned previously, the trustee selected to oversee that the provisions of the bond issue are carried out must ascertain periodically whether the market value of the mortgages placed in trust is equal to the agreed-upon level of overcollateralization. The pricing techniques used by the trustee to establish the market value of the pledged mortgages are very complex because (1) there are generally many different interest rates on mortgages placed in trust, (2) those mortgages will be amortizing principal, (3) many of the mortgages in the pool may be prepaid because many of them may allow the borrower to repay the outstanding loan balance at any time, and (4) some borrowers may default on loans. These latter two factors would obviously reduce the amount and number of mortgages in the pool.

To make an estimate of the value of mortgages in the pool (referred to as *marking the mortgages to market*), the trustee must value each of the mortgages in the pool by first establishing the number and outstanding balance of each mortgage in trust. Estimates must then be made of the current market yield demanded by investors for each type of mortgage based on assumptions about the period that each mortgage is expected to be outstanding (not the contract maturity period, because most mortgages on single-family residential properties are prepaid as properties are sold, loans are refinanced, borrowers default, etc.).[10] Hence, the valuation of the underlying security is a more complex undertaking, particularly when the prepayment patterns are considered. Many of the techniques that must be considered in evaluating such securities are also important when valuing mortgage pass-through securities.

Mortgage Pass-Through Securities

In 1968, Ginnie Mae initiated the mortgage-backed guarantee program. This program represented an attempt to create a mortgage-backed investment capable of competing with corporate and government securities for investment funds. As previously pointed out, one of the most serious objections that had to be overcome with this type of security was the issue of safety. Because mortgage-related securities would represent loans made by many individual borrowers with different income and household characteristics, an investment vehicle had to be created whereby the collateral underlying the mortgage security could be easily understood and yet be comparable to other securities.

We know that mortgages are subject to default risk and interest rate risk. Although fixed interest rate mortgage securities, like corporate and government bonds, would also be subject to interest rate risk, default risk could be eliminated by FHA insurance or dramatically reduced with a VA guarantee. Another characteristic of concern to potential investors in mortgage-related securities was the predictability of the income stream. Substitute investments, such as noncallable bonds, have very predictable interest payment schedules. As pointed out previously, mortgage payments can be delayed because of a household's inability to keep payments current or because of default. To overcome this lack of timeliness in payments, Ginnie Mae guaranteed the full and timely payment of principal and interest. GNMA's position as guarantor was that of a surety, with securities carrying the

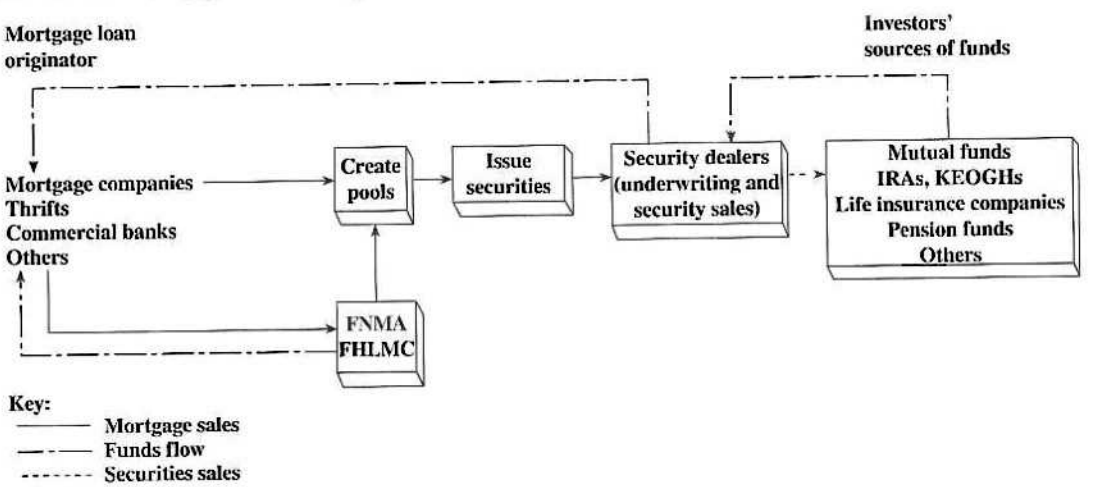
[10] Other methods of principal repayment may also be used, such as sinking fund retirements and call provisions. For a discussion, see any basic text dealing with investments.

GNMA guarantee having the full faith and credit of the U.S. government behind them. This full faith and credit guarantee meant that GNMA could borrow without limit from the Treasury. This unique guarantee made the GNMA security the most liquid of all secondary mortgage market securities.

Before the advent of the first mortgage-backed security, the pass-through, the only way an originator could sell a package of mortgage investments was to sell whole loans, which involved the transfer of ownership in addition to all of the investor concerns mentioned above. The mortgage pass-through overcame many of these problems. **Mortgage pass-through securities (MPTs)** are issued by a mortgage originator (e.g., mortgage company, thrift) and represent an undivided ownership interest in a pool of mortgages. The pool may consist of one or many mortgages. However, the usual minimum size of such a pool is $100 million, which could represent 1,000 or more residential mortgages. Each mortgage placed in the pool continues to be serviced by its originator or an approved servicer. A trustee is designated as the owner of the mortgages in the pool and ensures that all payments are made to individual security owners. Cash flows from the pool, which consist of principal and interest, less servicing and guarantee fees, are distributed to security holders. That is why the securities are called pass-throughs, because cash flows are "passed-through" to the investors by the mortgage servicer.

Exhibit 19–3 presents a flowchart showing how mortgage pass-through securities are originated and sold. Essentially, mortgages are originated by lenders and are pooled by them or sold to FNMA or FHLMC. If pooled by the originator, the originator will work with a securities underwriter to issue securities. These securities are then sold through security dealers to mutual funds, individuals with individual retirement accounts (IRAs), trust and pension fund administrators, life insurance companies, or even thrifts and commercial banks in geographic areas with a surplus of savings. This pattern of securitization enables originators of mortgages to ultimately reach the relatively small investor, who can now purchase an interest in a Ginnie Mae pass-through or another pass-through security by investing in a mutual fund or buying it directly.[11]

EXHIBIT 19–3 Mortgage Pass-Through Securities: Issuance and Funds Flow



[11] In addition to the pass-through process shown in Exhibit 19–3, there are a number of other programs related to this process that have evolved over time. These include the participation certificate (PC) program and the "swap" program, among others.

Important Characteristics of Mortgage Pools

Exhibit 19–4 provides information on the most important types of pass-through securities that have been used. Although all pass-through securities have the same underlying structure, some major differences between them should be pointed out. These differences are extremely important to issuers when creating mortgage pools and are equally important to investors when evaluating the possibility of investing in a mortgage pass-through security as opposed to a government bond, corporate bond, or another interest-bearing security.

