

The Residential Mortgage Market

LEARNING OBJECTIVES

After reading this chapter, you will understand

- what a mortgage is
- who the major originators of residential mortgages are
- the mortgage origination process
- the borrower and property characteristics considered by a lender in evaluating the credit risk of an applicant for a mortgage loan
- the risks associated with the origination process for residential mortgage loans
- what the servicing of a residential mortgage loan involves
- the types of residential mortgage loans based on lien status, credit classification, interest-rate type, amortization type, credit guarantees, loan balances, and prepayments and prepayment penalties
- what a prepayment is
- the cash flow of a mortgage loan
- what a prepayment penalty mortgage is
- risks associated with investing in mortgages
- the significance of prepayment risk

The mortgage market is a collection of markets, which includes a primary (or origination) market and a secondary market where mortgages trade. A mortgage is a pledge of property to secure payment of a debt. Typically, property refers to real estate. If the property owner (the mortgagor) fails to pay the lender (the mortgagee), the lender has the right to foreclose

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the loan and seize the property in order to ensure that it is repaid. The types of real estate properties that can be mortgaged are divided into two broad categories: single-family (one- to four-family) residential and commercial properties. The former category includes houses, condominiums, cooperatives, and apartments. Commercial properties are income-producing properties: multifamily properties (i.e., apartment buildings), office buildings, industrial properties (including warehouses), shopping centers, hotels, and health care facilities (e.g., senior housing care facilities).

Our focus in this chapter is on residential mortgage loans.

ORIGINATION OF RESIDENTIAL MORTGAGE LOANS

The original lender is called the **mortgage originator**. The principal originators of residential mortgage loans are thrifts, commercial banks, and mortgage bankers.

Mortgage originators may generate income from mortgage activity in one or more ways. First, they typically charge an **origination fee**. This fee is expressed in terms of points, where each point represents 1% of the borrowed funds. For example, an origination fee of two points on a $200,000 mortgage loan is $4,000. Originators also may charge application fees and certain processing fees. The second source of revenue is the profit that might be generated from selling a mortgage at a higher price than it originally cost. This profit is called **secondary market profit**. If mortgage rates rise, an originator will realize a loss when the mortgages are sold in the secondary market.

Although the sources of revenue attributable to the origination function are technically origination fees and secondary marketing profits, there are two other potential sources. First, mortgage originators may service the mortgages they originate, for which they obtain a **servicing fee**. Servicing of the mortgage involves collecting monthly payments from mortgagors and forwarding proceeds to owners of the loan, sending payment notices to mortgagors, reminding mortgagors when payments are overdue, maintaining records of mortgage balances, furnishing tax information to mortgagors, administering an escrow account for real estate taxes and insurance purposes, and, if necessary, initiating foreclosure proceedings. The servicing fee is a fixed percentage of the outstanding mortgage balance, typically 25 basis points to 100 basis points per year. The mortgage originator may sell the servicing of the mortgage to another party, who would then receive the servicing fee. Second, the mortgage originator may hold the mortgage in its investment portfolio.

Mortgage banking refers to the activity of originating mortgages. Banks and thrifts undertake mortgage banking. However, there are companies not associated with a bank or thrift that are involved in mortgage banking. These mortgage bankers, unlike banks and thrifts, typically do not invest in the mortgages that they originate. Instead, they derive their income from the origination fees. Commercial banks derive their income from all three sources.

The Mortgage Origination Process

Someone who wants to borrow funds to purchase a home will apply for a loan from a mortgage originator. Most mortgage loans are originated with a 30-year original term, although some borrowers prefer shorter maturities such 20, 15, or 10 years. The potential homeowner completes an application form, which provides financial information about the applicant, and pays an application fee; then the mortgage originator performs a credit evaluation of the applicant. The requirements specified by the originator in order to grant the loan are referred to as **underwriting standards.**

The two primary quantitative underwriting standards are (1) the **payment-to-income ratio (PTI),** and (2) the **loan-to-value ratio (LTV).** The first is the ratio of monthly payments to monthly income, which measures the ability of the applicant to make monthly payments (both mortgage and real estate tax payments). The lower this ratio, the greater the likelihood that the applicant will be able to meet the required payments.

The difference between the purchase price of the property and the amount borrowed is the borrower's down payment. The LTV is the ratio of the amount of the loan to the market (or appraised) value of the property. The lower this ratio, the greater the protection for the lender if the applicant defaults on the payments and the lender must repossess and sell the property. For example, if an applicant wants to borrow $225,000 on property with an appraised value of $300,000, the LTV is 75%. Suppose the applicant subsequently defaults on the mortgage. The lender can then repossess the property and sell it to recover the amount owed. But the amount that will be received by the lender depends on the market value of the property. In our example, even if conditions in the housing market are weak, the lender will still be able to recover the proceeds lent, if the value of the property declines by $75,000. Suppose, instead, that the applicant wanted to borrow $270,000 for the same property. The LTV would then be 90%. If the lender had to foreclose on the property and then sell it because the applicant defaults, there is less protection for the lender.

If the lender decides to lend the funds, it sends a **commitment letter** to the applicant. This letter commits the lender to provide funds to the applicant. The length of time of the commitment varies between 30 and 60 days. At the time of the commitment letter, the lender will require that the applicant pay a commitment fee. It is important to understand that the commitment letter obligates the lender—not the applicant—to perform. The commitment fee that the applicant pays is lost if the applicant decides not to purchase the property or uses an alternative source of funds to purchase the property. Thus, the commitment letter states that, for a fee, the applicant has the right but not the obligation to require the lender to provide funds at a certain interest rate and on certain terms.

At the time the application is submitted, the mortgage originator will give the applicant a choice among various types of mortgages. Basically, the choice is between a fixed-rate mortgage, an adjustable-rate mortgage, or some type of "hybrid" mortgage. In the case of a fixed-rate mortgage, the lender typically gives the applicant a choice as to when the interest rate on the mortgage will be determined. The three choices may be (1) at the time the loan application is submitted, (2) at the time a commitment letter is issued to the borrower, or (3) at the closing date (the date that the property is purchased).

These choices granted the applicant—the right to decide whether or not to close on the property and the right to select when to set the interest rate—expose the mortgage originator to certain risks, against which the originator will protect itself.

Mortgage originators can either (1) hold the mortgage in their portfolio, (2) sell the mortgage to an investor that wishes to hold the mortgage in its portfolio or that will place the mortgage in a pool of mortgages to be used as collateral for the issuance of a security, or (3) use the mortgage themselves as collateral for the issuance of a security. When a mortgage is used as collateral for the issuance of a security, the mortgage is said to be securitized. In the next chapter, we will discuss the securitization of residential mortgage loans.

When a mortgage originator intends to sell the mortgage, it will obtain a commitment from the potential investor (buyer). Two government-sponsored enterprises (GSEs) and several private companies buy mortgages. Because these entities pool these mortgages and sell them to investors, they are called conduits. We will discuss conduits in the next chapter.

The interest rate that the originator will set on the loan, referred to as the note rate, will depend on the interest rate required by the investor who plans to purchase the mortgage. At any time, there are different mortgage rates for delivery at different future times (30 days, 60 days, or 90 days).

The Risks Associated with Mortgage Origination

The loan applications being processed and the commitments made by a mortgage originator together are called its pipeline. Pipeline risk refers to the risks associated with originating mortgages. This risk has two components: price risk and fallout risk.

Price risk refers to the adverse effects on the value of the pipeline if mortgage rates in the market rise. If mortgage rates rise, and the mortgage originator has made commitments at a lower mortgage rate, it will either have to sell the mortgages when they close at a value below the funds lent to homeowners, or retain the mortgages as a portfolio investment earning a below-market mortgage rate. The mortgage originator faces the same risk for mortgage applications in the pipeline where the applicant has elected to fix the rate at the time the application is submitted.

Fallout risk is the risk that applicants or those who were issued commitment letters will not close (i.e., complete the transaction by purchasing the property with funds borrowed from the mortgage originator). A major reason that potential borrowers may cancel their commitment or withdraw their mortgage application is that mortgage rates have declined sufficiently so that it is economic to seek an alternative lender. Fallout risk is the result of the mortgage originator giving the potential borrower the right but not the obligation to close (that is, the right to cancel the agreement). There are reasons other than a decline in mortgage rates that may cause a potential borrower to fall out of the pipeline. There may be an unfavorable property inspection report, or the purchase could have been predicated on a change in employment that does not occur.

Mortgage originators have several alternatives to protect themselves against pipeline risk. To protect against price risk, the originator could get a commitment from the GSE or the private conduit to whom the mortgage originator plans to sell the mortgage. This sort of commitment is effectively a forward contract. The mortgage originator agrees to deliver a mortgage at a future date, and another party (either one of the GSEs or a private conduit) agrees to buy the mortgage at that time at a predetermined price (or mortgage rate).

Consider what happens, however, if mortgage rates decline and potential borrowers elect to cancel the agreement. The mortgage originator has agreed to deliver a mortgage with a specified mortgage rate. If the potential borrower does not close and the mortgage originator has made a commitment to deliver the mortgage to a GSE or private conduit, the

mortgage originator cannot back out of the transaction. As a result, the mortgage originator will realize a loss—it must deliver a mortgage at a higher mortgage rate in a lower mortgage rate environment. This is fallout risk.

Mortgage originators can protect themselves against fallout risk by entering into an agreement with a GSE or private conduit for optional rather than mandatory delivery of the mortgage. In such an agreement, the mortgage originator is effectively buying an option that gives it the right, but not the obligation, to deliver a mortgage. The agency or private conduit has sold that option to the mortgage originator and, therefore, charges a fee for allowing optional delivery.

Mortgage Servicers

Every mortgage loan must be serviced. As explained earlier, servicing of a mortgage loan involves collecting monthly payments and forwarding proceeds to owners of the loan, sending payment notices to mortgagors, reminding mortgagors when payments are overdue, maintaining records of principal balances, administering an escrow balance for real estate taxes and insurance purposes, initiating foreclosure proceedings if necessary, and furnishing tax information to mortgagors when applicable.

Mortgage servicers include bank-related entities, thrift-related entities, and mortgage bankers. There are five sources of revenue from mortgage servicing. The primary source is the servicing fee. This fee is a fixed percentage of the outstanding mortgage balance. Consequently, the revenue from servicing declines over time as the mortgage balance amortizes. The second source of servicing income arises from the interest that can be earned by the servicer from the escrow balance that the borrower often maintains with the servicer. The third source of revenue is the float earned on the monthly mortgage payment. This opportunity arises because of the delay permitted between the time the servicer receives the payment and the time that the payment must be sent to the investor. Fourth, there are three potential sources of ancillary income: (1) a late fee charged by the servicer if the payment is not made on time, (2) commissions from cross-selling their borrowers' life and other insurance products, and (3) fees generated from selling mailing lists. Finally, there are other benefits of servicing rights for servicers who are also lenders. Their portfolio of borrowers is a potential source for other loans, such as second mortgages, automobile loans, and credit cards.

Key Points That You Should Understand Before Proceeding

1. The mortgage originator is the original lender of mortgage funds, and the activity of originating mortgages is called mortgage banking.
2. The principal originators of residential mortgage loans are thrifts, commercial banks, and mortgage bankers.
3. Mortgage originators may generate income from origination fees, secondary market profit, servicing fees, and investment income from holding the mortgages.
4. The two primary factors in determining whether funds will be lent to a mortgage loan applicant are the PTI and LTV.
5. Two GSEs and several private companies buy mortgages for purposes of pooling them and selling them to investors.
6. Pipeline risk is the risk associated with mortgage origination; it is made up of price risk and fallout risk.

TYPES OF RESIDENTIAL MORTGAGE LOANS

There are different types of residential mortgage loans. They can be classified according to the following attributes:

- lien status
- credit classification
- interest rate type
- amortization type
- credit guarantees
- loan balances
- prepayments and prepayment penalties[1]

Lien Status

The **lien status** of a mortgage loan indicates the loan's seniority in the event of the forced liquidation of the property due to default by the obligor. For a mortgage loan that is a **first lien**, the lender would have first call on the proceeds of the liquidation of the property if it were to be repossessed. A mortgage loan could also be a **second lien** or **junior lien**, and the claims of the lender on the proceeds in the case of liquidation come after the holders of the first lien are paid in full.

Credit Classification

A loan that is originated where the borrower is viewed to have a high credit quality (i.e., where the borrower has strong employment and credit histories, income sufficient to pay the loan obligation without compromising the borrower's creditworthiness, and substantial equity in the underlying property) is classified as a **prime loan**. A loan originated where the borrow is of lower credit quality is classified as a **subprime loan**. Between the prime and subprime sector is a somewhat nebulous category referred to as an **alternative-A loan** or, more commonly, **alt-A loan**. These loans are considered to be prime loans (the "A" refers to the A grade assigned by underwriting systems), but they have some attributes that either increase their perceived credit riskiness or cause them to be difficult to categorize and evaluate.

In assessing the credit quality of a mortgage applicant, lenders look at various measures. The starting point is the applicant's *credit score*. Several firms collect data on the payment histories of individuals from lending institutions and, using statistical models, evaluate and quantify individual creditworthiness in terms of a credit score. Basically, a credit score is a numerical grade of the credit history of the borrower. The three most popular credit reporting companies that compute credit scores are Experian, Transunion, and Equifax. Although the credit scores have different underlying methodologies, the scores generically are referred to as **FICO scores**.[2] Typically, a lender will obtain more than one score in order to minimize the impact of variations in credit scores across providers. FICO scores range from 350 to 850. The higher the FICO score, the lower the credit risk.

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[1] See Frank J. Fabozzi, Anand K. Bhattacharya, and William S. Berliner, *Mortgage-Backed Securities: Products, Structuring, and Analytical Techniques* (Hoboken, NJ: John Wiley & Sons, 2007).

[2] This is because credit scoring companies generally use a model developed by Fair, Isaacs & Company. The model uses 45 criteria to rank the creditworthiness of an individual.

The LTV has proven to be a good predictor of default: the higher the LTV, the greater the likelihood of default. By definition, the LTV of the loan in a purchase transaction is a function of both the down payment and the purchase price of the property. However, borrowers refinance their loans when rates decline. When a lender is evaluating an application from a borrower who is refinancing, the LTV is dependent upon the requested amount of the new loan and the market value of the property as determined by an appraisal. When the loan amount requested exceeds the original loan amount, the transaction is referred to as a **cash-out refinancing**. If, instead, the loan balance remains unchanged, the transaction is said to be a **rate-and-term refinancing** or **no-cash refinancing**. That is, the purpose of the loan is refinancing, to either obtain a better note rate or change the term of the loan.

Lenders calculate income ratios such as the PTI to assess the applicant's ability to pay. These ratios compare the monthly payment that the applicant would have to pay if the loan is granted to the applicant's monthly income. The most common measures are the front ratio and the back ratio. The **front ratio** is computed by dividing the total monthly payments (which includes interest and principal on the loan plus property taxes and homeowner insurance) by the applicant's pretax monthly income. The **back ratio** is computed in a similar manner. The modification is that it adds other debt payments such as auto loan and credit card payments to the total payments. In order for a loan to be classified as "prime," the front and back ratios should be no more than 28% and 36%, respectively.

The credit score is the primary attribute used to characterize loans as either prime or subprime. Prime (or A grade) loans generally have FICO scores of 660 or higher, front and back ratios with the above-noted maximum of 28% and 36%, and LTVs less than 95%. Alt-A loans may vary in a number of important ways. While subprime loans typically have FICO scores below 660, the loan programs and grades are highly lender-specific. One lender might consider a loan with a 620 FICO score to be a "B rated loan," while another lender would grade the same loan higher or lower, especially if the other attributes of the loan (such as the LTV) are higher or lower than average levels.

Interest Rate Type

The note rate on a mortgage loan, the interest rate that the borrower agrees to pay, can be fixed or change over the life of the loan. For a **fixed-rate mortgage (FRM)**, the interest rate is set at the closing of the loan and remains unchanged over the life of the loan.

For an **adjustable-rate mortgage (ARM)**, as the name implies, the note rate changes over the life of the loan. The note rate is based on both the movement of an underlying rate called the **index** or **reference rate**, and a spread over the index called the **margin**. Two categories of reference rates have been used in ARMs: (1) market-determined rates, and (2) calculated rates based on the cost of funds for thrifts. Market-determined rates include the London Interbank Offered Rate (LIBOR), the one-year Constant Maturity Treasury (CMT), and the 12-month Moving Treasury Average (MTA), a rate calculated from monthly averages of the one-year CMT. The two most popular calculated rates are the Eleventh Federal Home Loan Bank Board District Cost of Funds Index (COFI) and the National Cost of Funds Index. Depository institutions prefer to hold ARMs in their portfolios rather than FRMs because ARMs provide a better match with their liabilities.

The basic ARM is one that resets periodically and has no other terms that affect the monthly mortgage payment. Typically, the mortgage rate is affected by other terms. These

include (1) **periodic caps** and (2) **lifetime rate caps** and floors. Periodic caps limit the amount that the interest rate may increase or decrease at the reset date. The periodic rate cap is expressed in percentage points. Most ARMs have an upper limit on the mortgage rate that can be charged over the life of the loan. This lifetime loan cap is expressed in terms of the initial rate; the most common lifetime cap is 5% to 6%. For example, if the initial mortgage rate is 7% and the lifetime cap is 5%, the maximum interest rate that the lender can charge over the life of the loan is 12%. Many ARMs also have a lower limit (floor) on the interest rate that can be charged over the life of the loan.

A popular form of an ARM is the **hybrid ARM**. For this loan type, for a specified number of years (three, five, seven, and 10 years), the note rate is fixed. At the end of the initial fixed-rate period, the loan resets in a fashion very similar to that of more traditional ARM loans.

Amortization Type

The amount of the monthly loan payment that represents the repayment of the principal borrowed is called the **amortization**. Traditionally, both FRMs and ARMs were **fully amortizing loans**. What this means is that the monthly mortgage payments made by the borrower not only provide the lender with the contractual interest but also are sufficient to completely repay the amount borrowed when the last monthly mortgage payment is made. Thus, for example, for a fully amortizing 30-year loan, at the end of the 360th month, the last mortgage payment is sufficient to pay off any loan balance so that after that last payment the amount owed is zero.