Not all mortgage-backed securities are alike. When you are reviewing the characteristics listed in Exhibit 19–4, pay particular attention to how the market value of a pass-through security, which is backed by an underlying pool of mortgage loans made to borrowers, will respond to general changes in market interest rates. The change in market value of a particular security depends on the characteristics of the mortgages in the underlying pool, the response of borrowers to changes in interest rates, and the changes in borrower behavior in response to changes affecting their demand for housing, employment opportunities, and other influences. Borrowers may choose to refinance or repay their loans in response to changes in interest rates. As economic conditions change, they may sell their present house to buy another or to take a job transfer to another region. In these cases, they would very likely prepay their outstanding mortgages. These factors are extremely important to investors who must evaluate the timing of the receipt of cash flows when estimating value.

Security Issuers and Guarantors

The first security type listed in Exhibit 19–4 is referred to as a GNMA pass-through, which is usually issued by mortgage companies, thrifts, commercial banks, and other organizations that originate FHA and VA mortgages. The remaining two security types, participation certificates and mortgage-backed securities, are securities issued by FHLMC

EXHIBIT 19–4 Selected Characteristics of Mortgage Pass-Through Securities

Issuer	Mortgage companies, thrifts, others: GNMA pass-throughs	FHLMC: participation certificates	FNMA: mortgage-backed securities
Guarantor against default on mortgages	FHA,VA, FmHA	Private mortgage insurance, FHA/VA	FHA/VA, private mortgage insurance
Types of mortgages in pool* seconds	*FRM, GPM, MH, ARM*	*FRM, GPM, ARM, MF,* seconds	FRM, GPM, ARM, MF,
Interest rate on mortgages in underlying pools allowed to vary?	Yes	Yes	Yes
Seasoned mortgages allowed in pools?	Yes	Yes	Yes
Nature of payment guarantee	Timely payment of P & I and prepayments	Timely payment of P & I and eventual prepayments	Timely payment of P & I and prepayments
Guarantor	GNMA and credit of U.S. government	FHLMC only	FNMA only

*Key
FRM = 1–4 single-family, 30-year fixed rate mortgages.
GPM = Graduated payment mortgages.
ARM = Adjustable rate mortgages.
MH = Manufactured housing mortgages.
MF = Multifamily housing mortgages.
Seconds = Mortgage pools secured by second mortgages.

and FNMA, respectively. As previously mentioned, the latter two securities are backed by pools of mortgages that are purchased from originators by FHLMC and FNMA, which, in turn, provide a timely payment guarantee. In these cases, FNMA and FHLMC act as intermediaries, purchasing smaller quantities of mortgages from many originators, and then accumulating larger pools against which they issue securities.

Default Insurance

GNMA pass-through securities are backed with FHA-VA mortgages that carry either insurance or a guarantee against default losses. When it first began, this program was limited to FHA-VA pools because private mortgage default insurance on conventional mortgages was not generally available. Even today, with the availability of private mortgage insurance, major issuers of pass-through securities usually do not mix *both* FHA-VA and conventional mortgages in the same pool because of the greater depth of FHA default insurance coverage and the VA guarantee compared with conventional default coverage. As shown in Exhibit 19–4, GNMA pass-throughs still contain mortgages with FHA-VA backing, whereas FNMA and FHLMC pass-throughs may be based on separate pools of either FHA-VA backing or conventional mortgages. In their conventional mortgage-backed programs, both FNMA and FHLMC require conventional mortgages with loan-to-value ratios greater than 80 percent to carry private mortgage insurance.

Payment Patterns and Security for Mortgages in Pools

As Exhibit 19–4 indicates, most mortgage varieties may be individually pooled for a pass-through security issue. This is true for mortgages with adjustable payment patterns such as adjustable rate mortgages (ARMs); graduated payment mortgages (GPMs); mortgages secured by single family, multifamily, and mobile homes; and even second-lien mortgages. However, the vast majority of mortgages used in the pass-through security market are fixed interest rate loans secured by mortgages on single-family houses.

The rule about not mixing FHA-VA and conventional mortgages in the same pool generally applies to payment patterns and the nature of loan security and loan maturity. In other words, mortgage pools are usually grouped according to (1) payment patterns (e.g., ARMs), (2) maturity (e.g., second mortgages with 10-year terms), or (3) security (e.g., single-family homes, mobile homes). The reason this is done is that investors must be able to predict the cash flow pattern that they can expect to receive in a pass-through security with some confidence. If pools contained mortgages with many different payment patterns, investors would have a more difficult time assessing the likely cash flow pattern that they could expect to receive. The payment pattern of individuals making fixed interest rate loans may vary considerably from those making ARMs, second liens, and so on. As we will see in the material on pricing securities, expected prepayment patterns dramatically affect expected yields on mortgage securities. Hence, a general rule followed thus far has been to keep mortgage pools as homogeneous as possible so that their prepayment patterns are somewhat easier for investors to assess.

Coupon Rates, Interest Rates, and Number of Seasoned Mortgages in Pools

Pass-through securities issues guaranteed by Fannie Mae and Freddie Mac have allowed for a mixture of *interest rates* on mortgages included in a pool to enable a faster accumulation of larger pools for securitization. This pattern has been followed by security issuers, who believe that the variation in cash flows caused by mixing such mortgages is not large enough to offset the lower issuance costs on very large mortgage pools (i.e., economies of scale).

When Freddie Mac began its PC pass-through program, it allowed a variation of 200 basis points (from highest to lowest) in interest rates on mortgages packaged in the same pool. Fannie Mae allowed a 200-basis-point range with its first mortgage-backed security offering

in 1981. The GNMA pass-through programs provide that some pools contain mortgages with the same interest rate, while others allow a variation of 100 basis points on mortgages in the underlying pool. These ranges are subject to revision by the guarantors from time to time.[12]

The variation in interest rates on a mortgage pool may be very important for investors to consider, because in each case the *coupon rate* promised to investors purchasing securities is generally based on the *lowest* interest rate on *any* mortgage in the pool, less servicing and guarantee fees. This means that for two security issues bearing the same coupon rate, expected cash flows to investors in the pool containing mortgages with different rates will be less variable than cash flows to investors in the pool with the same interest rates. This occurs because each mortgage included in a pool with different interest rates will have a lower likelihood of prepayment than pooled mortgages with the same interest rate. This likelihood exists because mortgages with one interest rate are *all* more likely to be prepaid, should interest rates decline. This would obviously make the pattern of expected cash flows more variable.

Another important factor relating to the amount and timing of cash flows received by investors is the maturity distribution of mortgages and the extent to which "seasoned" mortgages are included in a pool. *Seasoning* is a term used to describe the age, or number of years, that a loan has been outstanding before it is placed in a pool. The scheduled maturity date for a pass-through security issue is generally the date on which the mortgage with the longest remaining maturity in the pool is scheduled to be repaid, assuming no prepayment. Each guarantor listed in Exhibit 19–4 places limitations on the number of seasoned mortgages allowed in a pool. Most GNMA-insured mortgage pools generally contain mortgages made within one year of pool formation. Fannie Mae and Freddie Mac generally allow for more variation in seasoning in pools that they guarantee. The concern over seasoning is important because the more seasoned a mortgage is, the greater the likelihood of prepayment. The likelihood that borrowers will sell houses, change job locations, and so on increases with the length of time the mortgage has been outstanding.

On the other hand, the risk of default is usually greatest in the early years of the life of a mortgage. Hence, seasoned mortgages tend to reduce the possibility of prepayment because of default. However, to the extent seasoning reduces or increases the likelihood of prepayment, more variation in cash flows results, which makes evaluation of the security more difficult for investors. This will, in turn, affect the price investors are willing to pay for the security.

Number of Mortgages and Geographic Distribution

Other factors relating to mortgages in the underlying pool that may affect the predictability and, hence, the variability of the monthly cash flows on pass-through securities are the *number* and *geographic* distribution of mortgages in the pool.

Both of these factors may be critical when estimating the yield on a pass-through security because they influence the expected repayment of principal. Generally, the larger the dollar amount of the pool issue, the more individual mortgages will be contained in the pool; and the larger the number of mortgages in the pool, all else being equal, the more predictable the monthly cash flow. This means that the likelihood of a major change in cash flows owing to default or prepayment of one or a few individual mortgages will not significantly affect future cash flows paid to investors. Most mortgage pools underlying pass-throughs are in minimum denominations of $100 million. If the average mortgage size is about $100,000, most pools of residential mortgages will contain at least 1,000 mortgages. This may be enough to assure investors that changes in cash flows caused by a small number of mortgages are minimal.

Geographic factors are important because they may affect the likelihood of prepayment and default. Certain regions of the country may be affected more by economic downturns

[12] The GNMA I pass-through program requires all mortgages in a pool to have the same interest rate.

and resulting unemployment than others and, hence, may have higher default rates. Prepayment rates, because of mobility by borrowers due to their age and family status, may be higher in some areas than others. A mortgage pool with more geographic diversity tends to insulate investors from cash flow irregularities.

Borrower Characteristics and Loan Prepayment

Perhaps more important than any of the other explicit pool characteristics discussed in conjunction with Exhibit 19–4 are borrower characteristics, or the socioeconomic makeup of individuals who have made the mortgage loans and are the ultimate source of cash flows for the mortgage pool. These characteristics are important because (1) households prepay existing mortgage loans as they adjust their consumption of housing over time in response to changes in income, family size, and tastes; (2) like other economic entities, households respond to changes in interest rates by refinancing their loans when interest rates fall and postponing adjustments in housing consumption when interest rates rise; and (3) households may default on loan obligations because of loss of employment, divorce, and so on, and although most pools have default insurance, the mortgage balance is prepaid upon default. Therefore, changes in borrower behavior with respect to these characteristics will affect the expected cash flows on loans and expected maturities. Indeed, depending on borrower behavior, the expected maturity of a loan may vary significantly, therefore affecting the expected yield on the mortgage. Unfortunately, not much information about borrower characteristics for individual loans in an underlying mortgage pool is made available to investors in pass-through securities. Hence, even though it is an important variable affecting cash flows on mortgage securities, no reliable source of information is generally available to investors.

Nuisance Calls

Where the prepayment rate reaches the point where a diminishing number and amount of mortgages remain in the pool, say about 10 percent of the initial pool amount, the servicer may call the remainder of the securities. This call is referred to as a *nuisance* or *cleanup call* and is used when the cost of servicing begins to become large relative to servicing income.

Mortgage Pass-Through Securities: A General Approach to Pricing

As we have seen, many things influence the pricing of a mortgage pass-through security (or any mortgage-backed security). We can summarize these influences as follows:

1. *Interest rate risk*—Reductions in market value due to an unanticipated rise in interest rates. This risk is generally greatest for pools containing fixed interest rate loans.
2. *Default risk*—Losses due to borrower default. For single-family loans, the likelihood of default losses is lowest for FHA-insured mortgages, slightly greater for VA-guaranteed mortgages, and generally greater for privately insured mortgages. This source of risk is also generally higher for ARMs and variable payment mortgages.
3. *Risk of delayed payment of principal and interest*—This source of risk can be evaluated in relation to the financial strength of the guarantor because the guarantee of *timely payment* is only as good as the ability of the guarantor to perform on the guarantee. GNMA is backed by the full faith and credit of the U.S. government, and presumably so are FNMA and FHLMC now that they are both under federal government control.
4. *Prepayment risk*—Loss in yield because of greater-than-anticipated loan repayments. In general, most mortgage loans are prepaid before the stated maturity date. Hence, when investing in a pass-through, an investor must estimate expected cash flows by including an assessment of the prepayment rate on loans in the underlying pools.

In the case of fixed interest rate mortgage pools, the impact of prepayment on cash flows passed through to investors will vary according to the:

a. Number of mortgages in the pool.
b. Distribution of interest rates on such mortgages.
c. Number of seasoned mortgages included in the pool.
d. Geographic location of borrowers.
e. Household (borrower) characteristics.
f. Unanticipated events (e.g., flood, earthquake).

Although the above sources of risk are important to issuers and investors, information available on mortgage pools is usually limited to very general borrower and mortgage characteristics. Information usually available on mortgage pools is discussed in the following sections.

Pass-Through Rates, Yields, and Servicing Fee

The pass-through rate is the coupon rate of interest promised by the issuer of a pass-through security to the investor. The yield to maturity, or internal rate of return, on such a security is equal to this rate only when it is issued at par value.

The coupon rate on pass-throughs is lower than the lowest rate of interest on any mortgage in the pool. The difference between the two rates is known as the *servicing fee.* The GNMA I, which allows no variance in interest rates in the underlying pool, has a total servicing fee of .5 percent, or 50 basis points below the interest rates on all mortgages in the pool. The servicing fee is divided between the guarantor fee and the loan services fee and is calculated as a percentage of the outstanding principal balance of the pool. As an example, GNMA takes .06 percent or 6 basis points of the outstanding principal balance of the pool as its fee for guarantee of timely payment of principal and interest, while the remaining 44 basis points of the servicing fee are retained by the servicer. For mortgage pass-through securities that allow a range of interest rates on mortgages in the pool (e.g., GNMA II), the coupon rate will be set lower than the lowest mortgage rate in the pool.