Fully amortizing fixed-rate loans have a payment that is constant over the life of the loan. For example, suppose a loan has an original balance of $200,000, a note rate of 7.5%, and a term of 30 years. Then the monthly mortgage payment would be $1,398.43. The formula for calculating the monthly mortgage payment is provided in Table 1, as well as the illustration showing how $1,398.43 is obtained. Assuming that the borrower has made all monthly payments on a timely basis, then after the last monthly mortgage payment is made, the outstanding balance is zero (i.e., the loan is paid off). This can be seen in the schedule shown in Table 2, which is referred to as an **amortization schedule**. (Not all 360 months are shown to conserve space.) The column labeled "Principal Repayment" is the monthly scheduled principal repayment or amortization of the loan. Notice that in the 360th month, the ending balance is zero. Also note that in each month the amount of the monthly mortgage payment applied to interest declines. This is because the amount of the outstanding balance declines each month.

In the case of an ARM, the monthly mortgage payment adjusts periodically. Thus, the monthly mortgage payments must be recalculated at each reset date. This process of resetting the mortgage loan payment is referred to as **recasting the loan**. For example, consider once again a $200,000 30-year loan. Assume that the loan adjusts annually and that the initial note rate (i.e., the note rate for the first 12 months) is 7.5%. How much of the loan will be outstanding at the end of one year? We can determine this from Table 2 by looking at the last column ("Ending Balance") for month 12. That amount is $198,156.33. (Alternatively, the formula in Table 1 can be used.) Now recasting the loan involves computing the monthly mortgage payment that will fully amortize a loan of $198,156.33 for 29 years (348 months) because after one year there are 29 years remaining on the loan. The note rate used is the reset rate. Suppose that the reset rate is 8.5%. Then the monthly

Table 1 Mortgage Calculation Formulas

1. *Monthly mortgage payment:*

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

where

MP = monthly mortgage payment ($)
MB_o = original mortgage balance ($)
i = note rate divided by 12 (in decimal)
n = number of months of the mortgage loan

Illustration:

$MB_o = \$200{,}000; i = 0.075/12 = 0.00625; n = 360$

$$MP = \$200{,}000\left[\frac{0.00625(1.00625)^{360}}{(1.00625)^{360} - 1}\right] = \$1{,}398.43.$$

2. *The remaining mortgage balance at the end of month* t:

$$MB_t = MB_o\left[\frac{(1+i)^n - (1+i)^t}{(1+i)^n - 1}\right]$$

where

MB_t = mortgage balance after t months

Illustration:

$MB_o = \$200{,}000; i = 0.00625; n = 360; t = 12$

$$MB_t = \$200{,}000\left[\frac{(1.00625)^{360} - (1.00625)^{12}}{(1.00625)^{360} - 1}\right] = \$198{,}156.33$$

3. *The scheduled principal repayment for month* t:

$$SP_t = MB_o\left[\frac{i(1+i)^{t-1}}{(1+i)^n - 1}\right]$$

where

SP_t = scheduled principal repayment for month t

Illustration:

$MB_o = \$200{,}000; i = 0.00625; n = 360; t = 12$

$$SP_{12} = \$200{,}000\left[\frac{0.00625(1.00625)^{12-1}}{(1.00625)^{360} - 1}\right] = \$158.95$$

mortgage payment to fully amortize the loan is $1,535.26 and that is the monthly mortgage payment for the next 12 months.

In recent years, several types of nontraditional amortization schemes have become popular in the mortgage market. The most popular is the **interest-only product.** With this type of loan, only interest is paid for a predetermined period of time called the **lockout period.** Following the lockout period, the loan is recast such that the monthly

Table 2 Amortization Schedule

Original balance	$200,000.00
Note rate	7.50%
Term	30 years
Monthly payment	$1,398.43

Month	Beginning Balance	Interest	Principal Repayment	Ending Balance
1	$200,000.00	$1,250.00	$148.43	$199,851.57
2	199,851.57	1,249.07	149.36	199,702.21
3	199,702.21	1,248.14	150.29	199,551.92
4	199,551.92	1,247.20	151.23	199,400.69
5	199,400.69	1,246.25	152.17	199,248.52
6	199,248.52	1,245.30	153.13	199,095.39
7	199,095.39	1,244.35	154.08	198,941.31
8	198,941.31	1,243.38	155.05	198,786.27
9	198,786.27	1,242.41	156.01	198,630.25
10	198,630.25	1,241.44	156.99	198,473.26
11	198,473.26	1,240.46	157.97	198,315.29
12	198,315.29	1,239.47	158.96	198,156.33
13	198,156.33	1,238.48	159.95	197,996.38
14	197,996.38	1,237.48	160.95	197,835.43
...	...	...	...	...
89	182,656.3	1,141.60	256.83	182,399.81
90	182,399.81	1,140.00	258.43	182,141.37
91	182,141.37	1,138.38	260.05	181,881.33
...	...	...	...	...
145	165,499.73	1,034.37	364.06	165,135.73
146	165,135.73	1,032.10	366.33	164,769.40
147	164,769.40	1,029.81	368.62	164,400.77
...	...	...	...	...
173	154,397.69	964.99	433.44	153,964.24
174	153,964.24	962.28	436.15	153,528.09
175	153,528.09	959.55	438.88	153,089.21
...	...	...	...	...
210	136,417.23	852.61	545.82	135,871.40
211	135,871.40	849.20	549.23	135,322.17
212	135,322.17	845.76	552.67	134,769.51
...	...	...	...	...
290	79,987.35	499.92	898.51	79,088.84
291	79,088.84	494.31	904.12	78,184.71
292	78,184.71	488.65	909.77	77,274.94
...	...	...	...	...
358	4,143.39	25.90	1,372.53	2,770.85
359	2,770.85	17.32	1,381.11	1,389.74
360	1,389.74	8.69	1,389.74	0.00

mortgage payments will be sufficient to fully amortize the original amount of the loan over the remaining term of the loan. The interest-only product can be an FRM, ARM, or hybrid ARM.

For example, consider a $200,000 30-year interest-only loan with a lockout period of five years and a note rate of 7.5% (i.e., a FRM). For the first 60 months, the monthly mortgage payment is only the monthly interest, which is $1,250 (7.5% times $200,000 divided by 12). In the 61st month, the monthly mortgage payment must include both interest and amortization (principal repayment). The monthly mortgage payment for the remaining life of the mortgage loan is the payment necessary to fully amortize a $200,000 25-year loan with a note rate of 7.5%. That monthly mortgage payment is $1,477.98. Note the following. First, if the mortgage had been a 30-year fixed-rate loan at 7.5%, the monthly mortgage payment for the first five years would have been $1,398.43 instead of $1,250 for the interest-only loan. This is the appealing feature of the interest-only loan. The homeowner can purchase a more expensive home using an interest-only loan. The disadvantage for the homeowner is that for the remaining term of the loan, the interest-only loan requires a higher monthly mortgage payment ($1,477.98) compared to a 30-year fully amortizing loan ($1,398.43). However, if the homeowner anticipates a rise in income, this could more than offset the impact of the higher monthly mortgage payment. From the lender's perspective, however, there is greater credit risk. This is because at the end of five years, the lender's exposure remains at $200,000 rather than being reduced by the amortization over the lockout period.

Credit Guarantees

Mortgage loans can be classified based upon whether a credit guaranty associated with the loan is provided by the federal government, a GSE, or a private entity.

Loans that are backed by agencies of the federal government are referred to under the generic term of **government loans** and are guaranteed by the full faith and credit of the U.S. government. The Department of Housing and Urban Development (HUD) oversees two agencies that guarantee government loans. The first is the Federal Housing Administration (FHA), a governmental entity created by Congress in 1934 that became part of HUD in 1965. **FHA-insured loans** are for those borrowers who can afford only a low down payment and generally also have relatively low levels of income. The second is the Veterans Administration (VA), which is part of the U.S. Department of Veterans Affairs. The **VA-guaranteed loans** are made to eligible veterans and reservists, allowing them to receive favorable loan terms. Although there is no maximum amount for the loans that are guaranteed, typically the loans are limited to a statutorily determined amount because when the VA sells loans that it originates in the secondary market, these limits are important as explained later and in the next chapter.

In contrast to government loans, there are loans that have no *explicit* guaranty from the federal government. Such loans are said to obtained from "conventional financing" and therefore are referred to in the market as **conventional loans**. A conventional loan may not be insured when it is originated, but a loan may qualify to be insured when it is included in a pool of mortgage loans that backs a mortgage-backed security. More specifically, the mortgage-backed securities are those issued by two GSEs, Freddie Mac and Fannie Mae. Because the guarantees of Freddie Mac and Fannie Mae do not carry the full faith and credit of the U.S. government, they are not classified as government loans. We will discuss this further in the next chapter.

A conventional loan can be insured by a **private mortgage insurer**. Two examples of private mortgage insurers are MGIC Investment Corp. and the PMI Group, Inc. From an investor's perspective, the guaranty is only as good as the credit rating of the insurer.

Loan Balances

For government loans and the loans guaranteed by Freddie Mac and Fannie Mae, there are limits on the loan balance. The maximum loan size for one- to four-family homes changes every year, based on the percentage change in the average home price (for both new and existing homes) published by the Federal Housing Finance Board. The loan limits, referred to as **conforming limits**, for Freddie Mac and Fannie Mae are identical because they are specified by the same statute. Loans larger than the conforming limit are referred to as **jumbo loans**.

Prepayments and Prepayment Penalties

Homeowners often repay all or part of their mortgage balance prior to the scheduled maturity date. The amount of the payment made in excess of the monthly mortgage payment is called a **prepayment**. For example, consider the $200,000 30-year mortgage with a 7.5% note rate. The monthly mortgage payment is $1,398.43. Suppose the homeowner makes a payment of $5,398.43. This payment exceeds the monthly mortgage payment by $4,000. This amount represents a prepayment and reduces the outstanding mortgage balance by $4,000. For example, look at Table 2. Suppose that the prepayment is made in month 90. In the absence of the prepayment, the mortgage balance at the end of month 90 is $182,141.37. Because of the prepayment of $4,000, the mortgage balance at the end of month 90 is $178,141.37.

This type of prepayment is called a **partial prepayment** or **curtailment**. When a curtailment is made, the loan is not recast. Instead, the borrower continues to make the same monthly mortgage payment. The effect of the prepayment is that more of the subsequent monthly mortgage payment is applied to the principal. For example, once again assume that the prepayment of $4,000 is made in month 90. In the next month, month 91, the amount of interest to be paid is based on $178,141.37. The interest is $1,113.38 (7.5%/12 times $178,141.37), which is less than the amount shown in Table 2. Therefore, for month 91, the principal repayment is $1,398.43 minus the interest of $1,113.38, or $285.05 compared to the amount shown in Table 2 of $260.05. The net effect of the prepayment is that the loan is paid off faster than the scheduled maturity date. That is, the maturity of the loan is "curtailed."

The more common type of prepayment is one in which the entire mortgage balance is paid off. All mortgage loans have a "due on sale" clause, which means that the remaining balance of the loan must be paid when the house is sold. Existing mortgages can also be refinanced by the obligor if the prevailing level of mortgage rates declines, or if a more attractive financing vehicle is proposed to them.

Effectively, the borrower's right to prepay a loan in whole or in part without a penalty is a call option. A mortgage design that mitigates the borrower's right to prepay is the **prepayment penalty mortgage**. This mortgage design imposes penalties if the borrower prepays. The penalties are designed to discourage refinancing activity and require a fee to be paid if the loan is prepaid within a certain amount of time after funding. Penalties are typically structured to allow borrowers to partially prepay up to 20% of their loan each year the penalty is in effect, and charge the borrower six months of interest for prepayments on the remaining 80% of their balance. Some penalties are waived if the home is sold and are

described as "soft" penalties; hard penalties require the penalty to be paid even if the prepayment occurs as the sale of the underlying property.[3]

CONFORMING LOANS

Freddie Mac and Fannie Mae are GSEs whose mission is to provide liquidity and support to the mortgage market. Although they are private corporations, they receive a charter from the federal government. This federal charter allows these GSEs to operate with certain benefits that are not available to other corporations. However, the federal charter imposes limits on their business activities.

One of the ways that they fulfill their mission is by buying and selling mortgages.[4] The loans they purchase can be held in a portfolio or packaged to create a mortgage-backed security. The securities they create are the subject of the next chapter. Fannie Mae and Freddie Mac can buy or sell any type of residential mortgage, but the mortgages that are packaged into securities are restricted to government loans and those that satisfy their underwriting guidelines. The conventional loans that qualify are referred to as **conforming loans**. Thus, a conforming loan is simply a conventional loan that meets the underwriting standard of Fannie Mae and Freddie Mac. Conventional loans in the market are referred to as **conforming conventional loans** and **nonconforming conventional loans**.

One of the underwriting standards is the loan balance at the time of origination. As noted in the previous section, conventional loans that meet the underwriting standards of the two GSEs are called conforming limits. But there are other important underwriting standards that must be satisfied. These include:[5]

- type of property (primary residence, vacation/second home, investment property)
- loan type (e.g., fixed rate, ARM)
- transaction type (rate and term refinances, equity buyouts, cash-out refinances)
- loan-to-value ratio by loan type
- loan-to-value ratio by loan type and transaction type
- borrower credit history
- documentation

Qualifying for a conforming loan is important for both the borrower and the mortgage originator. This is because the two GSEs are the largest buyers of mortgages in the United States. Hence, loans that qualify as conforming loans have a greater probability of being purchased by Fannie Mae and Freddie Mac to be packaged into a mortgage-backed security. As a result, they have lower interest rates than nonconforming conventional loans.

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[3] The laws and regulations governing the imposition of prepayment penalties are established at the federal and state levels. Usually, the applicable laws for fixed-rate mortgages are specified at the state level. There are states that do not permit prepayment penalties on fixed-rate mortgages with a first lien. There are states that do permit prepayment penalties but restrict the type of penalty. For some mortgage designs, such as adjustable-rate and balloon mortgages, there are federal laws that override state laws.

[4] The two GSEs must allocate a specific percentage of the loans made for low- and moderate-income households or properties located in targeted geographic areas as designated by the Department of Housing and Urban Development. Such loans are classified as "affordable housing loans."

[5] See, for example, Fannie Mae's publication of January 2007, *Guide to Underwriting with DU*, which covers underwriting conventional loans. "DU" is Fannie Mae's automated underwriting system whose purpose is to assist mortgage lenders to make credit lending decisions.

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Key Points That You Should Understand Before Proceeding

1. Lien status indicates the lender's seniority in the event of a forced liquidation of the property.
2. In terms of credit classification, loans are classified as prime loans and subprime loans.
3. The note rate can be fixed over the life of the loan (FRM), adjust periodically based on a reference rate plus a margin (ARM), or be fixed for a specified number of years and then adjust for the remaining life of the mortgage (hybrid ARM).
4. Mortgage loans can be guaranteed by the federal government, a GSE, or a private entity.
5. A borrower can make a payment in excess of the monthly mortgage payment; the excess is referred to as a prepayment.
6. There are prepayment penalty mortgages available to mitigate the adverse impact of prepayment.

INVESTMENT RISKS

The principal investors in mortgage loans include thrifts and commercial banks. Pension funds and life insurance companies also invest in these loans, but their ownership is small compared to that of the banks and thrifts. Investors face four main risks by investing in residential mortgage loans: (1) credit risk, (2) liquidity risk, (3) price risk, and (4) prepayment risk.

Credit Risk

Credit risk is the risk that the homeowner/borrower will default. For FHA- and VA-insured mortgages, this risk is minimal. For privately insured mortgages, the risk can be gauged by the credit rating of the private insurance company that has insured the mortgage. For conventional mortgages that are uninsured, the credit risk depends on the credit quality of the borrower. The LTV ratio provides a useful measure of the risk of loss of principal in case of default. When the LTV ratio is high, default is more likely because the borrower has little equity in the property.

Liquidity Risk

Although there is a secondary market for mortgage loans, which we discuss in the next chapter, the fact is that bid–ask spreads are large compared to other debt instruments. That is, mortgage loans tend to be rather illiquid because they are large and indivisible.

Price Risk

The price of a fixed-income instrument will move in an opposite direction from market interest rates. Thus, a rise in interest rates will decrease the price of a mortgage loan.

R. Fabozzi 4th-31(B)

Prepayments and Cash Flow Uncertainty

The three components of the cash flow are

- interest
- principal repayment (scheduled principal repayment or amortization)
- prepayment

Prepayment risk is the risk associated with a mortgage's cash flow due to prepayments. More specifically, investors are concerned that borrowers will pay off a mortgage when prevailing mortgage rates fall below the loan's note rate. For example, if the note rate on a mortgage originated five years ago is 8% and the prevailing mortgage rate (i.e., rate at which a new loan can be obtained) is 5.5%, then there is an incentive for the borrower to refinance the loan. The decision to refinance will depend on several factors, but the single most important one is the prevailing mortgage rate compared to the note rate. The disadvantage to the investor is that the proceeds received from the repayment of the loan must be reinvested at a lower interest rate than the note rate.

This risk is the same as that faced by an investor in a callable corporate or municipal bond. However, unlike a callable bond, there is no premium that may have to be paid by the borrower in the case of a residential mortgage loan. Any principal repaid in advance of the scheduled due date is paid at par value. The exception, of course, is if the loan is a prepayment penalty mortgage.

Key Points That You Should Understand Before Proceeding

1. There are four main risks associated with investing in mortgages: credit risk, liquidity risk, price risk, and prepayment risk.
2. Credit risk can be reduced if the mortgage is insured by a government agency or a private insurance company.
3. Mortgages are not liquid assets—they tend to have a large bid–ask spread.
4. Because of prepayments, the investor is uncertain about the cash flows that will be realized from investing in a residential mortgage loan.

SUMMARY

A mortgage is a pledge of property to secure payment of a debt with the property typically a form of real estate. The two general types of real estate properties that can be mortgaged are single-family (one- to four-family) residential and commercial properties.

Mortgage originators (i.e., the original lenders) include thrifts, commercial banks, and mortgage bankers. Mortgage originators charge an origination fee and may generate additional income in other ways. Underwriting standards are the requirements specified by the originator in order to grant the loan. The two primary quantitative underwriting standards are the PTI and LIV.

A mortgage originator's pipeline consists of the loan applications being processed plus the commitments made. The risk associated with originating mortgages is pipeline risk, and this risk consists of price risk and fallout risk.

Every mortgage loan must be serviced. Mortgage servicers include bank-related entities, thrift-related entities, and mortgage bankers.