Weighted Average Coupon

The **weighted average coupon** (WAC) is a measure of the homogeneity of the coupon rates on mortgages in a pool. It is calculated as the average of the underlying mortgage interest rates weighted by the dollar balance of each mortgage as of the security issue date. WACs are meaningful only for pools that allow a variance in interest rates on mortgages. In most instances, the servicing and guarantee fee can be approximated as the difference between the WAC and the pass-through coupon rate.

Stated Maturity Date of Pool

The stated maturity date of the pass-through pool is the longest maturity date for any mortgage in the pool, assuming that no prepayments occur. For example, if 75 percent of the pool contained 15-year mortgages and the remaining 25 percent contained 20-year mortgages, the stated pool maturity would be 20 years. GNMA generally imposes more restrictions on the variance in mortgage maturities allowed in pools. FNMA and FHLMC pools may contain more seasoned loans with a wider range in stated maturity dates.

Weighted Average Maturity

Because the remaining term to stated maturity of mortgages in a pool may affect the prepayment rate of mortgages and, consequently, the yield of securities issued against the pool, the concept of a **weighted average maturity** was developed. The weighted-average

maturity is calculated as the average remaining term of the underlying mortgages as of the pass-through issue date, with the principal balance of the mortgage as the weighting factor.

Payment Delays by Servicer

Payment delay is the time lag between the time that the homeowners make their mortgage payments and the date that the servicing agent actually pays the investors holding the pass-through securities. This delay may range from 14 to 55 days. As with other securities, the timing of cash flows is important. Delays in payments received by investors obviously reduce yields.

Pool Factor

The **pool factor** is the outstanding principal balance divided by the original pool balance. This balance changes every month as mortgages are amortized and balances prepaid. The pool factor starts out as 1 and usually declines. (However, it may increase above 1 if the pool includes mortgages that allow negative amortization.) The pool factor is used to determine the current principal balance of the pool based on the outstanding balance of all mortgages remaining in the pool at any point in time. For example, if the pool factor is .9050 and the pool initially contained mortgages with $50,000 in balances outstanding, the current principal balance of the pool would be $50,000 × .9050 = $45,250. This factor is particularly important when securities are traded *after* the issue date, when subsequent buyers are considering how much to pay for a security. For example, as the pool factor becomes smaller, the remaining balances on mortgages in the pool are also becoming smaller; hence, the likelihood of prepayment becomes greater (holding all else constant).

Mortgage Pass-Through Payment Mechanics Illustrated

Exhibit 19–5 illustrates cash flow patterns that are important when evaluating mortgage pass-through securities. In this exhibit, it is assumed that $1 million of 10 percent fixed interest rate mortgages have been pooled as security for an issue of pass-through securities. The pass-through will carry a coupon, or pass-through, rate of 9.5 percent. The difference between the pooled mortgage rates and coupon rate, or .5 percent, is the servicing fee, which is assessed on the outstanding loan balances. To simplify the discussion, we have assumed that all mortgages in the pool have a maturity of 10 years and that mortgage payments, or cash flows and outflows in and out of the pool, occur annually.[13]

The cash flows passed through to individual security holders (column g) are based on annual mortgage payments for a 10 percent, 10-year mortgage on the initial pool balance of $1,000,000, resulting in total principal and interest payments generated by the pool (column c).[14] The servicing fee of .5 percent (column e) is then assessed on the outstanding loan balance at the end of each previous period and subtracted from total principal and interest payments. This results in actual payments to be made to all investors (column f). Because of the way servicing fees are calculated, payments passed through to investors (column f) are not the same from year to year, even though payments into the pool (column d) are level.[15] If no mortgages in the pool are prepaid (column e)—that is, all mortgages remain outstanding for their stated maturities—the principal balance in the pool will not reach zero until the end of the 10th year.

[13] For most pass-through issues, payments are made to investors monthly.

[14] Because all mortgages in the pool are 10 percent, 10-year loans, the constant payment in column (c) is computed as one annual payment on a $1,000,000 loan.

[15] If there are any prepayments (column c), this will also cause payments passed through to investors to vary from year to year.

EXHIBIT 19–5 **Cash Flows from Mortgage Pass-Through Security (Constant Payment, Fixed Rate, 10-Year Mortgage Pool, Interest Rate = 10%, Prepayment Assumed to Be 0%, Coupon Rate = 9.5%, Rounded)**

	(a)	(b)	(c)	(d)	(e)	(f)	(g)
End of Period	Pool Balance	P &I Payment	Principal Prepayment	Total Payments* (b) + (c)	Guarantee and Service Fees (0.5%)†	Total PMTs to Investors (b) – (e)	Payment to Individual Investor (f) ÷ 40
0	$1,000,000						$(25,000)
1	937,255	$162,745	$0	$162,745	$5,000	$157,745	3,944
2	868,235	162,745	0	$162,745	4,686	158,059	3,951
3	792,313	162,745	0	$162,745	4,341	158,404	3,960
4	708,799	162,745	0	$162,745	3,962	158,784	3,970
5	616,933	162,745	0	$162,745	3,544	159,201	3,980
6	515,881	162,745	0	$162,745	3,085	159,661	3,992
7	404,724	162,745	0	$162,745	2,579	160,166	4,004
8	282,451	162,745	0	$162,745	2,024	160,722	4,018
9	147,950	162,745	0	$162,745	1,412	161,333	4,033
10	0	162,745	0	$162,745	740	162,006	4,050

A.	
Value of cash flows to issuer if required rate is 9.50%	= $1,000,000
Value of cash flows to individual investors at 9.50	= $ 25,000
B.	
Value of cash flows to issuer if required rate is 8.50%	= $1,045,219
Value of cash flows to individual investors at 8.50	= $ 26,130
C.	
Value of cash flows to issuer if required rate is 10.50%	= $ 957,754
Value of cash flows to individual investors at 10.50	= $ 23,944

*Payments calculated on an annual basis.
†Based on pool balance at the end of the previous year.

The amount of cash that will be received by an issuer when this type of pool is formed and securitized depends on the prevailing market rate of return that investors demand on the investment. If it is assumed that, based on the pool characteristics discussed above, the market, or desired, rate of return is *equal* to the coupon rate (9.5%), then the amount to be received (paid) by the issuers (investors) will be $1 million (or 40 securities with a face value of $25,000 will be sold). This is based on the stream of annual cash flow payments in the exhibit, discounted at 9.5 percent. In this instance, the securities would be sold at par value, or $25,000 each.