Residential mortgage loans can be classified according to lien status (first and second liens), credit classification (prime and subprime), interest rate type (fixed rate and adjustable rate), amortization type (fully amortizing and interest-only), credit guarantees (government loans and conventional loans), loan balances, and prepayments and prepayment penalties.

The two GSEs, Fannie Mae and Freddie Mac, can purchase any type of loan; however, the only conventional loans that they can securitize to create a mortgage-backed security are conforming loans, that is, conventional loans that satisfy their underwriting standards.

The cash flow of a mortgage loan consists of interest, scheduled principal repayment, and prepayments. The lender faces four main risks by investing in residential mortgage loans: (1) credit risk, (2) liquidity risk, (3) price risk, and (4) prepayment risk. Prepayment risk is the risk associated with a mortgage's cash flow due to prepayments.

KEY TERMS

- Adjustable-rate mortgage (ARM)
- Alt-A loan
- Alternative-A loan
- Amortization
- Amortization schedule
- Back ratio
- Cash-out refinancing
- Commitment letter
- Conduit
- Conforming conventional loans
- Conforming limits
- Conforming loans
- Conventional loans
- Curtailment
- Fallout risk
- FHA-insured loans
- FICO score
- First lien
- Fixed-rate mortgage (FRM)
- Front ratio
- Fully amortizing loan
- Government loans
- Hybrid ARM
- Index
- Interest-only product
- Jumbo loans
- Junior lien
- Lien status
- Lifetime rate caps
- Loan-to-value ratio (LTV)
- Lockout period
- Margin
- Mortgage banking
- Mortgage originator
- Mortgage servicers
- No-cash refinancing
- Nonconforming conventional loans
- Note rate
- Origination fee
- Partial prepayment
- Payment-to-income ratio (PTI)
- Periodic caps
- Pipeline
- Pipeline risk
- Prepayment
- Prepayment penalty mortgage
- Prepayment risk
- Price risk
- Prime loan
- Private mortgage insurer
- Rate-and-term refinancing
- Recasting the loan
- Reference rate
- Second lien
- Secondary market profit
- Servicing fee
- Subprime loan
- Underwriting standards
- VA-guaranteed loans

QUESTIONS

1. What type of property is security for a residential mortgage loan?
2. **a.** What are the sources of revenue arising from mortgage origination?
   b. What are the risks associated with the mortgage origination process?
   c. What can mortgage originators do with a loan after originating it?
3. **a.** In selling a mortgage loan for future delivery, what is the advantage of obtaining an optional rather than mandatory delivery agreement?
   b. What is the disadvantage of optional delivery?
4. What are the sources of revenue for mortgage servicers?
5. What are the two primary factors in determining whether or not funds will be lent to an applicant for a residential mortgage loan?
6. All other factors constant, explain why the higher the loan-to-value ratio, the greater the credit risk to which the lender is exposed.
7. What is the difference between a cash-out refinancing and a rate-and-term refinancing?
8. What is the front ratio and back ratio and how do they differ?
9. **a.** What is the difference between a prime loan and a subprime loan?
   b. How are FICO scores used in classifying loans?
   c. What is an alternative-A loan?
10. **a.** What is an FHA-insured loan?
    b. What is a conventional loan?
11. **a.** What is meant by conforming limits?
    b. What is a jumbo loan?
12. **a.** When a prepayment is made that is less than the full amount to completely pay off the loan, what happens to future monthly mortgage payments for a fixed-rate mortgage loan?
    b. What is the impact of a prepayment that is less than the amount required to completely pay off a loan?
13. Consider the following fixed-rate, level-payment mortgage:
    Maturity = 360 months
    Amount borrowed = $100,000
    Annual mortgage rate = 10%
    a. Construct an amortization schedule for the first 10 months.
    b. What will the mortgage balance be at the end of the 360th month, assuming no prepayments?
    c. Without constructing an amortization schedule, what is the mortgage balance at the end of month 270, assuming no prepayments?
    d. Without constructing an amortization schedule, what is the scheduled principal payment at the end of month 270, assuming no prepayments?
14. Explain why in a fixed-rate mortgage the amount of the mortgage payment applied to interest declines over time, while the amount applied to the repayment of principal increases.
15. **a.** Why is the cash flow of a residential mortgage loan unknown?
    b. In what sense has the investor in a residential mortgage loan granted the borrower (homeowner) a call option?
16. Why do depository institutions prefer to invest in adjustable-rate mortgages rather than fixed-rate mortgages?
17. What is a hybrid ARM?
18. What is the advantage of a prepayment penalty mortgage from the perspective of the lender?
19. Explain whether you agree or disagree with the following statements:
    a. "Freddie Mac and Fannie Mae are only allowed to purchase conforming conventional loans."
    b. "In packaging loans to create a mortgage-backed security, Freddie Mac and Fannie Mae can only use government loans."
20. **a.** What features of an ARM will affect its cash flow?
    b. What are the two categories of benchmark indexes used in ARMs?

Residential Mortgage-Backed Securities Market

From Chapter 23 of *Foundations of Financial Markets and Institutions*, 4/e. Frank J. Fabozzi. Franco Modigliani. Frank J. Jones.
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Residential Mortgage-Backed Securities Market

LEARNING OBJECTIVES

After reading this chapter, you will understand

- the development of the current residential mortgage market and the role of public and private conduits
- the process of securitizing residential loans
- the different sectors in the residential mortgage-backed securities market: agency and nonagency
- the different types of agency mortgage-backed securities and their investment characteristics: pass-through securities, collateralized mortgage obligations, and stripped mortgage-backed securities
- what is meant by prepayment risk and how prepayments are measured
- how tranches with different prepayment risk are created in a collateralized mortgage obligation
- the two sectors of the nonagency mortgage-backed securities market: private label and subprime
- how credit risk is redistributed in a nonagency collateralized mortgage obligation
- the different credit enhancement mechanisms for a nonagency collateralized mortgage obligation
- the subprime crisis in the summer of 2007

Our major focus in this chapter is on the market for securities created from residential mortgage loans. The basic mortgage-backed security is the mortgage pass-through security. From this security, derivative mortgage-backed securities are created: **collateralized mortgage obligations (CMOs)** and stripped mortgage-backed securities. We begin by

describing how the process of securitizing mortgages resulted in the strong secondary mortgage market that exists today.

SECTORS OF THE RESIDENTIAL MORTGAGE-BACKED SECURITIES MARKET

The residential mortgage market can be divided into two subsectors based on the credit quality of the borrower: private label mort-gage market and subprime mortgage market. The former sector includes loans that (1) satisfy the underwriting standards of Ginnie Mae, Fannie Mae, and Freddie Mac (i.e., conforming loans); and (2) those that fail to conform for a reason other than credit quality or if the loan is not a first lien on the property. The subprime mortgage sector is the market for loans provided to borrowers with impaired credit rating or where the loan is a second lien.

All of these loans can be securitized in subsectors of the **residential mortgage-backed security (RMBS)** market. Loans that satisfy the underwriting standard of the agencies are typically used to create RMBS that are referred to as **agency mortgage-backed securities.** All other loans are included in what is referred to generically as **nonagency mortgage-backed securities.** In turn, this subsector is classified into **private label mortgage-backed securities**, where prime loans are the collateral, and **subprime mortgage-backed securities**, where subprime loans are the collateral. The names given to the nonagency mortgage-backed securities are arbitrarily assigned. Some market participants refer to private label mortgage-backed securities as "residential deals" or "prime deals." Subprime mortgage-backed securities are also referred to as "mortgage-related asset-backed securities."[1] In fact, market participants often classify agency mortgage-backed securities and private label mortgage-backed securities as part of the RMBS market and subprime mortgage-backed securities as part of the market for asset-backed securities. This classification is somewhat arbitrary. For purposes of this chapter, we will discuss all RMBS products and explain why a distinction is made between private label mortgage-backed securities and subprime mortgage-backed securities.

In terms of market size, the agency mortgage-backed security market is the largest sector of the U.S. investment-grade market. That is, of all securities that have an investment-grade rating (which includes U.S. Treasury securities), the agency mortgage-backed security market is the largest sector. In fact, as of 2008, it was roughly 45% of the investment-grade market. The agency mortgage-backed security market includes three types of securities: agency mortgage pass-through securities, agency CMOs, and agency stripped mortgage-backed securities. As will be explained in the following text, agency stripped mortgage-backed securities and agency CMOs are created from mortgage pass-through securities.

AGENCY PASS-THROUGH SECURITIES

Investing in mortgages exposes the investor to default risk, price risk, liquidity risk, and prepayment risk. A more efficient investment technique is to invest in a **mortgage pass-through security.** This is a security created when one or more holders of mortgages form

[1] See Frank J. Fabozzi, Anand K. Bhattacharya, and William S. Berliner, *Mortgage-Backed Securities: Products, Structuring, and Analytical Techniques* (Hoboken, NJ: John Wiley & Sons, 2007.)

a collection (pool) of mortgages and sell shares or participation certificates in the pool. A pool may consist of several thousand mortgages or only a few. The first mortgage pass-through security was created in 1968. Risk-averse investors prefer investing in a pool to investing in a single mortgage, partly because a mortgage pass-through security is considerably more liquid than an individual mortgage.

When a mortgage is included in a pool of mortgages that is used as collateral for a mortgage pass-through security, the mortgage is said to be **securitized**. Agency pass-through securities refer to mortgage pass-through securities issued by Ginnie Mae, Fannie Mae, or Freddie Mac. We describe these securities in this section.

Cash Flow Characteristics

The cash flow of a mortgage pass-through security depends on the cash flow of the underlying mortgages. As we explained in the previous chapter, the cash flow consists of monthly mortgage payments representing interest, the scheduled repayment of principal, and any prepayments.

Payments are made to securityholders each month. The amounts and the timing of the cash flow from the pool of mortgages and the cash flow passed through to investors, however, are not identical. The monthly cash flow for a pass-through security is less than the monthly cash flow of the underlying mortgages by an amount equal to servicing and other fees. The other fees are those charged by the issuer or guarantor of the pass-through security for guaranteeing the issue (discussed later).

The timing of the cash flow is also different. The monthly mortgage payment is due from each mortgagor on the first day of each month, but there is a delay in passing through the corresponding monthly cash flow to the securityholders. The length of the delay varies by the type of pass-through security.

Figure 1 illustrates the process of creating a mortgage pass-through security.

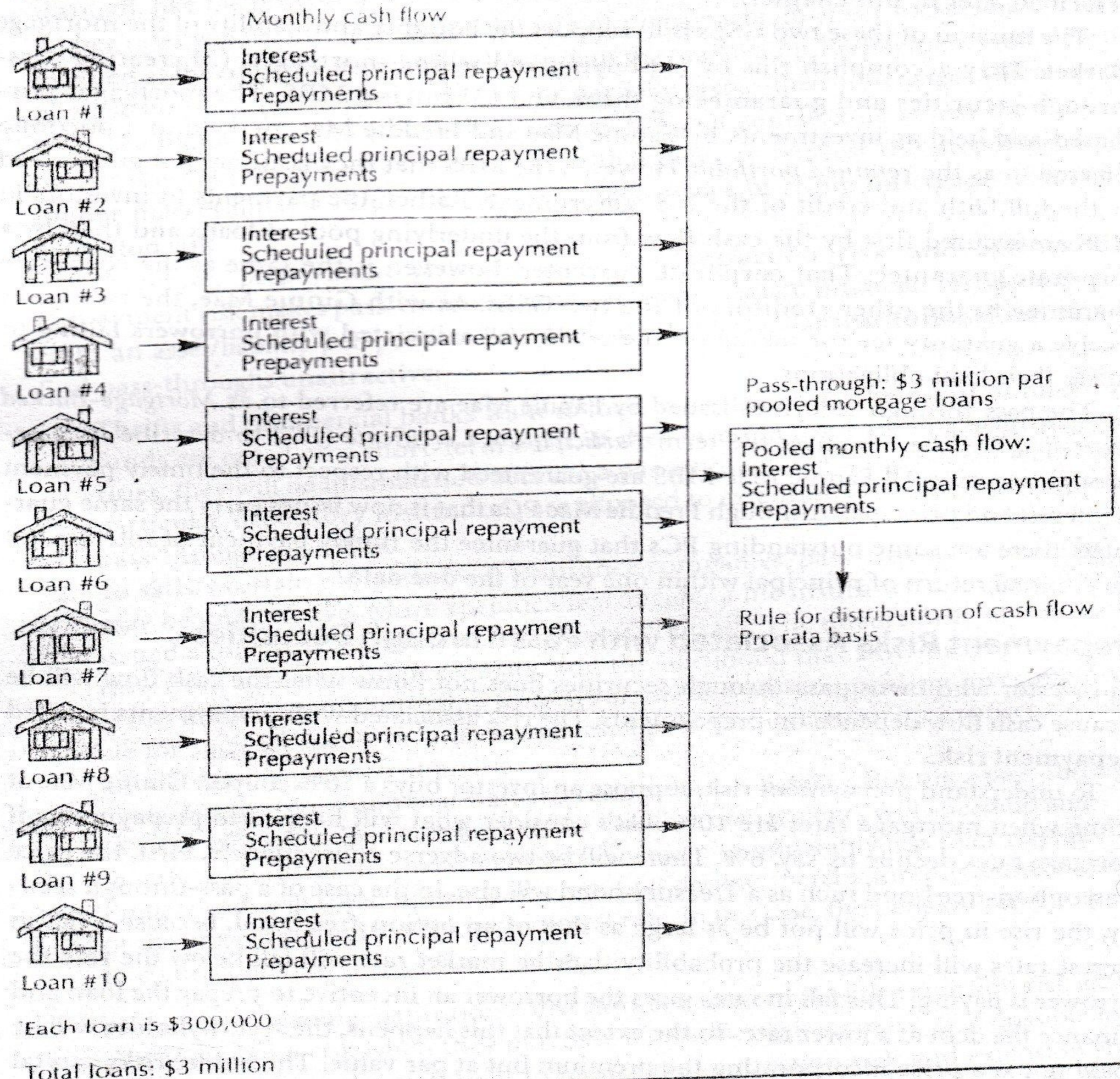
Issuers of Agency Pass-Through Securities

Agency pass-through securities are issued by the Government National Mortgage Association (Ginnie Mae), Fannie Mae, and Freddie Mac. These three entities were created by Congress to increase the supply of capital to the residential mortgage market and to provide support for an active secondary market.

Ginnie Mae is a federally related institution because it is part of the Department of Housing and Urban Development. As a result, the pass-through securities that it guarantees carry the full faith and credit of the U.S. government with respect to timely payment of both interest and principal. That is, the interest and principal are paid when due even if mortgagors fail to make their monthly mortgage payment. The security guaranteed by Ginnie Mae is actually called a **mortgage-backed security** (MBS). The first MBS was issued in 1968.

Although Ginnie Mae provides the guarantee, it is not the issuer. Pass-through securities that carry its guarantee and bear its name are issued by lenders it approves, such as thrifts, commercial banks, and mortgage bankers. These lenders receive approval only if the underlying loans satisfy the underwriting standards established by Ginnie Mae. When it guarantees securities issued by approved lenders, Ginnie Mae permits these lenders to

Figure 1 Illustration of Creation of a Mortgage Pass-Through Security



convert illiquid individual loans into liquid securities backed by the U.S. government. In the process, Ginnie Mae accomplishes its goal to supply funds to the residential mortgage market and provide an active secondary market. For the guarantee, Ginnie Mae receives a fee, called the **guaranty fee**.

Although the MBS issued by Fannie Mae and Freddie Mac are commonly referred to as "agency MBS," both are in fact shareholder-owned corporations chartered by Congress to fulfill a public mission. Their stocks trade on the New York Stock Exchange. Fannie Mae and Freddie Mac are government-sponsored enterprises (GSEs). In early September 2008, Fannie Mae and Freddie Mac were taken over by the U.S. government

because of the financial difficulties it faced as a result of the subprime mortgage crisis described later in this chapter.

The mission of these two GSEs is to support the liquidity and stability of the mortgage market. They accomplish this by (1) buying and selling mortgages, (2) creating pass-through securities and guaranteeing them, and (3) buying MBS. The mortgages purchased and held as investments by Fannie Mae and Freddie Mac are held in a portfolio referred to as the *retained portfolio*. However, the MBS that they issue are not guaranteed by the full faith and credit of the U.S. government. Rather, the payments to investors in MBS are secured first by the cash flow from the underlying pool of loans and then by a corporate guarantee. That corporate guarantee, however, is the same as the corporate guarantee to the other creditors of the two GSEs. As with Ginnie Mae, the two GSEs receive a guaranty fee for taking on the credit risk associated with borrowers failing to satisfy their loan obligations.

The pass-through securities issued by Fannie Mae are referred to as *Mortgage-Backed Securities*; Freddie Mac uses the term *Participation Certificate* (PC) to describe its pass-through security. All Fannie Mae MBS are guaranteed with respect to the timely payment of interest and principal. Although Freddie Mac PCs that it now issues carry the same guarantee, there are some outstanding PCs that guarantee the timely payment of interest but the eventual return of principal within one year of the due date.[2]

Prepayment Risks Associated with Pass-Through Securities

An investor who owns pass-through securities does not know what the cash flow will be because cash flow depends on prepayments. The risk associated with prepayments is called **prepayment risk**.

To understand prepayment risk, suppose an investor buys a 10% coupon Ginnie Mae at a time when mortgage rates are 10%. Let's consider what will happen to prepayments if mortgage rates decline to, say, 6%. There will be two adverse consequences. First, the price of an option-free bond such as a Treasury bond will rise. In the case of a pass-through security, the rise in price will not be as large as that of an option-free bond, because a fall in interest rates will increase the probability that the market rate will fall below the rate the borrower is paying. This fall in rates gives the borrower an incentive to prepay the loan and refinance the debt at a lower rate. To the extent that this happens, the securityholder will be repaid not at a price incorporating the premium but at par value. The holder risks capital loss, which reflects the fact that the anticipated reimbursements at par will not yield the initial cash flow.

The adverse consequences when mortgage rates decline are the same as those faced by holders of callable corporate and municipal bonds. As in the case of those instruments, the upside price potential of a pass-through security is truncated because of prepayments. This should not be surprising because a mortgage loan effectively grants the borrower the right to call the loan at par value. The adverse consequence when mortgage rates decline is referred to as **contraction risk**.