It is rarely ever true, however, that the rate of return demanded by investors is *exactly* equal to the coupon rate on a security. As we know, market interest rates change continually; hence, it would only be coincidental that interest rates on mortgages originated at some previous time and placed in a pool would bear interest rates exactly equal to the market rate demanded by investors at the time the securities were issued. Inasmuch as the annual cash flows into the pool based on payments received by borrowers are known at the time of issue and passed through to investors, the price received by the issuer will depend on the present value of all payments received by investors, discounted at the prevailing market rate of return. As discussed earlier, the latter rate is determined by the real rate of interest, inflationary expectations, and a premium for the various sources of risk. It is also based on yields available on alternative investments. We shall see that the periods that mortgages are expected to remain outstanding is also very important in the determination of the prices that investors are willing to pay for pass-through securities.

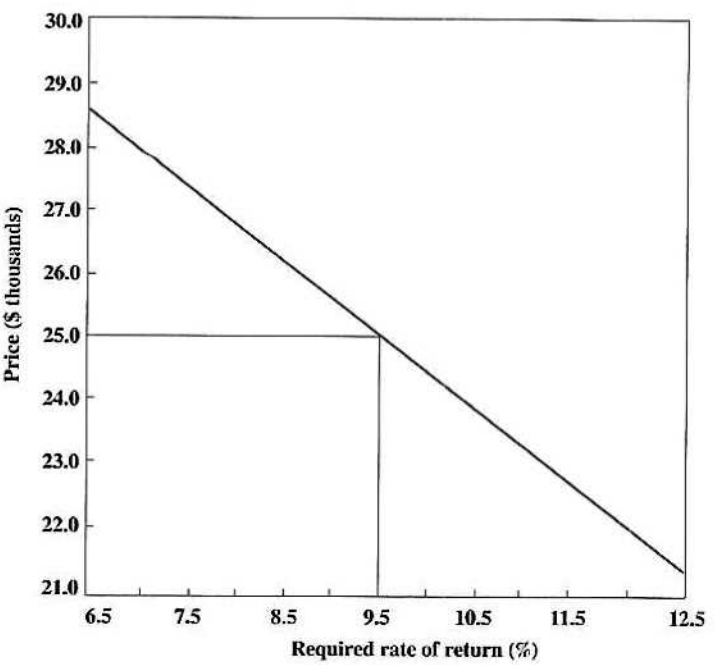
To illustrate the effect that market interest rates have on the price of pass-through securities, note that if the stream of cash flows paid to investors (column g) in Exhibit 19–5 is discounted at a market rate of 8.5 percent, the securities will sell at a premium or $26,130 (part B), the result of discounting payments in column (g) by 8.5 percent. If market rates were to rise to 10.50 percent at the time of issue, the security prices would reflect a *discount* of $23,944 (part C). Both of these calculations assume, however, that the expected maturity of the pass-through security is equal to the stated maturity of mortgages in the pool (10 years). Hence, the amortization of principal is assumed to occur over the full 10-year period; that is, no prepayment is assumed.

To provide some idea of the effect of the sensitivity of security prices to changes in market interest rates, Exhibit 19–6 shows the effect of rising and falling interest rates on the issue *price* of the mortgage pass-through securities in our example. (Keep in mind that the assumption regarding repayment of principal over the 10-year period remains the same.) Results show that for all rates of return desired by investors in excess of 9.5 percent, the pass-through is issued at a discount; when required rates decrease, the security is sold at a premium. Note that only when the required rate of return is *equal* to the promised coupon rate (9.5%) does the security sell at par value (an amount equal to the initial pool balance of $1,000,000, or $25,000 per security).

Prepayment Patterns and Security Prices

One problem that affects how securities are priced and is unique to the mortgage-backed securities market is the option that most borrowers have to prepay or repay the outstanding mortgage balance at any time.[16] This topic is important because when investors make

EXHIBIT 19–6
Relationship between Security Price and Required Rates of Return (Prepayment Rate Assumed to be 0%)



[16] There are some exceptions and additional facts that should be mentioned that affect mortgage prepayment. FHA and VA mortgages are assembled by buyers of properties. Hence, they are not always repaid when a property is sold. Conventional mortgages may contain a due-on-sale clause, which prohibits assumptions; hence, they would be more likely to be repaid if a property is sold. Some older conventional fixed interest rate mortgages may also contain prepayment penalties, which tend to discourage early repayment. Conventional mortgages made more recently and ARMs generally do not include such penalties.

comparisons between pass-throughs, corporate bonds, U.S. government bonds, and various state and local bond issues, the *expected* maturity period for pass-throughs is usually more difficult to estimate relative to the other investments. For example, when corporate bonds are issued, an *option to call* the outstanding principal is usually made explicit in the indenture agreement by specifying the price at which the bond may be called by the corporation each year that the bond issue is outstanding. Such options to call are usually included in the event that interest rates decline and the company wants to refinance the debt at a lower interest rate.[17]

As an alternative to call provisions, bond indentures issued by both corporations and state and local issuers may specify that a *scheduled* number of bonds will be called and retired in specific years after issue, regardless of what the current level of interest rates is at that time. This is not an option but a requirement of the indenture agreement.[18] The vast majority of U.S. government securities are issued for a stated maturity and are generally not callable. In other words, they are generally issued to run until maturity.[19]

The point is that other fixed interest rate securities are generally more predictable with respect to when repayment of principal can be expected. This is not true for mortgage pass-through securities. Hence, when comparing yields on pass-throughs with other securities, there is definitely some additional uncertainty regarding the rate of repayment of principal that investors must take into account.

Prepayment Assumptions

Because some prepayments by borrowers are likely to occur over time, as outstanding balances on mortgages contained in pools are repaid, proceeds are passed through to investors in pass-through securities. Pass-throughs of mortgage balances can be zero in months when interest rates increase and can accelerate rapidly when market interest rates decline. During the latter periods, many households choose to refinance. Mortgages are then paid off and removed from the pool as principal is passed through to investors.

When issuing pass-through securities, the issuer generally specifies both a coupon rate of interest (9.5% in our preceding example) *and* an offering price on the securities being issued. This offering price may be above or below par value. This specification is made because investors may demand a rate of return that is different from the coupon rate of 9.5 percent as market conditions vary at the time of issue. Even when no prepayments are assumed, the range in security prices may vary considerably, depending on the market rate of return demanded by investors (see Exhibit 19–6). However, because investors realize that there is also a strong likelihood that some prepayments will occur while they own these securities, issuers usually take into account some *assumed prepayment pattern* when pricing these securities. This is necessary to provide a more accurate estimate of cash flows (hence, yield to investors), rather than assuming that all borrowers will repay loans in accordance with a stated amortization schedule.