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[2] The securities issued by Fannie Mae and Freddie Mac are sometimes referred to as "conventional pass-through securities." This is because the collateral is typically conventional loans that conform to the underwriting standards of these two GSEs.

Now let's look at what happens if mortgage rates rise to 15%. The price of the pass-through, like the price of any bond, will decline. But again it will decline more because the higher rates will tend to slow down the rate of prepayment, in effect increasing the amount invested at the coupon rate, which is lower than the market rate. Prepayments will slow down because homeowners will not refinance or partially prepay their mortgages when mortgage rates are higher than the contractual rate of 10%. Of course, this is just the time when investors want prepayments to speed up so that they can reinvest the prepayments at the higher market interest rate. This adverse consequence of rising mortgage rates is called **extension risk.**

Therefore, prepayment risk encompasses contraction risk and extension risk. Prepayment risk makes pass-throughs unattractive for certain financial institutions to hold from an asset/liability perspective. Let's look at why particular institutional investors may find pass-throughs unattractive:

1. Thrifts and commercial banks want to lock in a spread over their cost of funds. Their funds are raised on a short-term basis. If they invest in fixed-rate pass-through securities, they will be mismatched because a pass-through is a longer-term security. In particular, depository institutions are exposed to extension risk when they invest in pass-through securities.
2. To satisfy certain obligations of insurance companies, pass-through securities may be unattractive. More specifically, consider a life insurance company that has issued a four-year guaranteed investment contract. The uncertainty about the cash flow from a pass-through security, and the likelihood that slow prepayments will result in the instrument being long-term, make it an unappealing investment vehicle for such accounts. In such instances, a pass-through security exposes the insurance company to extension risk.
3. Consider a pension fund that wants to fund a 15-year liability. Buying a pass-through security exposes the pension fund to the risk that prepayments will speed up and that the maturity of the investment will shorten to considerably less than 15 years. Prepayments will speed up when interest rates decline, thereby forcing reinvestment of the prepaid amounts at a lower interest rate. In this case, the pension fund is open to contraction risk.

We can see that some institutional investors are concerned with extension risk and others with contraction risk when they purchase a pass-through security. Is it possible to alter the cash flow of a pass-through so as to reduce the contraction risk and extension risk for institutional investors? This is explained later in this chapter when we cover collateralized mortgage obligations.

Prepayment Conventions

The only way to project a cash flow is to make some assumption about the prepayment rate over the life of the underlying mortgage pool. The prepayment rate assumed is called the **prepayment speed** or, simply, *speed.*

Conditional Prepayment Rate

The **conditional prepayment rate** (CPR) assumes that some fraction of the remaining principal in the pool is prepaid each year for the remaining term of the mortgage. The prepayment [illegible]med for a pool is based on the characteristics of the pool (including its

historical prepayment experience) and the current and expected future economic environment. It is referred to as a *conditional* rate because it is conditional on the remaining mortgage balance.

The CPR is an annual prepayment rate. To estimate monthly prepayments, the CPR must be converted into a monthly prepayment rate, commonly referred to as the **single-monthly mortality rate** (SMM). The following formula can be used to determine the SMM for a given CPR:

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

Suppose that the CPR used to estimate prepayments is 6%. The corresponding SMM is

$$\begin{aligned}\text{SMM} &= 1 - (1 - 0.06)^{1/12} \\ &= 1 - (0.94)^{0.08333} = 0.005143\end{aligned}$$

An SMM of w% means that approximately w% of the remaining mortgage balance at the beginning of the month, less the scheduled principal payment, will prepay that month. That is,

$$\begin{aligned}\text{Prepayment for month } t = \text{SMM} \times (&\text{Beginning mortgage balance for month } t \\ &- \text{Scheduled principal payment for month } t)\end{aligned} \tag{2}$$

For example, suppose that an investor owns a pass-through in which the remaining mortgage balance at the beginning of some month is $290 million. Assuming that the SMM is 0.5143% and the scheduled principal payment is $3 million, the estimated prepayment for the month is

$$0.005143 \times (\$290{,}000{,}000 - \$3{,}000{,}000) = \$1{,}476{,}041$$

Public Securities Association Benchmark

The **Public Securities Association (PSA) prepayment benchmark** is expressed as a monthly series of annual prepayment rates. The PSA benchmark assumes that prepayment rates are low for newly originated mortgages and then will speed up as the mortgages become seasoned.

The PSA benchmark assumes the following CPRs for 30-year mortgages:

1. a CPR of 0.2% for the first month, increased by 0.2% per month for the next 30 months when it reaches 6% per year, and
2. a 6% CPR for the remaining years.

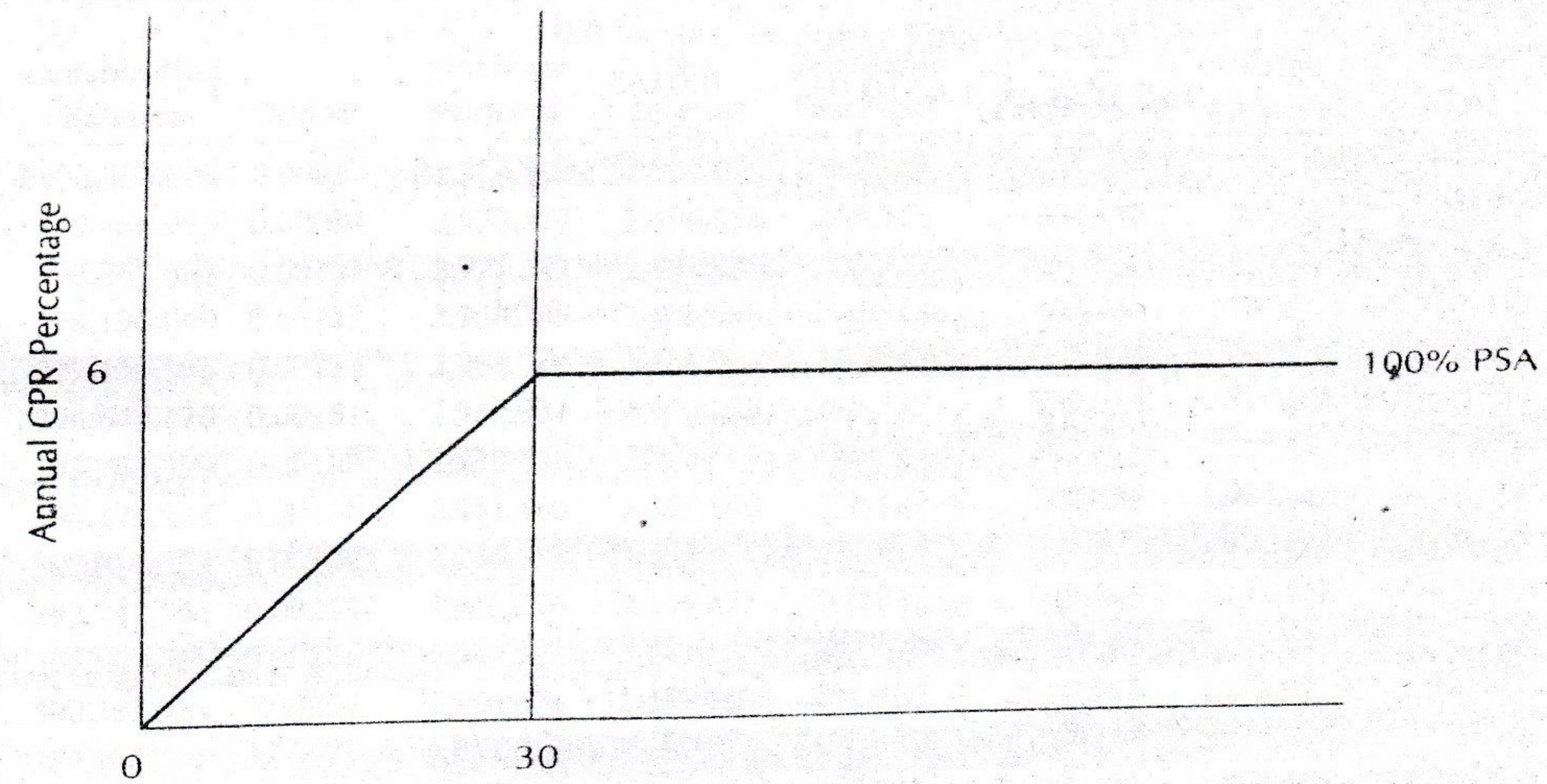
This benchmark, referred to as *100% PSA* or simply *100 PSA*, is graphically depicted in Figure 2. Mathematically, 100 PSA can be expressed as follows:

$$\begin{aligned}&\text{If } t \leq 30, \text{ then CPR} = 6\%(t/30) \\ &\text{If } t > 30, \text{ then CPR} = 6\%\end{aligned}$$

where t is the number of months since the mortgage originated.

Slower or faster speeds are then referred to as some percentage of PSA. For example, 50 PSA means one-half the CPR of the PSA benchmark prepayment rate; 150 PSA means one-and-a-half times the CPR of the PSA benchmark prepayment rate; 300 PSA means three

Figure 2 Graphical Depiction of 100 PSA



times the CPR of the benchmark prepayment rate. A prepayment rate of 0 PSA means that no prepayments are assumed.

The CPR is converted to an SMM using equation (1). For example, the SMMs for month 5, month 20, and months 31 through 360 assuming 100 PSA are calculated as follows:

For month 5,

$$\begin{aligned} \text{CPR} &= 6\%(5/30) = 1\% = 0.01 \\ \text{SMM} &= 1 - (1 - 0.01)^{1/12} \\ &= 1 - (0.99)^{0.083333} = 0.000837 \end{aligned}$$

For month 20,

$$\begin{aligned} \text{CPR} &= 6\%(20/30) = 4\% = 0.04 \\ \text{SMM} &= 1 - (1 - 0.04)^{1/12} \\ &= 1 - (0.96)^{0.083333} = 0.003396 \end{aligned}$$

For months 31 to 360,

$$\begin{aligned} \text{CPR} &= 6\% \\ \text{SMM} &= 1 - (1 - 0.06)^{1/12} \\ &= 1 - (0.94)^{0.083333} = 0.005143 \end{aligned}$$

The SMMs for month 5, month 20, and months 31 through 360 assuming 165 PSA are compu[illegible]d as follows:

For month 5,

$$\begin{aligned} \text{CPR} &= 6\%(5/30) = 1\% = 0.01 \\ 165\ \text{PSA} &= 1.65(0.01) = 0.0165 \\ \text{SMM} &= 1 - (1 - 0.0165)^{1/12} \\ &= 1 - (0.9835)^{0.083333} = 0.001386 \end{aligned}$$

For month 20,

$$\begin{aligned} \text{CPR} &= 6\%(20/30) = 4\% = 0.04 \\ 165\ \text{PSA} &= 1.65(0.04) = 0.066 \\ \text{SMM} &= 1 - (1 - 0.066)^{1/12} \\ &= 1 - (0.934)^{0.083333} = 0.005674 \end{aligned}$$

For months 31 to 360,

$$\begin{aligned} \text{CPR} &= 6\% \\ 165\ \text{PSA} &= 1.65(0.06) = 0.099 \\ \text{SMM} &= 1 - (1 - 0.099)^{1/12} \\ &= 1 - (0.901)^{0.083333} = 0.007828 \end{aligned}$$

Notice that the SMM assuming 165 PSA is not just 1.65 times the SMM assuming 100 PSA. It is the CPR that is a multiple of the CPR assuming 100 PSA.

Illustration of Monthly Cash Flow Construction

We now show how to construct a monthly cash flow for a hypothetical pass-through given a PSA assumption. For the purpos of this illustration, the underlying mortgages for this hypothetical pass-through are assumed to be fixed-rate, level-payment mortgages and the pass-through rate is assumed to be 7.5%. Furthermore, it is assumed that the weighted average maturity (WAM) of the pool of mortgages is 357 months.[3]

Table 1 shows the cash flow for selected months assuming 100 PSA. The cash flow is broken down into three components: (1) interest (based on the pass-through rate), (2) the regularly scheduled principal repayment, and (3) prepayments based on 100 PSA.

Let's walk through Table 1 column by column.

Column 1: This column is the month.

Column 2: This column gives the outstanding mortgage balance at the beginning of the month. It is equal to the outstanding balance at the beginning of the previous month reduced by the total principal payment in the previous month.

Column 3: This column shows the SMM for 100 PSA. Two things should be noted in this column. First, for month 1, the SMM is for a pass-through that has been seasoned three months. That is, the CPR is 0.8%. This is because the WAM is 357. Second, from month 27 on, the SMM is 0.00514, which corresponds to a CPR of 6%.

Column 4: The total monthly mortgage payment is shown in this column. Notice that the total monthly mortgage payment declines over time as prepayments reduce the mortgage balance outstanding. There is a formula to determine what the monthly mortgage balance will be for each month given prepayments.[4]

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[3] It is necessary to calculate a WAM for a pool of mortgages because not all the mortgages have the same number of months remaining to maturity.

[4] The formula is presented in Chapter 20 of Frank J. Fabozzi, *Fixed Income Mathematics: Analytical and Statistical Techniques* (Chicago: Probus Publishing, 1993).

Table 1 Monthly Cash Flows for 30-Year Mortgage

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Month	Outstanding Balance	SMM	Mortgage Payment	Net Interest	Scheduled Principal	Prepayment	Total Principal	Total Cash Flow
1	$400,000,000	0.00067	$2,975,868	$2,500,000	$267,535	$267,470	$535,005	$3,035,005
2	399,464,995	0.00084	2,973,877	2,496,656	269,166	334,198	603,364	3,100,020
3	398,861,631	0.00101	2,971,387	2,492,885	270,762	400,800	671,562	3,164,447
4	398,190,069	0.00117	2,968,399	2,488,688	272,321	467,243	739,564	3,228,252
5	397,450,505	0.00134	2,964,914	2,484,066	273,843	533,493	807,335	3,291,401
6	396,643,170	0.00151	2,960,931	2,479,020	275,327	599,514	874,841	3,353,860
7	395,768,329	0.00168	2,956,453	2,473,552	276,772	665,273	942,045	3,415,597
8	394,826,284	0.00185	2,951,480	2,467,664	278,177	730,736	1,008,913	3,476,577
9	393,817,371	0.00202	2,946,013	2,461,359	279,542	795,869	1,075,410	3,536,769
10	392,741,961	0.00219	2,940,056	2,454,637	280,865	860,637	1,141,502	3,596,140
11	391,600,459	0.00236	2,933,608	2,447,503	282,147	925,008	1,207,155	3,654,658
12	390,393,304	0.00254	2,926,674	2,439,958	283,386	988,948	1,272,333	3,712,291
13	389,120,971	0.00271	2,919,254	2,432,006	284,581	1,052,423	1,337,004	3,769,010
14	387,783,966	0.00288	2,911,353	2,423,650	285,733	1,115,402	1,401,134	3,824,784
15	386,382,832	0.00305	2,902,973	2,414,893	286,839	1,177,851	1,464,690	3,879,583
16	384,918,142	0.00322	2,894,117	2,405,738	287,900	1,239,739	1,527,639	3,933,378
17	383,390,502	0.00340	2,884,789	2,396,191	288,915	1,301,053	1,589,949	3,986,139
18	381,800,553	0.00357	2,874,992	2,386,253	289,884	1,361,703	1,651,587	4,037,840
19	380,148,966	0.00374	2,864,730	2,375,931	290,805	1,421,717	1,712,522	4,088,453
20	378,436,444	0.00392	2,854,008	2,365,228	291,678	1,481,046	1,772,724	4,137,952
21	376,663,720	0.00409	2,842,830	2,354,148	292,503	1,539,658	1,832,161	4,186,309
22	374,831,559	0.00427	2,831,201	2,342,697	293,279	1,597,525	1,890,804	4,233,501
23	372,940,755	0.00444	2,819,125	2,330,880	294,005	1,654,618	1,948,623	4,279,503
24	370,992,132	0.00462	2,806,607	2,318,701	294,681	1,710,908	2,005,589	4,324,290
25	368,986,543	0.00479	2,793,654	2,306,166	295,307	1,765,368	2,061,675	4,367,841
26	366,924,868	0.00497	2,780,270	2,293,280	295,883	1,820,970	2,116,852	4,410,133
27	364,808,016	0.00514	2,766,461	2,280,050	296,406	1,874,688	2,171,094	4,451,144
28	362,636,921	0.00514	2,752,233	2,266,481	296,879	1,863,519	2,160,398	4,426,879
29	360,476,523	0.00514	2,738,078	2,252,978	297,351	1,852,406	2,149,758	4,402,736
30	358,326,766	0.00514	2,723,996	2,239,542	297,825	1,841,347	2,139,173	4,378,715
...								
100	231,249,776	0.00514	1,898,682	1,445,311	332,928	1,187,608	1,520,537	2,965,848
101	229,729,239	0.00514	1,888,917	1,435,808	333,459	1,179,785	1,513,244	2,949,052
102	228,215,995	0.00514	1,879,202	1,426,350	333,990	1,172,000	1,505,990	2,932,340
103	226,710,004	0.00514	1,869,536	1,416,938	334,522	1,164,252	1,498,774	2,915,712
104	225,211,230	0.00514	1,859,923	1,407,570	335,055	1,156,541	1,491,596	2,899,166
105	223,719,634	0.00514	1,850,357	1,398,248	335,589	1,148,867	1,484,456	2,882,703
...								
200	109,791,339	0.00514	1,133,751	686,196	390,872	563,668	954,540	1,640,736
201	108,838,316	0.00514	1,127,920	680,239	390,994	557,746	948,740	1,628,980

(Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Month	Outstanding Balance	SMM	Mortgage Payment	Net Interest	Scheduled Principal	Prepayment	Total Principal	Total Cash
202	107,889,576	0.00514	1,122,119	674,310	391,617	552,863	944,480	1,618,790
203	106,945,096	0.00514	1,116,348	668,407	392,241	548,003	940,243	1,608,650
204	106,004,852	0.00514	1,110,607	662,530	392,866	543,164	936,029	1,598,560
205	105,068,823	0.00514	1,104,895	656,680	393,491	538,347	931,838	1,588,518
...								
300	32,383,611	0.00514	676,991	202,398	457,727	164,195	621,923	824,320
301	31,761,689	0.00514	673,510	198,511	458,457	160,993	619,449	817,960
302	31,142,239	0.00514	670,046	194,639	459,187	157,803	616,990	811,629
303	30,525,249	0.00514	666,600	190,783	459,918	154,626	614,545	805,328
304	29,910,704	0.00514	663,171	186,942	460,651	151,462	612,113	799,055
305	29,298,591	0.00514	659,761	183,116	461,385	148,310	609,695	792,811
...								
350	4,060,411	0.00514	523,138	25,378	495,645	18,334	513,979	539,356
351	3,546,432	0.00514	520,447	22,165	496,435	15,686	512,121	534,286
352	3,034,311	0.00514	517,770	18,964	497,226	13,048	510,274	529,238
353	2,524,037	0.00514	515,107	15,775	498,018	10,420	508,437	524,213
354	2,015,600	0.00514	512,458	12,597	498,811	7,801	506,612	519,209
355	1,508,988	0.00514	509,823	9,431	499,606	5,191	504,797	514,228
356	1,004,191	0.00514	507,201	6,276	500,401	2,591	502,992	509,269
357	501,199	0.00514	504,592	3,132	501,199	0	501,199	504,331

Column 5: The monthly interest paid to the pass-through investor is found in this column. This value is determined by multiplying the outstanding mortgage balance at the beginning of the month by the pass-through rate of 7.5% and dividing by 12.