[17] To include this option in the agreement with investors, however, the issuer usually includes a schedule of premiums in excess of par value that will be paid to bondholders if the option to call is exercised by the corporation. This premium is paid because (1) the market value of the bonds will have increased if market rates have fallen and calling in the bond would deprive bondholders of an increase in market value and (2) if investors expect to own the bonds for the entire maturity period, refinancing by the company may represent an unanticipated interruption in cash flows, and bondholders would have to reinvest at lower interest rates.

[18] These retirements amount to an implicit method of amortization (e.g., a mortgage) and are usually accomplished with a sinking fund that is used (1) to call bonds as scheduled, by serial number at either a premium or par value, (2) to call a percentage of the original issue at random by serial number at either par value or a premium, or (3) to use sinking funds to enter the market and repurchase bonds at market value.

[19] A limited number of U.S. government bond issues are callable for a specified number of years prior to maturity.

Methods that issuers use to include prepayment assumptions when pricing securities fall into four broad classes:

1. *Average maturity.* This method assumes, for example, that a pool of 10-year mortgages is scheduled to amortize principal based on a 10-year maturity, but the pool is totally paid off after some average period of time, such as the fifth year. Hence, when calculating yields or pricing securities, issuers assume that regular mortgage payments will be made for five years, and the principal due at that time will amount to a balloon payment. This method has the advantage of simplicity because an average prepayment rate is chosen to represent all mortgages in the pool. Further, choosing an average maturity has the effect of facilitating comparison with traditional bonds.

The disadvantages of this technique far outweigh its advantages. There is considerable evidence that the so-called five-year-average-life convention is not an adequate method of handling the prepayment problem and will usually result in under- or overestimation of yield. As previously explained, prepayments are the product of numerous factors, including interest rate changes and household characteristics. Hence, using an average maturity may not reflect changes underlying these characteristics.

2. *Constant rates of prepayment.* This method of handling prepayment assumes that a constant percentage of the total mortgages in the pool will be paid off every year. The advantages of the **constant prepayment assumption** are that it is simple to understand and prepayments are easy to compute. However, empirical evidence suggests that prepayments due to defaults occur more frequently early in the life of most mortgages. Hence, most constant prepayment rates tend to understate prepayment in earlier years and overstate it in later years. While this method may be preferable to an average maturity, it is also not likely to reflect underlying pool characteristics.

3. *FHA prepayment experience.* Prepayment assumptions based on empirical evidence from actual prepayment experience collected by the FHA over several decades have been suggested as a guide for making more accurate prepayment assumptions. The FHA has developed an extensive database on mortgage terminations as a part of its insurance program. This database contains the total number of mortgage terminations during a single policy year, including information on the number resulting from defaults and repayments. Many argue that prepayment assumptions could be based on this FHA experience. For example, if slower or faster prepayment on pools of mortgages is expected because of differences in investor expectations, those rates could be adjusted to be less than 100 percent or greater than 100 percent of FHA experience, and yields could be disclosed to investors.

However, the FHA data on prepayment experience are not without shortcomings. Major problems are encountered when applying historic FHA experience to current mortgage pools because the precise causes of prepayment (e.g., changes in interest rates, borrowers' employment) over time are difficult to determine. There is no assurance that this pattern will repeat in the future; the FHA does not keep enough detailed data on each mortgage and borrower to enable a systematic investigation into the causes of prepayment behavior.

4. *The PSA prepayment model.* The **PSA prepayment model** was developed by the Public Securities Association to simplify the FHA prepayment experience model. Even though it suffers from the same shortcomings as the FHA prepayment experience model, it has become an industry standard for prepayment assumptions used by most issuers of mortgage-backed securities. Simply put, the model is based on monthly prepayment rates, which vary during the life of a mortgage pool underlying the security. At present, the standard PSA prepayment rate curve (referred to as *100% PSA*) begins at .2 percent per month for the first year, and then increases by .2 percent each month until month 30. It then remains at .5 percent per month, or 6 percent per year, for the remaining stated maturity

period of the pool. The model combines both FHA experience and the constant rate of repayment approach.

Because investors and issuers are aware that yields are likely to be affected by the rate of loan repayment, the PSA assumption is widely used to convey both price and yield information to investors at the time of issue. To provide prospective security buyers with additional information about the sensitivity of yields to different prepayment rates at the time of issue, a series of yield quotes based on various PSA repayment rates (e.g., 75% PSA, 150% PSA) are placed on the prospectus.

The Effects of Prepayment Illustrated

To illustrate the effects of prepayment on cash flows to investors in mortgage pass-through securities, a schedule of payments is shown in Exhibit 19–7. The rate of prepayment is assumed to be 10 percent each year based on the pool balance at the end of the preceding period. Payments in column (g) should be compared to those in Exhibit 19–5, which are based on a zero prepayment rate. However, in spite of these differences, when cash flows in column (g) of both exhibits are discounted at 9.5 percent, the present value in

EXHIBIT 19–7 **Cash Flows from Mortgage Pass-Through Security (Constant Payment, Fixed Rate, 10-Year Mortgage Pool, Interest Rate = 10%, Prepayment Assumed to Be 10%, Coupon Rate = 9.5%, Rounded)**

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End of Period	(a) Pool Balance	(b) P&I Payment	(c) Principal Prepayment	(d) Total Payments* (b) + (c)	(e) Guarantee and Service Fees (0.5%)†	(f) Total PMTs to Investors (b) − (e)	(g) Payment to Individual Investor (f) ÷ 40
0	$1,000,000						$(25,000)
1	837,255	$162,745	$100,000	$262,745	$5,000	$257,745	6,444
2	691,873	145,381	83,725	229,107	4,186	224,921	5,623
3	562,186	129,688	69,187	198,875	3,459	195,415	4,885
4	446,710	115,476	56,219	171,695	2,811	168,884	4,222
5	344,142	102,568	44,671	147,239	2,234	145,005	3,625
6	253,358	90,784	34,414	125,198	1,721	123,477	3,087
7	173,431	79,927	25,336	105,263	1,267	103,996	2,600
8	103,692	69,739	17,343	87,082	867	86,215	2,155
9	43,946	59,746	10,369	70,115	518	69,597	1,740
10	0	48,340	0	48,340	220	48,120	1,203
A.							
Value of cash flows to issuer if required rate is 9.50%				= $1,000,000			
Value of cash flows to individual investors at 9.50				= $ 25,000			
B.							
Value of cash flows to issuer if required rate is 8.50%				= $1,033,908			
Value of cash flows to individual investors at 8.50				= $ 25,848			
C.							
Value of cash flows to issuer if required rate is 10.50%				= $ 967,970			
Value of cash flows to individual investors at 10.50				= $ 24,199			

*Payments calculated on an annual basis.
†Based on pool balance at the end of the previous year.

both cases equals $1 million, or $25,000 per investor. This result occurs because even though the 10 percent prepayment assumption results in more cash flows early in the life of the pool, interest is still calculated at 9.5 percent on the outstanding balance at all times. Therefore, even though the investor is receiving *principal* on the pass-through faster, interest continues on the outstanding balance at 9.5 percent. Hence, the present value of both columns (g) in Exhibits 19–5 and 19–7, when discounted at 9.5 percent, equals $25,000.