Column 6: This column gives the regularly scheduled principal repayment. This is the difference between the total monthly mortgage payment (the amount shown in column 4) and the gross coupon interest for the month. The gross coupon interest is 8.125% multiplied by the outstanding mortgage balance at the beginning of the month, then divided by 12.

Column 7: The prepayment for the month is reported in this column. The prepayment is found by using equation (2). So, for example, in month 100, the beginning mortgage balance is \$231,249,776, the scheduled principal payment is \$332,298, and the SMM at 100 PSA is 0.00514301 (only 0.00514 is shown in the table to save space), so the prepayment is

$$0.00514301 \times (\$231,249,776 - \$332,928) = \$1,187,608$$

Column 8: The total principal payment, which is the sum of columns 6 and 7, is shown in this column.

Column 9: The projected monthly cash flow for this pass-through is shown in this last column. The monthly cash flow is the sum of the interest paid to the pass-through investor (column 5) and the total principal payments for the month (column 8).

Table 2 shows selected monthly cash flows for the same pass-through assuming 165 PSA.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Month	Outstanding Balance	SMM	Mortgage Payment	Net Interest	Scheduled Principal	Prepayment	Total Principal	Total Cash Flow
1	$400,000,000	0.00111	$2,975,868	$2,500,000	$267,535	$ 442,389	$ 709,923	$3,209,923
2	399,290,077	0.00139	2,972,575	2,495,563	269,048	552,847	821,896	3,317,459
3	398,468,181	0.00167	2,968,456	2,490,426	270,495	663,065	933,560	3,423,986
4	397,534,621	0.00195	2,963,513	2,484,591	271,873	772,949	1,044,822	3,529,413
5	396,489,799	0.00223	2,957,747	2,478,061	273,181	882,405	1,155,586	3,633,647
6	395,334,213	0.00251	2,951,160	2,470,839	274,418	991,341	1,265,759	3,736,598
7	394,068,454	0.00279	2,943,755	2,462,928	275,583	1,099,664	1,375,246	3,838,174
8	392,693,208	0.00308	2,935,534	2,454,333	276,674	1,207,280	1,483,954	3,938,287
9	391,209,254	0.00336	2,926,503	2,445,058	277,690	1,314,099	1,591,789	4,036,847
10	389,617,464	0.00365	2,916,666	2,435,109	278,631	1,420,029	1,698,659	4,133,769
11	387,918,805	0.00393	2,906,028	2,424,493	279,494	1,524,979	1,804,473	4,228,965
12	386,114,332	0.00422	2,894,595	2,413,215	280,280	1,628,859	1,909,139	4,322,353
13	384,205,194	0.00451	2,882,379	2,401,282	280,986	1,731,581	2,012,567	4,413,850
14	382,192,626	0.00480	2,869,375	2,388,704	281,613	1,833,058	2,114,670	4,503,374
15	380,077,956	0.00509	2,855,603	2,375,487	282,159	1,933,203	2,215,361	4,590,848
16	377,862,595	0.00538	2,841,068	2,361,641	282,623	2,031,931	2,314,554	4,676,195
17	375,548,041	0.00567	2,825,779	2,347,175	283,006	2,129,159	2,412,164	4,759,339
18	373,135,877	0.00597	2,809,746	2,332,099	283,305	2,224,805	2,508,110	4,840,210
19	370,627,766	0.00626	2,792,980	2,316,424	283,521	2,318,790	2,602,312	4,918,735
20	368,025,455	0.00656	2,775,493	2,300,159	283,654	2,411,036	2,694,690	4,994,849
21	365,330,765	0.00685	2,757,296	2,283,317	283,702	2,501,466	2,785,169	5,068,486
22	362,545,596	0.00715	2,738,402	2,265,910	283,666	2,590,008	2,873,674	5,139,584
23	359,671,922	0.00745	2,718,823	2,247,950	283,545	2,676,588	2,960,133	5,208,083
24	356,711,789	0.00775	2,698,575	2,229,449	283,338	2,761,139	3,044,477	5,273,926
25	353,667,312	0.00805	2,677,670	2,210,421	283,047	2,843,593	3,126,640	5,337,061
26	350,540,672	0.00835	2,656,123	2,190,879	282,671	2,923,885	3,206,556	5,397,435
27	347,334,116	0.00865	2,633,950	2,170,838	282,209	3,001,955	3,284,164	5,455,002
28	344,049,952	0.00865	2,611,167	2,150,312	281,662	2,973,553	3,255,215	5,405,527
29	340,794,737	0.00865	2,588,581	2,129,967	281,116	2,945,400	3,226,516	5,356,483
30	337,568,221	0.00865	2,566,190	2,109,801	280,572	2,917,496	3,198,067	5,307,869
...								
100	170,142,350	0.00865	1,396,958	1,063,390	244,953	1,469,591	1,714,544	2,777,933
101	168,427,806	0.00865	1,384,875	1,052,674	244,478	1,454,765	1,699,243	2,751,916
102	166,728,563	0.00865	1,372,896	1,042,054	244,004	1,440,071	1,684,075	2,726,128
103	165,044,489	0.00865	1,361,020	1,031,528	243,531	1,425,508	1,669,039	2,700,567
104	163,375,450	0.00865	1,349,248	1,021,097	243,060	1,411,075	1,654,134	2,675,231
105	161,721,315	0.00865	1,337,577	1,010,758	242,589	1,396,771	1,639,359	2,650,118

(Continued)

Table 2 Monthly Cash Flow for [illegible] and a WAM of 357 Months Assuming 165 PSA (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Month	Outstanding Balance	SMM	Mortgage Payment	Net Interest	Scheduled Principal	Prepayment	Total Principal	Total Cash Flow
200	56,746,664	0.00865	585,990	354,667	201,767	489,106	690,874	1,045,540
201	56,055,790	0.00865	580,921	350,349	201,377	483,134	684,510	1,034,859
202	55,371,280	0.00865	575,896	346,070	200,986	477,216	678,202	1,024,273
203	54,693,077	0.00865	570,915	341,832	200,597	471,353	671,950	1,013,782
204	54,021,127	0.00865	565,976	337,632	200,208	465,544	665,752	1,003,384
205	53,355,375	0.00865	561,081	333,471	199,820	459,789	659,609	993,080
300	11,758,141	0.00865	245,808	73,488	166,196	100,269	266,465	339,953
301	11,491,677	0.00865	243,682	71,823	165,874	97,967	263,841	335,664
302	11,227,836	0.00865	241,574	70,174	165,552	95,687	261,240	331,414
303	10,966,596	0.00865	239,485	68,541	165,232	93,430	258,662	327,203
304	10,707,934	0.00865	237,413	66,925	164,912	91,196	256,107	323,032
305	10,451,827	0.00865	235,360	65,324	164,592	88,983	253,575	318,899
...								
350	1,235,674	0.00865	159,202	7,723	150,836	9,384	160,220	167,943
351	1,075,454	0.00865	157,825	6,722	150,544	8,000	158,544	165,266
352	916,910	0.00865	156,460	5,731	150,252	6,631	156,883	162,614
353	760,027	0.00865	155,107	4,750	149,961	5,277	155,238	159,988
354	604,789	0.00865	153,765	3,780	149,670	3,937	153,607	157,387
355	451,182	0.00865	152,435	2,820	149,380	2,611	151,991	154,811
356	299,191	0.00865	151,117	1,870	149,091	1,298	150,398	152,259
357	148,802	0.00865	149,809	930	148,802	0	148,802	149,732

Average Life

The stated maturity of a mortgage pass-through security is an inappropriate measure of the security's life because of prepayments. Instead, market participants commonly use the security's average life. The **average life** of a mortgage-backed security is the average time to receipt of principal payments (scheduled principal payments and projected prepayments), weighted by the amount of principal expected. Mathematically, the average life is expressed as follows:

$$\text{Average life} = \sum_{t=1}^{T} \frac{t \times \text{Principal received at time } t}{12(\text{Total principal})}$$

where T is the number of months.

The average life of a pass-through depends on the PSA prepayment assumption. To see this, the average life follows for different prepayment speeds for the pass-through we used to illustrate the cash flow for 100 PSA and 165 PSA in Table 1 and Table 2:

PSA speed	50	100	165	200	300	400	500	600	700
Average life	15.11	11.66	8.76	7.68	5.63	4.44	3.68	3.16	2.78

Key Points That You Should Understand Before Proceeding

1. A mortgage pass-through security is created when one or more holders of mortgages form a collection (pool) of mortgages and sell shares or PCs in the pool.
2. The cash flow of a mortgage pass-through security depends on the cash flow of the underlying mortgages, which consists of monthly mortgage payments representing interest, the scheduled repayment of principal, and any prepayments.
3. The three major types of pass-through securities are guaranteed by either Ginnie Mae (a federally related entity), Fannie Mae (a government-sponsored enterprise), or Freddie Mac (a government-sponsored enterprise), and are referred to as agency pass-through securities.
4. There are private issuers of mortgage pass-through securities that are not explicitly or implicitly guaranteed by the U.S. government; these securities are called nonagency pass-through securities.
5. Of the mortgage pass-through securities guaranteed by one of the three agencies, only those guaranteed by Ginnie Mae carry the full faith and credit of the U.S. government; nonagency pass-through securities are rated by a commercial rating company, and often they are supported by credit enhancements so that they can obtain a high rating.
6. An investor in a mortgage pass-through security is exposed to prepayment risk, which can be decomposed into two types of risk, contraction risk and extension risk.
7. The cash flow of a mortgage pass-through is projected based on an assumed PSA.

AGENCY COLLATERALIZED MORTGAGE OBLIGATIONS

Some institutional investors are concerned with extension risk and others with contraction risk when they invest in a pass-through. This problem can be mitigated by redirecting the cash flows of mortgage pass-through securities to different bond classes, called **tranches**, so as to create securities that have different exposure to prepayment risk and, therefore, different risk/return patterns than the pass-through securities from which the tranches were created.

When the cash flows of pools of mortgage pass-through securities are redistributed to different bond classes, the resulting securities are called **agency CMOs**. The creation of a CMO cannot eliminate prepayment risk; it can only distribute the various forms of this risk among different classes of bondholders. The CMO's major financial innovation is that the securities created more closely satisfy the asset/ liability needs of institutional investors and thus broaden the appeal of mortgage-backed products to traditional bond investors.

Rather than list the different types of tranches that can be created in a CMO structure, we will show how the tranches can be created. This will provide an excellent illustration of financial engineering. Although there are many different types of CMOs that have been created, we will only look at three of the key innovations in the CMO market: sequential-pay tranches, accrual tranches, and planned amortization class bonds. Two other important tranches that are not illustrated here are the *floating-rate tranche* and *inverse floating-rate tranche.*

Sequential-Pay Collateralized Mortgage Obligations

The first CMO was created in 1983 and was structured so that each class of bond would be retired sequentially. Such structures are referred to as **sequential-pay CMOs**. To illustrate a sequential-pay CMO, we discuss CMO-1, a hypothetical deal made up to illustrate the basic

features of the structure. The collateral for this hypothetical CMO is a hypothetical pass-through with a total par value of $400 million and the following characteristics: (1) The pass-through coupon rate is 7.5%, (2) the weighted average coupon (WAC) is 8.125%, and (3) the WAM is 357 months. This is the same pass-through that we used earlier in this chapter to describe the cash flow of a pass-through based on some PSA assumption.

From this $400 million of collateral, four bond classes or tranches are created. Their characteristics are summarized in Table 3. The total par value of the four tranches is equal to the par value of the collateral (i.e., the pass-through security). In this simple structure, the coupon rate is the same for each tranche and also the same as the coupon rate on the collateral. There is no reason why this must be so, and, in fact, typically the coupon rate varies by tranche.

Now remember that a CMO is created by redistributing the cash flow—interest and principal—to the different tranches based on a set of payment rules. The payment rules at the bottom of Table 3 describe how the cash flow from the pass-through (i.e., collateral) is to be distributed to the four tranches. There are separate rules for the payment of the coupon interest and the payment of principal, the principal being the total of the regularly scheduled principal payment and any prepayments.

In CMO-1, each tranche receives periodic coupon interest payments based on the amount of the outstanding balance at the beginning of the month. The disbursement of the principal, however, is made in a special way. A tranche is not entitled to receive principal until the entire principal of the tranche has been paid off. More specifically, tranche A receives all the principal payments until the entire principal amount owed to that bond class, $194,500,000, is paid off; then tranche B begins to receive principal and continues to do so until it is paid the entire $36,000,000. Tranche C then receives principal, and when it is paid off, tranche D starts receiving principal payments.

Although the priority rules for the disbursement of the principal payments are known, the precise amount of the principal in each period is not. This will depend on the cash flow and, therefore, on the principal payments of the collateral, which will depend on the actual prepayment rate of the collateral. An assumed PSA speed allows the cash flow to be projected. Table 2 shows the cash flow (interest, regularly scheduled principal repayment, and prepayments)

Table 3 CMO-1: A Hypothetical Four-Tranche Sequential-Pay Structure

Tranche	Par Amount	Coupon Rate
A	$194,500,000	7.5%
B	36,000,000	7.5
C	96,500,000	7.5
D	73,000,000	7.5
Total	$400,000,000	

Payment rules:

1. *For payment of periodic coupon interest:* Disburse periodic coupon interest to each tranche on the basis of the amount of principal outstanding at the beginning of the period.
2. *For disbursement of principal payments:* Disburse principal payments to tranche A until it is completely paid off. After tranche A is completely paid off, disburse principal payments to tranche B until it is completely paid off. After tranche B is completely paid off, disburse principal payments to tranche C until it is completely paid off. After tranche C is completely paid off, disburse principal payments to tranche D until it is completely paid off.

assuming 165 PSA. Assuming that the collateral does prepay at 165 PSA, the cash flow available to all four tranches of CMO-1 will be precisely the cash flow shown in Table 2.

To demonstrate how the priority rules for CMO-1 work, Table 4 shows the cash flow for selected months assuming the collateral prepays at 165 PSA. For each tranche, the table shows (1) the balance at the end of the month, (2) the principal paid down

Table 4: Monthly Cash Flow for Selected Months for CMO-1 Assuming 165 PSA

	Tranche A			Tranche B		
Month	Balance	Principal	Interest	Balance	Principal	Interest
1	$194,500,000	$ 709,923	$1,215,625	$36,000,000	$ 0	$225,000
2	193,790,077	821,896	1,211,188	36,000,000	0	255,000
3	192,968,181	933,560	1,206,051	36,000,000	0	225,000
4	192,034,621	1,044,822	1,200,216	36,000,000	0	225,000
5	190,989,799	1,155,586	1,193,686	36,000,000	0	225,000
6	189,834,213	1,265,759	1,186,464	36,000,000	0	225,000
7	188,568,454	1,375,246	1,178,553	36,000,000	0	225,000
8	187,193,208	1,483,954	1,169,958	36,000,000	0	225,000
9	185,709,254	1,591,789	1,160,683	36,000,000	0	225,000
10	184,117,464	1,698,659	1,150,734	36,000,000	0	225,000
11	182,418,805	1,804,473	1,140,118	36,000,000	0	225,000
12	180,614,332	1,909,139	1,128,840	36,000,000	0	225,000
75	12,893,479	2,143,974	80,584	36,000,000	0	225,000
76	10,749,504	2,124,925	67,184	36,000,000	0	225,000
77	8,624,569	2,106,062	53,904	36,000,000	0	225,000
78	6,518,507	2,087,353	40,741	36,000,000	0	225,000
79	4,431,154	2,068,807	27,695	36,000,000	0	225,000
80	2,362,347	2,050,422	14,765	36,000,000	0	225,000
81	311,926	311,926	1,950	36,000,000	1,720,271	225,000
82	0	0	0	34,279,729	2,014,130	214,248
83	0	0	0	32,265,599	1,996,221	201,660
84	0	0	0	30,269,378	1,978,468	189,184
85	0	0	0	28,290,911	1,960,869	176,818
95	0	0	0	9,449,331	1,793,089	59,058
96	0	0	0	7,656,242	1,777,104	47,852
97	0	0	0	5,879,138	1,761,258	36,745
98	0	0	0	4,117,880	1,745,550	25,737
99	0	0	0	2,372,329	1,729,979	14,827
100	0	0	0	642,350	642,350	4,015
101	0	0	0	0	0	0
102	0	0	0	0	0	0
103	0	0	0	0	0	0
104	0	0	0	0	0	0
105	0	0	0	0	0	0

(Continued)

Table 4 Monthly Cash Flows for a Hybrid Mortgage CMO Tranche Assuming 165 PSA (Continued)

	Tranche C			Tranche D		
Month	Balance	Principal	Interest	Balance	Principal	Interest
1	$96,500,000	$ 0	$603,125	$73,000,000	$ 0	$456,250
2	96,500,000	0	603,125	73,000,000	0	456,250
3	96,500,000	0	603,125	73,000,000	0	456,250
4	96,500,000	0	603,125	73,000,000	0	456,250
5	96,500,000	0	603,125	73,000,000	0	456,250
6	96,500,000	0	603,125	73,000,000	0	456,250
7	96,500,000	0	603,125	73,000,000	0	456,250
8	96,500,000	0	603,125	73,000,000	0	456,250
9	96,500,000	0	603,125	73,000,000	0	456,250
10	96,500,000	0	603,125	73,000,000	0	456,250
11	96,500,000	0	603,125	73,000,000	0	456,250
12	96,500,000	0	603,125	73,000,000	0	456,250
...						
95	96,500,000	0	603,125	73,000,000	0	456,250
96	96,500,000	0	603,125	73,000,000	0	456,250
97	96,500,000	0	603,125	73,000,000	0	456,250
98	96,500,000	0	603,125	73,000,000	0	456,250
99	96,500,000	0	603,125	73,000,000	0	456,250
100	96,500,000	1,072,194	603,125	73,000,000	0	456,250
101	95,427,806	1,699,243	596,424	73,000,000	0	456,250
102	93,728,563	1,684,075	585,804	73,000,000	0	456,250
103	92,044,489	1,669,039	575,278	73,000,000	0	456,250
104	90,375,450	1,654,134	564,847	73,000,000	0	456,250
105	88,721,315	1,639,359	554,508	73,000,000	0	456,250
...						
175	3,260,287	869,602	20,377	73,000,000	0	456,250
176	2,390,685	861,673	14,942	73,000,000	0	456,250
177	1,529,013	853,813	9,556	73,000,000	0	456,250
178	675,199	675,199	4,220	73,000,000	170,824	456,250
179	0	0	0	72,829,176	838,300	455,182
180	0	0	0	71,990,876	830,646	449,943
181	0	0	0	71,160,230	823,058	444,751
182	0	0	0	70,337,173	815,536	439,607
183	0	0	0	69,521,637	808,081	434,510
184	0	0	0	68,713,556	800,690	429,460
185	0	0	0	67,912,866	793,365	424,455
...						
350	0	0	0	1,235,674	160,220	7,723
351	0	0	0	1,075,454	158,544	6,722
352	0	0	0	916,910	156,883	5,731
353	0	0	0	760,027	155,238	4,750
354	0	0	0	604,789	153,607	3,780
355	0	0	0	451,182	151,991	2,820
356	0	0	0	299,191	150,389	1,870
357	0	0	0	148,802	148,802	930

(regularly scheduled principal repayment plus prepayments), and (3) interest. In month 1, the cash flow for the collateral consists of principal payment of $709,923 and interest of $2.5 million (0.075 times $400 million divided by 12). The interest payment is distributed to the four tranches based on the amount of the par value outstanding. So, for example, tranche A receives $1,215,625 (0.075 times $194,500,000 divided by 12) of the $2.5 million. The principal, however, is all distributed to tranche A. Therefore, the cash flow for tranche A in month 1 is $1,925,548. The principal balance at the end of month 1 for tranche A is $193,790,076 (the original principal balance of $194,500,000 less the principal payment of $709,923). No principal payment is distributed to the three other tranches because there is still a principal balance outstanding for tranche A. This will be true for months 2 through 80.

After month 81, the principal balance will be zero for tranche A. For the collateral, the cash flow in month 81 is $3,318,521, consisting of a principal payment of $2,032,196 and interest of $1,286,325. At the beginning of month 81 (end of month 80), the principal balance for tranche A is $311,926. Therefore, $311,926 of the $2,032,196 of the principal payment from the collateral will be disbursed to tranche A. After this payment is made, no additional principal payments are made to this tranche as the principal balance is zero. The remaining principal payment from the collateral, $1,720,271, is disbursed to tranche B. According to the assumed prepayment speed of 165 PSA, tranche B then begins receiving principal payments in month 81.

Table 4 shows that tranche B is fully paid off by month 100, when tranche C now begins to receive principal payments. Tranche C is not fully paid off until month 178, at which time tranche D begins receiving the remaining principal payments. The maturity (i.e., the time until the principal is fully paid off) for these four tranches assuming 165 PSA would be 81 months for tranche A, 100 months for tranche B, 178 months for tranche C, and 357 months for tranche D.

Let's look at what has been accomplished by creating the CMO. First, as shown earlier in this chapter, the average life for the pass-through is 8.76 years, assuming a prepayment speed of 165 PSA. Table 5 reports the average life of the collateral and the four tranches assuming different prepayment speeds. Notice that the four tranches have average lives that

Table 5 Average Life of the Collateral and the Four Tranches of CMO

Prepayment Speed (PSA)	Average life for Collateral	Tranche A	Tranche B	Tranche C	Tranche D
50	15.11	7.48	15.98	21.02	27.24
100	11.66	4.90	10.86	15.78	24.58
165	8.76	3.48	7.49	11.19	20.27
200	7.68	3.05	6.42	9.60	18.11
300	5.63	2.33	4.64	6.81	13.36
400	4.44	1.94	3.70	5.31	10.34
500	3.68	1.69	3.12	4.38	8.35
600	3.16	1.51	2.74	3.75	6.96
700	2.78	1.38	2.47	3.30	5.95

are both shorter and longer than the collateral, thereby attracting investors who have a preference for an average life different from that of the collateral.

There is still a major problem: There is considerable variability of the average life for the tranches. We will see how this can be tackled later on. However, there is some protection provided for each tranche against prepayment risk. This is because prioritizing the distribution of principal (i.e., establishing the payment rules for principal) effectively protects the shorter-term tranche A in this structure against extension risk. This protection must come from somewhere, so it comes from the three other tranches. Similarly, tranches C and D provide protection against extension risk for tranches A and B. At the same time, tranches C and D benefit because they are provided protection against contraction risk, the protection coming from tranches A and B.

Accrual Bonds

In CMO-1, the payment rules for interest provide for all tranches to be paid interest each month. In many sequential-pay CMO structures, at least one tranche does not receive current interest. Instead, the interest for that tranche would accrue and be added to the principal balance. Such a bond class is commonly referred to as an **accrual tranche**, or a **Z bond** (because the bond is similar to a zero-coupon bond). The interest that would have been paid to the accrual bond class is then used to speed up paying down the principal balance of earlier bond classes.

To see this, consider CMO-2, a hypothetical CMO structure with the same collateral as CMO-1 and with four tranches, each with a coupon rate of 7.5%. The structure is shown in Table 6. The difference is in the last tranche, Z, which is an accrual bond.

Let's look at month 1 and compare it to month 1 in Table 4 based on 165 PSA. The principal payment from the collateral is $709,923. In CMO-1, this is the principal paydown for tranche A. In CMO-2, the interest for tranche Z, $456,250, is not paid to that tranche but instead is used to pay down the principal of tranche A. So, the principal payment to tranche A is $1,166,173, the collateral's principal payment of $709,923 plus the interest of $456,250 that was diverted from tranche Z.

Table 6: CMO-2

Tranche	Par Amount	Coupon Rate
A	$194,500,000	7.5%
B	36,000,000	7.5
C	96,500,000	7.5
Z (Accrual)	73,000,000	7.5
Total	$400,000,000	

Payment rules:

1. *For payment of periodic coupon interest:* Disburse periodic coupon interest to tranches A, B, and C on the basis of the amount of principal outstanding at the beginning of the period. For tranche Z, accrue the interest based on the principal plus accrued interest in the previous period. The interest for tranche Z is to be paid to the earlier tranches as a principal paydown.
2. *For disbursement of principal payments:* Disburse principal payments to tranche A until it is completely paid off. After tranche A is completely paid off, disburse principal payments to tranche B until it is completely paid off. After tranche B is completely paid off, disburse principal payments to tranche C until it is completely paid off. After tranche C is completely paid off, disburse principal payments to tranche Z until the original principal balance plus accrued interest is completely paid off.

The inclusion of the accrual tranche results in a shortening of the expected final maturity for tranches A, B, and C. The final payout for tranche A is 64 months rather than 81 months, for tranche B it is 77 months rather than 100 months, and for tranche C it is 112 rather than 178 months.

The average lives for tranches A, B, and C are shorter in CMO-2 compared to CMO-1 because of the inclusion of the accrual bond. For example, at 165 PSA, the average lives are as follows:

Structure	Tranche A	Tranche B	Tranche C
CMO-2	2.90	5.86	7.87
CMO-1	3.48	7.49	11.19

The reason for the shortening of the nonaccrual tranches is that the interest that would be paid to the accrual bond is being allocated to the other tranches. Tranche Z in CMO-2 will have a longer average life than tranche D in CMO-1.

Thus, shorter-term tranches and a longer-term tranche are created by including an accural bond. The accrual bond appeals to investors who are concerned with reinvestment risk. Since there are no coupon payments to reinvest, reinvestment risk is eliminated until all the other tranches are paid off.

Planned Amortization Class Tranches

Many investors were still concerned about investing in an instrument that they continued to perceive as posing significant prepayment risk because of the substantial average variability despite the innovations designed to reduce prepayment risk. Traditional corporate bond buyers sought a structure with both the characteristics of a corporate bond (either a bullet maturity or a sinking fund type of schedule for principal repayment) and high credit quality. While CMOs satisfied the second condition, they did not satisfy the first.

In 1987, CMO issuers began issuing bonds with the characteristic that if prepayments are within a specified range, the cash flow pattern is known. The greater predictability of the cash flow for these classes of bonds, referred to as **planned amortization class (PAC) bonds,** occurs because there is a principal repayment schedule that must be satisfied. PAC bondholders have priority over all other classes in the CMO issue in receiving principal payments from the underlying collateral. The greater certainty of the cash flow for the PAC bonds comes at the expense of the non-PAC classes, called the **support bonds** or **companion bonds.** It is these bonds that absorb the prepayment risk. Because PAC bonds have protection against both extension risk and contraction risk, they are said to provide *two-sided prepayment protection.*

To illustrate how to create a PAC bond, we will use as collateral the $400 million pass-through with a coupon rate of 7.5%, a WAC of 8.125%, and a WAM of 357 months. The second column of Table 7 shows the principal payment (regularly scheduled principal repayment plus prepayments) for selected months assuming a prepayment speed of 90 PSA, and the next column shows the principal payments for selected months assuming that the pass-through prepays at 300 PSA.

The last column of Table 7 gives the *minimum* principal payment if the collateral speed is 90 PSA or 300 PSA for months 1 to 349. (After month 346, the outstanding principal balance will be paid off if the prepayment speed is between 90 PSA and 300 PSA.) For

Table 7 Monthly Principal Payments for $400 Million 7.00% Coupon Pass-Through with an 8.125% WAC and a 357 WAM Assuming Prepayment Rates of 90 PSA and 300 PSA

Month	At 90% PSA	At 300% PSA	Minimum Principal Payment—the PAC Schedule
1	$ 508,169.52	$1,075,931.20	$ 508,169.52
2	569,843.43	1,279,412.11	569,843.43
3	631,377.11	1,482,194.45	631,377.11
4	692,741.89	1,683,966.17	692,741.89
5	753,909.12	1,884,414.62	753,909.12
6	814,850.22	2,083,227.31	814,850.22
7	875,536.68	2,280,092.68	875,536.68
8	935,940.10	2,474,700.92	935,940.10
9	996,032.19	2,666,744.77	996,032.19
10	1,055,784.82	2,855,920.32	1,055,784.82
11	1,115,170.01	3,041,927.81	1,115,170.01
12	1,174,160.00	3,224,472.44	1,174,160.00
13	1,232,727.22	3,403,265.17	1,232,727.22
14	1,290,844.32	3,578,023.49	1,290,844.32
15	1,348,484.24	3,748,472.23	1,348,484.24
16	1,405,620.17	3,914,344.26	1,405,620.17
17	1,462,225.60	4,075,381.29	1,462,225.60
18	1,518,274.36	4,231,334.57	1,518,274.36
...			
101	1,458,719.34	1,510,072.17	1,458,719.34
102	1,452,725.55	1,484,126.59	1,452,725.55
103	1,446,761.00	1,458,618.04	1,446,761.00
104	1,440,825.55	1,433,539.23	1,433,539.23
105	1,434,919.07	1,408,883.01	1,408,883.01
...			
211	949,482.58	213,309.00	213,309.00
212	946,033.34	209,409.09	209,409.09
213	942,601.99	205,577.05	205,577.05
...			
346	618,684.59	13,269.17	13,269.17
347	617,071.58	12,944.51	12,944.51
348	615,468.65	12,626.21	12,626.21
349	613,875.77	12,314.16	3,432.32
350	612,292.88	12,008.25	0
351	610,719.96	11,708.38	0
352	609,156.96	11,414.42	0
353	607,603.84	11,126.28	0
354	606,060.57	10,843.85	0
355	604,527.09	10,567.02	0
356	603,003.38	10,295.70	0
357	601,489.39	10,029.78	0

example, in the first month, the principal payment would be $508,169.52 if the collateral prepays at 90 PSA and $1,075,931.20 if the collateral prepays at 300 PSA. Thus, the minimum principal payment is $508,169.52, as reported in the last column of Table 7. In month 103, the minimum principal payment is also the amount if the prepayment speed is 90 PSA, $1,446,761, compared to $1,458,618.04 for 300 PSA. In month 104, however, a prepayment speed of 300 PSA would produce a principal payment of $1,433,539.23, which is less than the principal payment of $1,440,825.55 assuming 90 PSA. So, $1,433,539.23 is reported in the last column of Table 7. In fact, from month 104 on, the minimum principal payment is the one that would result, assuming a prepayment speed of 300 PSA.

In fact, if the collateral prepays at *any* speed between 90 PSA and 300 PSA, the minimum principal payment would be the amount reported in the last column of Table 7. For example, if we had included principal payment figures assuming a prepayment speed of 200 PSA, the minimum principal payment would not change: From month 11 through month 103, the minimum principal payment is that generated from 90 PSA, but from month 104 on, the minimum principal payment is that generated from 300 PSA.

This characteristic of the collateral allows for the creation of a PAC bond, assuming that the collateral prepays over its life at a constant speed between 90 PSA and 300 PSA. A schedule of principal repayments that the PAC bondholders are entitled to receive before any other bond class in the CMO is specified. The monthly schedule of principal repayments is as specified in the last column of Table 7, which shows the minimum principal payment. Although there is no assurance that the collateral will prepay between these two speeds, a PAC bond can be structured to assume that it will.

Table 8 shows a CMO structure, CMO-3, created from the $400 million, 7.5% coupon pass-through with a WAC of 8.125% and a WAM of 357 months.

There are just two bond classes in this structure: a 7.5% coupon PAC bond created assuming 90 to 300 PSA with a par value of $243.8 million, and a support bond with a par value of $156.2 million.

Table 9 reports the average life for the PAC bond and the support bond in CMO-3 assuming various *actual* prepayment speeds. Notice that between 90 PSA and 300 PSA, the average life for the PAC bond is stable at 7.26 years. However, at slower or faster PSA speeds, the schedule is broken, and the average life changes, lengthening when the prepayment

Table 8 CMO-3 CMO Structure with One PAC Bond and One Support Bond

Tranche	Par Amount	Coupon Rate
P (PAC)	$243,800,000	7.5%
S (Support)	156,200,000	7.5%
Total	$400,000,000	

Payment rules:

1. *For payment of periodic coupon interest:* Disburse periodic coupon interest to each tranche on thebasis of the amount of principal outstanding at the beginning of the period.
2. *For disbursement of principal payments:* Disburse principal payments to tranche P based on its schedule of principal repayments. Tranche P has priority with respect to current and future principal payments to satisfy the schedule. Any excess principal payments in a month over the amount necessary to satisfy the schedule for tranche P are paid to tranche S. When tranche S is completely paid off, all principal payments are to be made to tranche P regardless of the schedule.

Table 9 Average Life for PAC Bond and Support Bond for Various Prepayment Speeds

Prepayment Rate (PSA)	PAC Bond (P)	Support Bond (S)
0	15.97	27.26
50	9.44	24.00
90	7.26	18.56
100	7.26	18.56
150	7.26	12.57
165	7.26	11.16
200	7.26	8.38
250	7.26	5.37
300	7.26	3.13
350	6.56	2.51
400	5.92	2.17
450	5.38	1.94
500	4.93	1.77
700	3.70	1.37

Key Points That You Should Understand Before Proceeding

1. A CMO is a security backed by a pool of mortgage pass-through securities or mortgages and is referred to as a derivative security.
2. In a CMO structure, there are several bond classes called tranches.
3. With the exception of support bonds, a CMO reduces the uncertainty concerning the maturity of a tranche, thereby providing a risk/return pattern not available with typical mortgage pass-through securities.
4. Tranche types that have been included in a CMO structure are sequential-pay bonds, accrual bonds (or Z-bonds), PAC bonds, and support bonds.
5. A PAC bond is a class of bonds designed to reduce prepayment risk by specifying a schedule for the amortization of the principal owed to the bondholder; the reduction in the prepayment risk comes at the expense of the support bonds.

speed is less than 90 PSA and shortening when it is greater than 300 PSA. Even so, there is much greater variability for the average life of the support bond. The average life for the support bond is substantial.

AGENCY STRIPPED MORTGAGE-BACKED SECURITIES

Agency stripped mortgage-backed securities, introduced by Fannie Mae in 1986, are another example of derivative mortgage securities. A mortgage pass-through security divides the cash flow from the underlying pool of mortgages on a pro rata basis to the securityholders. A stripped mortgage-backed security is created by altering that distribution of principal and interest from a pro rata distribution to an unequal distribution. The result is that some of the securities created will have a price/yield relationship that is

different from the price/yield relationship of the underlying mortgage pool. Stripped mortgage-backed securities, if properly used, provide a means by which investors can hedge prepayment risk.

The first generation of stripped mortgage-backed securities were partially stripped. We can see this by looking at the stripped mortgage-backed securities issued by Fannie Mae in mid 1986. The Class B stripped mortgage-backed securities were backed by FNMA pass-through securities with a 9% coupon. The mortgage payments from the underlying mortgage pool were distributed to Class B-1 and Class B-2 so that both classes received an equal amount of the principal, but Class B-1 received one-third of the interest payments while Class B-2 received two-thirds.

In a subsequent issue, Fannie Mae distributed the cash flow from the underlying mortgage pool in a far different way. Using FNMA 11% coupon pools, Fannie Mae created Class A-1 and Class A-2. Class A-1 was given 4.95% of the 11% coupon interest, while Class A-2 received the other 6.05%. Class A-1 was given almost all of the principal payments, 99%, while Class A-2 was allotted only 1% of the principal payments.

In early 1987, stripped mortgage-backed securities began to be issued allocating all the interest to one class [called the **interest-only (IO) class**] and all the principal to the other class [called the **principal-only (PO) class**]. The IO class receives no principal payments. IO and PO securities are also referred to as **mortgage strips**.