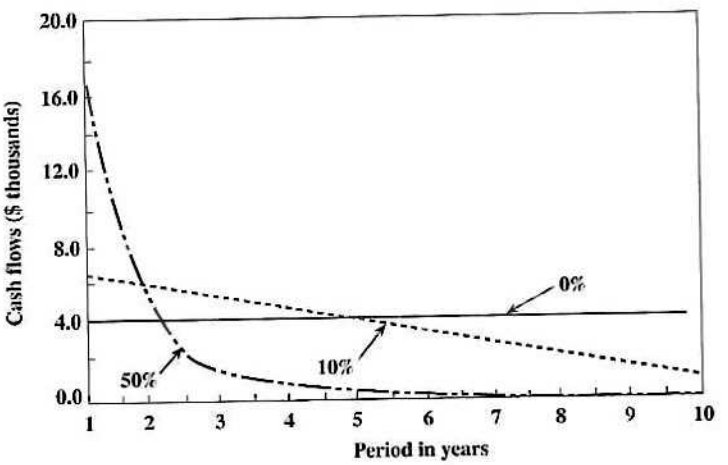
Exhibit 19–8 depicts cash flows from a pool assuming 0 percent, 10 percent, and 50 percent prepayment rates. Obviously, the cash flow to investors will vary dramatically, depending on the repayment rate. Also, as previously discussed, in the unlikely event that the market rate of return demanded by investors is equal to the coupon rate on the pass-through security, the security will always sell at par value, or $25,000, regardless of the prepayment rate. (Think about why this result is true.)

Security Prices and Expected Yields

As previously pointed out, when mortgage pass-through securities are priced by the issuer (with the advice of security underwriters), some assessment of yields expected by investors *at the time of issue* must be made. Further, this yield is likely to be different from the coupon rate on securities at the time of issue. This assessment is usually made by (1) establishing the extent of the premium that investors expect in excess of current yields on government securities with maturities in the same expected maturity range or (2) considering the current yields on other pass-throughs currently trading in the market. Establishing the premium may be difficult in the former case because of the uncertainty in repayment rates on pass-throughs. It may be difficult in the latter case because pricing of other pass-throughs assumes that the characteristics underlying both pools are the same. Nonetheless, the securities must be priced to sell to investors at the time of issue.

Let us turn back to our example. If we *assume* after considering all current market conditions and future expectations regarding repayment that the issuer decides that an expected yield of 8.5 percent will be required to successfully sell all securities to investors *and* that the prepayment rate will be 10 percent, then the security price will be equal to the present value of cash flows in column (g) of Exhibit 19–7 discounted at 8.5 percent. This yields a price of $25,848, or a premium of $848 over the $25,000 par value (see part B of Exhibit 19–7). The security is now said to be "priced at 103.39 percent of par ($25,848 ÷ $25,000) to yield 8.5 percent." However, the issuer will usually provide yield information to the investor by assuming *faster* and *slower prepayment rates*. This is accomplished by taking the offering price for the security ($25,848) and setting it equal to the

EXHIBIT 19–8
Mortgage Pass-Through Security Cash Flow Payments to Individual Investors at Various Prepayment Rates

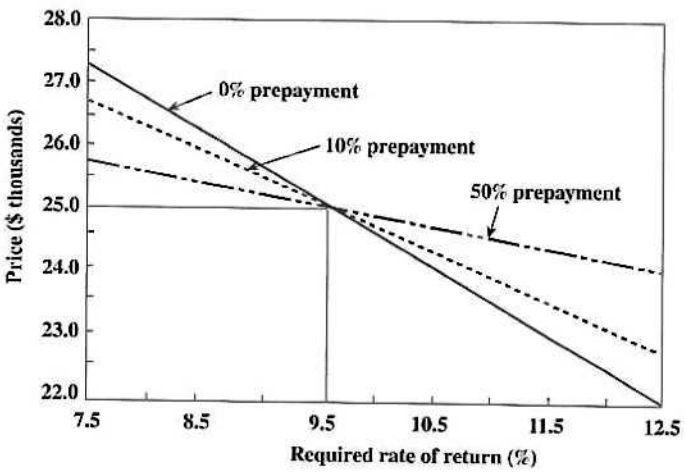


expected cash flows that would occur above and below 10 percent prepayment, and then solving for the internal rate of return. Faster (or slower) rates of prepayment will cause the yield to be lower (or higher) in this example. The investor is willing to pay a premium of $848 in this example because the coupon rate is higher than the investor's required yield. But because the mortgages in the pool are likely to be prepaid sooner than expected, the investor will not benefit from the higher coupon rate for very long because of the increase in prepayments. Hence, the premium must reflect not only the relationship between the coupon rate on the security and the market yield on similar investments demanded by investors, but also the expected rate of repayment by homeowners. On the other hand, if market yields indicated that at the time of issue the security should be priced to yield 10.5 percent at 10 percent prepayment, it would be issued at a discount, or at a price of $24,199 (see part C of Exhibit 19–7). In this case, mortgages are not likely to be prepaid so quickly by homeowners; hence, the expected rate of repayment decreases and the discount paid on the security must reflect this as well as coupon rates and market yields.

Market Interest Rates and Price Behavior on Mortgage Pass-Throughs

To illustrate the very important relationships between changes in interest rates and varying rates of prepayment, Exhibit 19–9 shows that if the market rate of interest were to fall to 7.5 percent, investors having a 9.5 percent coupon rate pass-through security would expect an *increase* in its *price* because of the decline in interest rates. Further, if there were no prepayment assumed (i.e., 0%), the price of the pass-through would increase from $25,000 to approximately $27,500. However, if interest rates decline and the prepayment rate accelerates because more borrowers choose to refinance or pay off loans, the price will not rise to the extent that it would have if no increase in prepayments occurred. This can be seen by comparing prices at extreme rates of repayment, such as prices at 0 percent PSA (no prepayment), with prices at 50 percent for interest rates less than 9.5 percent. Note that even if interest rates *decline,* if the prepayment rate accelerates to 50 percent, the price at a 7.5 percent demanded yield would now be only slightly in excess of $25,000 compared with about $27,500 assuming no prepayment. On the other hand, when market interest rates are *greater* than the coupon rate, prices of mortgage pass-throughs (MPTs) will fall, and by a greater amount as repayments slow. This can also be seen by comparing prices for interest rates greater than 9.5 percent at 0 percent and 50 percent. Hence, prices of mortgage pass-throughs (MPTs) are *inversely* related to interest rates; however, they are less sensitive to declines in interest rates and more sensitive to increases in interest rates because rates of repayment are likely to accelerate as interest rates fall and slow as

EXHIBIT 19–9
Mortgage Pass-Through Security Prices at Various Required Rates of Return and Prepayment Rates



Web App

Go to the Government National Mortgage Association (Ginnie Mae) Web site (www.ginniemae.gov). What has the average rate been on Ginnie Mae mortgage- backed securities in recent years?

interest rates rise. This asymmetry affects the duration of the investment and its convexity. **Convexity** is a measure of the sensitivity of duration to changes in interest rates. For example, because prepayments may decelerate with rising interest rates, MPTs usually exhibit negative convexity resulting from an increase in duration. This limit on premiums is referred to as **price compression**. Further, as interest rates decline and prepayments accelerate, all cash flows received by investors must be reinvested at lower interest rates. This prospect is perhaps the most serious problem that investors perceive when investing in mortgage pass-through securities. It is this problem, coupled with other factors, that has given rise to collateralized mortgage obligations (CMOs), one of the mortgage-related securities that we will cover in the next chapter.

A Note on MBBs and MPTs

We previously indicated that the trustee is required to periodically "mark the mortgage collateral to the market" to determine whether the overcollateralization requirements of bond issues are being maintained. The methodology just outlined for pricing MPTs is the methodology that a trustee would generally follow to establish the market value of the mortgage pool for an issue of mortgage-backed bonds (MBBs). Further, with MBBs, *issuers bear prepayment risk* by virtue of the overcollateralization requirement. In other words, as prepayments accelerate and mortgages are prepaid, more mortgages must be replaced in the pool. With MPTs, *security holders bear prepayment risk* because all prepayments are passed through to investors. This means that (1) MBBs should be priced to provide lower yields than MPTs because the MBB issuer bears prepayment risk and (2) as market interest rates change, the price of MBBs will not reflect accelerated prepayment rates. As shown in Exhibit 19–9, this is not the case for MPTs. If all other terms of the MPT offering described in our examples were exactly the same for an MBB offering, the price behavior for the MBB would be represented by the 0 percent curve.

Key Terms

constant prepayment assumption, *650*
convexity, *654*
Federal Home Loan Mortgage Corporation (FHLMC), *633*
Federal National Mortgage Association (FNMA), *630*
Government National Mortgage Association (GNMA), *631*
mortgage-backed bonds (MBBs), *635*
mortgage pass-through securities (MPTs), *640*
pool factor, *646*
price compression, *654*
PSA prepayment model, *650*
secondary mortgage market, *629*
weighted average coupon, *645*
weighted average maturity, *645*

Useful Websites

www.fanniemae.com—Fannie Mae/Federal National Mortgage Association (privately owned) provides information about becoming a homeowner.

www.ginniemae.gov—Ginnie Mae/Government National Mortgage Association is within HUD and ensures mortgage funds are available throughout the United States, especially in rural and urban areas where it is harder to borrow money. Ginnie Mae guarantees securities backed by pools.

www.hud.gov—U.S. Department of Housing and Urban Development.

www.fha.gov—Federal Housing Administration.

www.freddiemac.com—Federal Home Loan Mortgage Corporation.

www.va.gov—Veteran's Administration. See www.homeloans.va.gov for information on VA guaranteed loans.

Questions

1. What is the secondary mortgage market? List three reasons why it is important.
2. What were the three principal activities of FNMA under its 1954 charter? What is its principal function now?
3. Name two ways that FNMA currently finances its secondary mortgage operations.
4. When did GNMA come into existence? What was its original function? What is its main function now?
5. Why was the formation of FHLMC so important?
6. What is a mortgage-related security? What are the similarities and differences between mortgage securities and corporate bonds?
7. Name the principal types of mortgage-related securities. What are the differences between them?
8. There are several ways that mortgages can be sold in the secondary market. Choose two and compare and contrast their length of distribution channel, relative ease of transaction, and efficiency as they relate to maximizing funds flow from sale.
9. What is the function of the optional delivery commitment?
10. What is a mortgage swap certificate?
11. Name five important characteristics of mortgage pools. Tell why each is important.
12. In general, would a falling rate of market interest cause the price of an MPT security to increase or decrease? Would the increase or decrease be greater if the security was issued at a discount? Would an increase in prepayment be likely or unlikely? Describe with an example.

Problems

1. Two 25-year maturity mortgage-backed bonds are issued. The first bond has a par value of $10,000 and promises to pay a 10.5 percent annual coupon, while the second is a zero coupon bond that promises to pay $10,000 (par) after 25 years, with interest accruing at 10 percent. At issue, bond market investors require a 12 percent interest rate on both bonds.
   a. What is the initial price on each bond?
   b. Now assume that both bonds promise interest at 10.5 percent, compounded semiannually. What will be the initial price for each bond?
   c. If market interest rates fall to 9.5 percent at the end of the fifth year, what will be the value of each bond, assuming annual payments as in (*a*) (state both as a percentage of par value and actual dollar value)?
2. The Green Mortgage Company has originated a pool containing 75 ten-year fixed interest rate mortgages with an average balance of $100,000 each. All mortgages in the pool carry a coupon of 12 percent. (For simplicity, assume that all mortgage payments are made *annually* at 12% interest.) Green would now like to sell the pool to FNMA.
   a. Assuming a constant annual prepayment rate of 10 percent (for simplicity, assume that prepayments are based on the pool balance at the end of each year), what will be the price that Green should obtain on the date of issuance if market interest rates were (1) 11 percent? (2) 12 percent? (3) 9 percent?
   b. Assume that five years have passed since the date in (*a*). What will the pool factor be? If market interest rates are 12 percent, what price can Green obtain then?
   c. Instead of selling the pool of mortgages in (*a*), Green decides to securitize the mortgages by issuing 100 pass-through securities. The coupon rate will be 11.5 percent and the servicing and guarantee fee will be .5 percent. However, the current market rate of return is now

10.5 percent. How much will Green obtain for this offering of MPTs? What will each purchaser pay for an MPT security, assuming the same prepayment rate as in (*a*)?

d. Assume now that immediately after purchase in (*c*), interest rates fall to 9 percent and that the prepayment rates are expected to accelerate to 20 percent per year, beginning at the end of the first year. What will the MPT security be worth now?

3. **Excel.** Refer to the "Ch19 MPS" tab in the Excel Workbook provided on the website.

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a. Find the value of the cash flows to the issuer and to individual investors based on a required rate of return of 7.5 percent.

b. Find the value of the cash flows to the issuer and to individual investors based on a required rate of return of 11.5 percent.