The PO security is purchased at a substantial discount from par value. The yield an investor realizes depends on the speed at which prepayments are made. The faster the prepayments, the higher the investor's yield. For example, suppose there is a mortgage pool consisting of only 30-year mortgages, with $400 million in principal, and that investors can purchase POs backed by this mortgage pool for $175 million. The dollar return on this investment will be $225 million. How quickly that dollar return is recovered by PO investors determines the yield that will be realized. In the extreme case, if all homeowners in the underlying mortgage pool decide to prepay their mortgage loans immediately, PO investors will realize the $225 million immediately. At the other extreme, if all homeowners decide to remain in their homes for 30 years and make no prepayments, the $225 million will be spread out over 30 years, which would result in a lower yield for PO investors.

A PO is a security whose price would rise when interest rates decline and fall when interest rates rise. This is typical of all the bonds we have discussed thus far in this book. A characteristic of a PO is that its price is very sensitive to changes in interest rates.

An IO has no par value. In contrast to the PO investor, the IO investor wants prepayments to be slow. The reason is that the IO investor receives interest only on the amount of the principal outstanding. When prepayments are made, less dollar interest will be received as the outstanding principal declines. In fact, if prepayments are too fast, the *IO investor may not recover the amount paid for the IO.* The unique aspect of an IO is that its price changes in the *same* direction as the change in interest rates. Moreover, as in the case of the PO, its price is highly responsive to a change in interest rates.

Because of these price volatility characteristics of stripped mortgage-backed securities, institutional investors have used them to control the risk of a portfolio of mortgage-backed securities so as to create a risk/return pattern that better fits their needs.

Key Points That You Should Understand Before Proceeding

1. A stripped mortgage-backed security is created by distributing the principal and interest from a pool of underlying mortgages on an unequal basis to two classes of securityholders.
2. A stripped mortgage-backed security is another example of a derivative mortgage security.
3. Stripped mortgage-backed securities can be used to hedge a portfolio exposed to prepayment risk.
4. There are two types of stripped mortgage-backed securities: partially stripped and IO/PO securities.

NONAGENCY MORTGAGE-BACKED SECURITY

Nonagency MBS represent MBS issued by entities other than Ginnie Mae, Fannie Mae, and Freddie Mac. Nonagency MBS are issued by conduits of (1) commercial banks (e.g., Citigroup's CitiMortgage), (2) investment banking firms, and (3) entities not associated with either commercial banks or investment banking firms (e.g. Countrywide Financial Corp.

For an agency CMO, we said that there are pass-through, CMO, and stripped MBS. Typically, the structure that is used for a nonagency MBS is the CMO structure, referred to as a **nonagency CMO**. The creation of a nonagency CMO is different from that of an agency CMO. When we described agency CMOs, we said that the process first involves pooling loans to create an agency pass-through security. Then a pool of agency pass-through securities is pooled to create an agency CMO. In a nonagency CMO, the loans are pooled and used to create different bond classes, which we refer to as tranches.

Credit Enhancement

Unlike agency MBS, nonagency CMOs are rated by one or more of the credit rating agencies. Because there is no government guarantee or guarantee by a GSE, to receive an investment-grade rating these securities must be structured with additional credit support. The credit support is needed to absorb expected losses from the underlying loan pool due to defaults. This additional credit support is referred to as a **credit enhancement**. There are different forms of credit enhancement: (1) senior-subordinate structure, (2) excess spread, (3) overcollateralization, and (4) **monoline insurance**. We will describe them briefly here.

When rating agencies assign a rating to the tranches in a nonagency CMO, they look at the credit risk associated with a tranche. Basically, that analysis begins by looking at the credit quality of the underlying pool of loans. For example, a pool of loans can consist of prime borrowers or subprime borrowers. Obviously, one would expect that a pool consisting of prime borrowers would have fewer expected losses as a percentage of the dollar amount of the loan pool compared to a pool consisting of subprime borrowers. Given the credit quality of the borrowers in the pool and other factors such as the structure of the transaction, a rating agency will determine the dollar amount of the credit enhancement needed for a particular tranche to receive a specific credit rating. The process by which the rating agencies determine the amount of credit enhancement needed is referred to as *sizing the transaction*.

There are standard mechanisms for providing credit enhancement in nonagency CMOs. We will describe these mechanisms shortly. When prime loans are securitized, the credit enhancement mechanisms and therefore the structures are not complicated. In contrast, when subprime loans are securitized, the structures are more complex because of the need for greater credit enhancement. Since these more complex structures are found in certain types of ABS, market participants classify securitization involving subprime loans as part of the ABS market (recall that they are referred to as mortgage-related ABS).

Senior-Subordinate Structure

In a **senior-subordinate structure**, two general categories of tranches are created: a senior tranche and subordinate tranches. For example, consider the following hypothetical nonagency CMO structure consisting of $400 million of collateral:

Tranche	Principal Amount	Credit Rating
X1	$350 million	AAA
X2	$ 20 million	AA
X3	$ 10 million	A
X4	$ 5 million	BBB
X5	$ 5 million	BB
X6	$ 5 million	B
X7	$ 5 million	not rated

Notice that there are seven tranches in this transaction. The tranche with the highest rating is referred to as the *senior tranche.* The *subordinate tranches* are those below the senior tranche. The rules for the distribution of the cash flow (interest and principal) among the tranches as well as how losses are to be distributed are explained in the prospectus. These rules are referred to as the deal's *waterfall.* Basically, the losses are distributed based on the tranche's position in the structure. Losses start from the bottom (the lowest or unrated tranche) to the senior tranche. For example, if over the life of this nonagency CMO the losses are less than $5 million, only tranche X7 will realize a loss. If the loss is, say, $15 million, tranches X7, X6, X5, and X4 will realize total losses and the other tranches no losses.

Note a few points about this structure. First, the credit enhancement for tranches is being provided by other tranches within the structure. For example, the senior tranche, X1, is being protected against losses up to $50 million. This is because it is only until $50 million of losses are realized that tranche X1 will realize a loss. Tranche X4 has credit enhancement of $20 million because the collateral can realize $20 million in losses before tranche X4 realizes a loss.

Second, compare what is being done to distribute credit risk in this nonagency CMO compared to an agency CMO. In an agency CMO, there is no credit risk. What is being done in creating the different tranches is the redistribution of prepayment risk. In contrast, in a nonagency CMO, there is both credit risk and prepayment risk. By creating the senior-subordinate tranches, credit risk is being redistributed among the tranches in the structure. Hence, what is being done is *credit tranching.* Can prepayment risk also be redistributed? This is typically done in nonagency CMOs but only at the senior tranche level. That is, the $350 million of senior tranches in our hypothetical nonagency CMO structure can be carved up to create senior tranches with different exposure to prepayment risk.

Finally, when the tranches are sold in the market, they are sold at different yields. Obviously, the lower the credit rating of a tranche, the higher the yield at which it must be offered.

Excess Spread

Excess spread is basically the interest from the collateral that is not being used to satisfy the liabilities (i.e., the interest payments to the tranches in the structure) and the fees (such as mortgage servicing and administrative fees). The excess spread can be used to help offset any losses. If the excess spread is retained in the structure rather than paid out, it can be accumulated in a reserve account and used to pay not only current losses experienced by the collateral but future losses. Hence, excess spread is a form of credit enhancement.

Because the loan rate on subprime loans is greater than the loan rate on prime loans and because the expected losses are greater for subprime loans, excess spread is an important source of credit enhancement for subprime MBS.

Overcollateralization

In our hypothetical nonagency CMO, the liabilities are $400 million and are assumed to match the amount of the collateral. Suppose instead that the collateral has a par value of $405 million. This means that the assets exceed the liabilities by $5 million. This excess collateral is referred to as **overcollateralization** and can be used to absorb losses. Hence, it is a form of credit enhancement.

Overcollateralization is more commonly used as a form of credit enhancement in subprime deals than in prime deals. This is one of the aspects that makes subprime deals more complicated because there are a series of tests built into the structure as to when collateral can be released.

Monoline Insurance

Some insurance companies, by charter, provide only financial guarantees. These insurance companies are called *monoline insurance companies.* These are the same companies that provide the guaranty for insured municipal bonds. For RMBS, they provide the same function and therefore this is viewed as a form of credit enhancement.

Subprime Mortgage-Backed Security Meltdown

In the previous chapter, we discussed subprime loans. In this chapter, we discussed their securitization. In the summer of 2007, there was a crisis in the subprime MBS market and this crisis led to a credit and liquidity crisis that had a rippling impact on other sectors of the credit market and the equity market through 2008. This episode is referred to as the "subprime meltdown."

There is a good deal that will be written about this crisis in the future. As of this writing, there are widely differing viewpoints regarding the crisis. Some market observers saw it as the inevitable bursting of the "housing bubble" that had characterized the housing market in prior years. Others viewed it as the product of unsavory practices by mortgage lenders who deceived subprime borrowers into purchasing homes that they could not afford. Moreover, specific mortgage designs such as hybrid interest-only loans, which made it possible for a subprime borrower to obtain a loan that could have been expected to cause financial difficulties in the future

when loan rates were adjusted upward in the case of a hybrid loan or higher mortgage payments after the lockout period in the case of an interest-only loan. Of course, mortgage lenders blamed borrowers for misleading them. Another contingent laid the blame at the feet of Wall Street bankers who packaged subprime loans into bonds and sold them to investors and the rating agencies that gave these bonds investment-grade ratings.

Whatever the precise cause, it's hard to deny that securitization—the financial framework that allowed Wall Street to package these loans into RMBS—is of enormous benefit to the economy. Securitization has increased the supply of credit to homeowners and reduced the cost of borrowing. It also spreads the risk among a larger pool of investors rather than concentrating it in a small group of banks and thrifts and makes credit available to a wider group of borrowers. Critics of securitization argue that such borrowers may not be suitable candidates for loans and the only reason why a lender would make such loans is because it does not hold them on its balance sheet but rather sells the loans into the market either to a conduit that will securitize the loans or will securitize them itself.

While it can be argued that not all those who were shut out from the market prior to securitization were in fact weak borrowers, there is no question that in the case of the securitization of subprime loans that the low credit standards of lenders was the major reason for the problem. However, that is an attack on underwriting standards for the mortgage sector and not a reason for attacking securitization in general. Securitization is an important and legitimate way for the financial markets to function more efficiently today than in the past. It is not smoke-and-mirror financial structures that fraudulent companies have used to hide the true nature of their operations. Real securitization, while sometimes complex, generally takes place in regulated debt markets with the participation of sophisticated parties such as underwriters, loan servicers, institutional investors, rating agencies, and monoline insurance companies that provide financial guarantees. Each of these has a unique role that helps to produce a balanced—but not a riskless—result.

As explained in this chapter, the securitization of subprime loans works by dividing pools of credit into classes, or tranches, separated by the amount of risk each class represents. Naturally, the classes with less risk offer lower potential returns while the classes with more risk offer higher potential returns. Investors in the riskier, or more junior, tranches are paid only after the investors in the senior classes are paid. Senior tranches, therefore, are well cushioned from defaults—reflected in typically high credit ratings, but relatively low returns. Similarly, rating agencies generally assign lower ratings to the more junior classes, but classes can earn relatively high returns as long as the pool of loans performs well.

The more junior, riskier classes are purchased by sophisticated institutional investors who understand that they will sometimes incur losses, but hope for high enough returns over a long period of time to offset possible losses. In fact, as we have stressed throughout this book, a financial product is not created randomly. Rather, the demand must come from investors. In the case of RMBS backed by subprime loans, it came ultimately from hedge fund managers. Basically, the major purchasers of subprime MBS were portfolio managers of collateralized debt obligations (CDOs). Managers of CDOs created tranches that were effectively leveraged positions in a portfolio of RMBS. Hedge fund managers bought the tranches that were necessary for a transaction to get done. Thus, in the absence of the demand by hedge fund managers for these tranches, it is likely that fewer CDOs that purchased subprime MBS would have been done. So, one question that

must be asked is whether one should be concerned that this institutional investor group was hurt by the subprime meltdown. Hedge funds are in the business of taking large bets and if they do not work out, that's a normal business risk.

Rating agencies were also viewed by some market observers as being a major contributor to the crisis. Recall that to aid investors in comparing the relative credit risk of securities, issuers generally ask one or more rating agency to assign a credit rating to the securitization. Although no one, not even the rating agencies, can always accurately predict the performance of a bond over time, the agencies' long-term track record is solid. Their published research shows that AAA—the highest rated—securities have experienced extraordinarily low credit losses—the lowest among structured credits. AA rated securities have experienced the next lowest losses, and so forth. The research has also demonstrated that the credit loss experience of securitized products is quite similar to that of like-rated corporate securities, so that ratings are comparable across debt markets. However, this does not mean that in every instance, highly rated securities will perform well, or low-rated instruments will perform poorly. The accuracy of ratings, like any other indicator of credit risk, can only be assessed on a statistical basis over a long period of time. Nor does it mean that ratings will necessarily remain the same over time. Rating agencies continually monitor the securities they have rated and as performance and expectations of credit losses change, the agency may upgrade or downgrade a given rating. Unfortunately, it is only the anomalous episodes like the subprime market crisis that captures widespread market attention.

What is surprising is why the crisis occurred in July 2007. There was no new information in the market at the time. Investors knew well before that time all about the potential defaults. Moreover, since 2005, the rating agencies took action that was transparent to the market. Specifically, rating agencies adjusted their criteria and assumptions regarding how they were rating subprime MBS transactions, they downgraded some issues, and they publicly commented on their concerns about the subprime sector.

The impact of the suprime mortgage crisis on the financial markets has been devastating. But the suggestion that it was securitization that caused this would be wrong. In a speech by Robert Steel, Under Secretary of the U.S. Department of the Treasury, before the American Securitization forum in February 5, 2008, he stated:

> The securitization market is an example of how this incredible pace of innovation has changed financial markets. Secretary Paulson and I have been very clear—we believe that the benefits of securitization are significant. It enables investors to improve their risk management, achieve better risk adjusted returns and access more liquidity.
>
> While being an advocate for the benefits of your industry, it is also important for me to be straightforward. We must be honest and admit some degree of malfeasance. It is clear that in some instances market participants acted inappropriately. Secretary Paulson has indicated that certain adjustments to the mortgage process, such as licensing standards for mortgage originators, would help in weeding out the bad actors. Commonsense licensing standards would take into account prior fraudulent or criminal activity, and should require initial and ongoing education.[5]

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[5] http://www.ustreas.gov/press/releases/hp808.htm

Mr. Steel further remarked

> Secretary Paulson is leading the President's Working Group to evaluate broad, long-term lessons-learned from current challenges, and where appropriate make recommendations.
>
> Securitization can remain a strong market in the future, but market participants must accept some degree of responsibility and commit to lessons-learned.

In a September 20, 2007, article in *The Economist*, "When it goes wrong . . .," the following comment was made regarding securitization

> But do not expect a rush back to the ways of the 1960s. Securitisation has become far too important for that. Indeed, it has not yet fulfilled its promise. Wall Street eggheads may be licking their wounds at present, but they will soon be coming up with even more products. And, given time, there will no doubt be another wave of buying. More importantly, the transformation of sticky debt into something more tradable, for all its imperfections, has forged hugely beneficial links between individual borrowers and vast capital markets that were previously out of reach. As it comes under scrutiny, the debate should be about how this system can be improved, not dismantled.

SUMMARY

In this chapter, we discussed the market for RMBS and the important role that securitization played in the development of the secondary mortgage market. The RMBS market is divided into two sectors: agency MBS and nonagency MBS.

MBS issued by Ginnie Mae, Fannie Mae, and Freddie Mac are included in the agency MBS sector. The loans that are used as collateral in these securities are conforming loans. Agency MBS include pass-through securities, CMOs, and stripped MBS. CMOs are created from pass-through securities to address the prepayment risk associated with investing in pass-through securities—contraction risk and extension risk. CMO tranches are created to meet the different needs of institutional investors. Like a CMO, a stripped MBS is created from a pass-through security. The purpose of creating a stripped MBS is to provide an instrument that can be used to control the risk of a portfolio of mortgage-related securities.

The nonagency MBS market is divided into the private label MBS market and subprime MBS market. Nonagency MBS require that credit enhancement be provided to protect against losses from the underlying pool of loans. Mechanisms for credit enhancement include senior-subordinate structures, excess spread, overcollateralization, and monoline insurance. The senior-subordinate structure allows for the redistribution of credit risk among the tranches in the structure. The difference in the creation of prime MBS and subprime MBS is the complexity of the structure for dealing with credit enhancement.

TERMS

- ccrual tranche
- ency CMO
- ency mortgage-backed securities
- ency pass-through securities
- ency stripped mortgage-backed securities
- Average life
- Collateralized mortgage obligation (CMO)
- Companion bonds
- Conditional prepayment rate (CPR)
- Contraction risk

- Credit enhancement
- Excess spread
- Extension risk
- Guaranty fee
- Interest-only (IO) class
- Mortgage-backed security (MBS)
- Mortgage pass-through securities
- Mortgage strips
- Monoline insurance
- Nonagency CMO
- Nonagency mortgage-backed securities
- Overcollateralization
- Planned amortization class (PAC) bond
- Prepayment risk
- Prepayment speed
- Principal-only (PO) class
- Private label mortgage-backed securities
- Public Securities Association (PSA) prepayment benchmark
- Residential mortgage-backed security
- Securitize
- Senior-subordinate structure
- Sequential-pay CMOs
- Single-monthly mortality rate (SMM)
- Subprime mortgage-backed securities
- Support bond
- Tranches
- Z bond

QUESTIONS

1. What is a mortgage pass-through security?
2. Describe the cash flow of a mortgage pass-through security.
3. How has securitization enhanced the liquidity of mortgages?
4. What are the different types of agency pass-through securities?
5. How does the guaranty for a Ginnie Mae MBS differ from that of a MBS issued by Fannie Mae and Freddie Mac?
6. What is meant by prepayment risk, contraction risk, and extension risk?
7. Why would a pass-through be an unattractive investment for a savings and loan association?
8. What is meant by the average life of a pass-through?
9. Why is an assumed prepayment speed necessary to project the cash flow of a pass-through?
10. A cash flow for a pass-through typically is based on some prepayment benchmark. Describe the benchmark.
11. What does a conditional prepayment rate of 8% mean?
12. What does 150 PSA mean?
13. How does a CMO alter the cash flow from mortgages so as to shift the prepayment risk across various classes of bondholders?
14. "By creating a CMO, an issuer eliminates the prepayment risk associated with the underlying mortgages." Do you agree with this statement? Explain.
15. Explain the effect of including an accrual tranche in a CMO structure on the average lives of the sequential-pay structures.
16. What types of investors would be attracted to an accrual bond?
17. What was the motivation for the creation of PAC bonds?
18. Describe how the schedule for a PAC tranche is created.
19. a. Why is it necessary for a nonagency MBS to have credit enhancement?
    b. Who determines the amount of credit enhancement needed?
20. What is the difference between a prime and subprime MBS? Be sure to mention how they differ in terms of credit enhancement.
21. a. What is meant by a senior-subordinate structure?
    b. Why is the senior-subordinate structure a form of credit enhancement?
22. How can excess spread be a form of credit enhancement?



Market for Commercial Mortgage Loans and Commercial Morgage-Backed Securities

LEARNING OBJECTIVES

After reading this chapter, you will understand

- how commercial mortgage loans differ from residential mortgage loans
- the different property types for which commercial mortgage loans are obtained
- the two indicators of performance used for evaluating commercial mortgage loans—debt-to-service coverage ratio and loan-to-value ratio
- the different types of call protection provided for in commercial mortgage loans and in a commercial mortgage-backed security
- what balloon risk is for a commercial mortgage loan and a commercial mortgage-backed security
- differences in structuring a commercial mortgage-backed and residential mortgage-backed securities transaction
- the structural features of a commercial mortgage-backed securities deal
- the different types of servicers in a commercial mortgage-backed securities deal
- how commercial mortgage-backed securities trade in the market

The mortgage market consists of residential mortgages and commercial mortgages. Residential mortgage loans are for properties with one to four single-family units and are used to create residential mortgage-backed securities. In this chapter, we look at commercial mortgage loans and securities backed by commercial mortgages—commercial mortgage-backed securities.

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COMMERCIAL MORTGAGE LOANS

Commercial mortgage loans are for mortgage loans for income-producing properties. A commercial mortgage loan is originated either to finance the purchase of a commercial property or refinance a prior mortgage obligation on a commercial property. Commercial mortgage loans are **nonrecourse loans**, which means that if the borrower fails to make the contractual payments, the lender can only look to the income-producing property backing the loan for interest and principal repayment.

The major property types that have been securitized are

- multifamily properties
- apartment buildings
- office buildings
- industrial properties (including warehouses)
- shopping centers
- hotels
- health care facilities (e.g., senior housing care facilities)

Indicators of Potential Performance

Because commercial mortgage loans are nonrecourse loans, the lender looks only to the property to generate sufficient cash flow to repay principal and to pay interest. If there is a default, the lender looks to the proceeds from the sale of the property for repayment and has no recourse to the borrower for any unpaid balance. There are different risks associated with investing in each property type.

Regardless of the property type, the two measures that have been found to be key indicators of the potential credit performance are the debt-to-service coverage ratio and the loan-to-value ratio.

The **debt-to-service coverage (DSC) ratio** is the ratio of a property's **net operating income** (NOI) divided by the debt service. The NOI is defined as the rental income reduced by cash operating expenses (adjusted for a replacement reserve). A ratio greater than 1 means that the cash flow from the property is sufficient to cover debt servicing. The higher the ratio, the more likely it is that the borrower will be able to meet debt servicing from the property's cash flow.

The **loan-to-value (LTV) ratio** is a measure used in residential mortgage loans. For residential mortgage loans, "value" is either market value or appraised value. For income-producing properties, the value of the property is based on the fundamental principles of valuation: The value of an asset is the present value of its expected cash flow. Valuation requires projecting an asset's cash flow and discounting it at an appropriate interest rate(s). In valuing commercial property, the cash flow is the future NOI. A discount rate (a single rate), referred to as the "capitalization rate," reflecting the risks associated with the cash flow is then used to compute the present value of the future NOI. Consequently, there can be considerable variation in the estimates of NOI and the appropriate capitalization rate in estimating a property's value. Thus, investors are often skeptical about estimates of value and the resulting LTVs reported for properties.

Call Protection

For residential mortgage loans, only prepayment penalty mortgages provide some protection against prepayments. For commercial mortgage loans, call protection can take the

following forms: (1) prepayment lockout, (2) defeasance, (3) prepayment penalty points, and (4) yield maintenance charges.

A **prepayment lockout** is a contractual agreement that prohibits any prepayments during a specified period of time, called the **lockout period**. The lockout period can be from two to 10 years. After the lockout period, call protection usually comes in the form of either prepayment penalty points or yield maintenance charges.

With **defeasance**, the borrower provides sufficient funds for the servicer to invest in a portfolio of Treasury securities that replicates the cash flows that would exist in the absence of prepayments. Defeasance is a method commonly used by municipal bond issuers for prerefunding a bond issue. For example, in May 2005, the Fountainbleau Hilton in Miami was defeased.

Prepayment penalty points are predetermined penalties that must be paid by the borrower if the borrower wishes to refinance. For example, 5-4-3-2-1 is a common prepayment penalty point structure. That is, if the borrower wishes to prepay during the first year, the borrower must pay a 5% penalty; in the second year, a 4% penalty would apply; and so on.

A **yield maintenance charge**, in its simplest terms, is designed to make the lender indifferent as to the timing of prepayments. The yield maintenance charge, also called the make whole charge, makes it uneconomical to refinance solely to get a lower mortgage rate. The simplest and most restrictive form of yield maintenance charge ("Treasury flat yield maintenance") penalizes the borrower based on the difference between the mortgage coupon rate and the prevailing Treasury rate.

Balloon Maturity Provisions

Commercial mortgage loans are typically balloon loans requiring substantial principal payment at the end of the balloon term. If the borrower fails to make the balloon payment, the borrower is in default. The lender may extend the loan and in so doing will typically modify the original loan terms. During the workout period for the loan, a higher interest rate will be charged, the **default interest rate**. The risk that a borrower will not be able to make the balloon payment because the borrower either cannot arrange for refinancing by the balloon payment date or cannot sell the property to generate sufficient funds to pay off the balloon balance is called **balloon risk**. Because the term of the loan will be extended by the lender during the workout period, balloon risk is also referred to as **extension risk**.

Key Points That You Should Understand Before Proceeding

1. Commercial mortgage loans are nonrecourse loans for the purchase of income-producing properties, the major ones being apartment buildings, office buildings, industrial properties, shopping centers, hotels, and health care facilities.
2. The two measures that have been found to be key indicators of the potential credit performance of a commercial mortgage loan are the DSC ratio and the LTV ratio.
3. Call protection for commercial mortgage loans includes prepayment lockout, defeasance, prepayment penalty points, and yield maintenance charges.
4. Balloon risk associated with a commercial mortgage loan is the risk that a borrower will not be able to make the balloon payment because either the borrower cannot arrange for refinancing at the balloon payment date or cannot sell the property to generate sufficient funds to pay off the balloon balance.

COMMERCIAL MORTGAGE-BACKED SECURITIES

Many types of commercial loans can be sold by the originator as a commercial whole loan or structured into a **commercial mortgage-backed security** (CMBS) transaction. A CMBS is a security backed by one or more commercial mortgage loans. The whole loan market, which is largely dominated by insurance companies and banks, is focused on loans between $10 and $50 million issued on traditional property types (multifamily, retail, office, and industrial). CMBS transactions, on the other hand, can involve loans of virtually any size (from as small as $1 million to single property transactions as large as $200 million) and/or property type. Worldwide, the four largest property types that have been securitized, representing more than 80% of market issuance, have been retail properties such as shopping centers, office buildings, hotels, and multifamily houses. In the first quarter of 2006, for example, the share of these four property types in CMBS was as follows: shopping centers (36%), office buildings (23%), hotels (14%), and multifamily houses (13%).[1]

Issuers of Commercial Mortgage-Backed Securities

As with residential mortgage-backed securities (RMBS), CMBS can be issued by Ginnie Mae, Fannie Mae, Freddie Mac, and private entities. All of the securities issued by Ginnie Mae, Fannie Mae, and Freddie Mac are consistent with their mission of providing funding for residential housing. This includes securities backed by nursing home projects and health care facilities.

Ginnie Mae–issued securities are backed by Federal Housing Administration–insured multifamily housing loans. These loans are called **project loans**. From these loans, Ginnie Mae creates project loan pass-through securities. The securities can be backed by a single project loan on a completed project or one or more project loans. Freddie Mac and Fannie Mae purchase multifamily loans from approved lenders and either retain them in their portfolio or use them as collateral for a security. This is no different from what these two government-sponsored enterprises do with single-family mortgage loans that they acquire.

Although securities backed by Ginnie Mae and issued by the two government-sponsored enterprises constitute the largest sector of the RMBS market, it is the securities issued by private entities that is by far the largest sector of the CMBS market. Typically, it is more than 97% of the market.

CMBS are backed by either newly originated or seasoned commercial mortgage loans. Most CMBS are backed by newly originated loans. CMBS can be classified by the type of loan pool. The first type of CMBS are those backed by a single borrower. Usually such CMBS are backed by large properties such as regional malls or office buildings. The investors in this type of CMBS are insurance companies. In the first quarter of 2006, single-borrower deals represented about 12% of market issuance in the U.S. market but 71% of deals outside the United States.

The second type of CMBS is that backed by loans to multiple borrowers. This is the most common type of CMBS and is backed by a variety of property types. The most prevalent form of deal backed by commercial mortgage loans to multiple borrowers is the **conduit deal**. These deals are created by investment banking firms that establish a conduit arrangement with

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[1] As reported by *Commercial Mortgage Alert*.

mortgage bankers to originate commercial mortgage loans specifically for the purpose of securitizing them (i.e., creating CMBS). The mortgage bankers originate and underwrite the loans using the capital provided by the investment banking firm. There are multiple borrower CMBS deals that combine loans that are included in conduit deals with a large or "mega" loan. These CMBS deals are called **fusion deals or hybrid deals**. For the first quarter of 2006, fusion deals dominated the U.S. market—79% of market issuance—while outside the United States, conduit/fusion deals made up 23% of market issuance.

As noted earlier, a CMBS deal can be backed by seasoned commercial mortgage loans. A seasoned loan is one that is already residing on the balance sheet of a bank or insurance company. Typically, the reason why a bank or insurance company will securitize a seasoned commercial loan is to remove the loan from its balance sheet; that is, it uses securitization to restructure its balance sheet. CMBS deals in the United States that are backed by seasoned collateral usually represent less than 3% of market issuance.

Servicers

As with a nonagency RMBS, a servicer is required and plays an important role. The responsibilities of the servicer include collecting monthly loan payments, keeping records relating to payments, maintaining property escrow for taxes and insurance, monitoring the condition of underlying properties, preparing reports for the trustee, and transferring collected funds to the trustee for payment to bondholders.

In a CMBS transaction, there is usually a master servicer and special servicer. The **master servicer** is responsible for (1) overseeing the deal, (2) verifying that all servicing agreements are being maintained, and (3) facilitating the timely payment of interest and principal. This last function is critical for a CMBS transaction. If a loan is in default, it is the master servicer that must provide for servicing advances. To fulfill this role, the master servicer must have the financial capacity to provide advances.

A **special servicer** is responsible for delinquent loans and workout situations. Basically, the objective of the special service is to maximize the recovery of defaulted loans.

Illustration of a Commercial Mortgage-Backed Security Deal

In the previous chapter, we discussed how an agency CMO and a nonagency CMO are created. The structure of a CMBS deal is much the same. There are different bond classes or tranches and there are rules for the distribution of interest, principal, and losses.

Table 1 shows the bond classes of a CMBS deal, Banc of America Commercial Mortgage Trust 2006-1. Only the bond classes offered to the public are identified. The credit rating for each bond class is shown. For the bond classes offered, the senior certificates in this CMBS deal are Class A-1, Class A-2, Class A-3A, Class A-3B, Class A-4, Class A-1A, and Class XP Certificates. The junior certificates are Class A-M, Class A-J, Class B, Class C, and Class D. The subordination (credit support), priority of payment, and order of loss allocation as set forth in the prospectus supplement are reproduced in Figure 1.

The mortgage pool consists of 192 loans. A loan may be for more than one property. Table 2 shows the number of mortgage properties by type. The 10 largest loans in the mortgage pool are listed in Table 3, along with the LTV and DSC ratios at the time of issuance.

The master servicer for this deal is Capital Markets Servicing Group of Bank of America. The special servicer is Midland Loan Services, Inc.

Table 1 CMBS Deal Illustration: Banc of America Commercial Mortgage Trust 2006-1

Class	Balance	Coupon Rate	Moody/S&P Rating
Class A-1	$ 81,500,000	5.219%	Aaa/AAA
Class A-2	84,400,000	5.334%	Aaa/AAA
Class A-3A	130,100,000	5.447%	Aaa/AAA
Class A-3B	25,000,000	5.447%	Aaa/AAA
Class A-4	616,500,000	5.372%(a)	Aaa/AAA
Class A-1A	355,399,000	5.378%(a)	Aaa/AAA
Class A-M	203,766,000	5.421%(a)	Aaa/AAA
Class A-J	142,637,000	5.46%(a)	Aaa/AAA
Class XP	1,989,427,000	0.3406%(b)	Aaa/AAA
Class B	20,377,000	5.49%(a)	Aa1/AA+
Class C	22,924,000	5.509%(a)	Aa2/AA
Class D	20,376,000	5.6424%(c)	Aa3/AA–

(a) The Class A-4, Class A-1A, Class A-M, Class A-J, Class B, and Class C Certificates will each accrue interest at a fixed rate subject to a cap at the weighted average net mortgage rate.
(b) The Class D Certificates will accrue interest at the weighted average net mortgage rate minus 0.134%.
(c) The Class XP Certificates will accrue interest on their related notional amount as described in the prospectus supplement.

Source: *Prospectus Supplement*

Differences Between CMBS and Nonagency RMBS Structuring

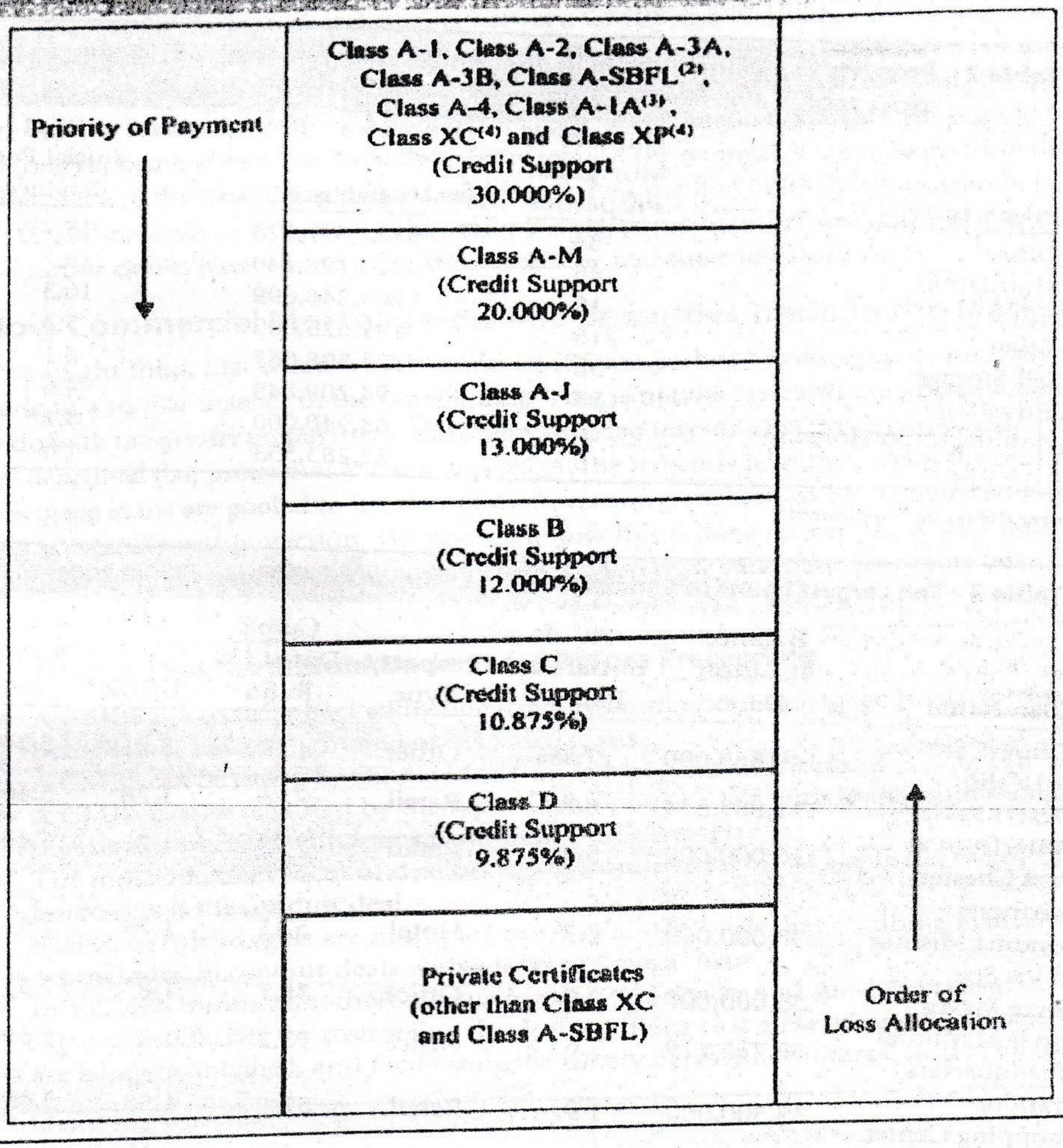
The structure of a transaction is the same as in a nonagency RMBS in that most structures have multiple bond classes (tranches) with different ratings, and there are rules for the distribution of interest and principal to the bond classes. However, there are three major differences due to the features of the underlying loans.[2]

First, as explained earlier, prepayment terms for commercial mortgages differ significantly from residential mortgages. The former impose prepayment penalties or restrictions on prepayments. Although there are residential mortgages with prepayment penalties, they are a small fraction of the market. In structuring a CMBS, there are rules for the allocation of any prepayment penalties among the bondholders. In addition, if there is a defeasance, the credit risk of a CMBS virtually disappears because it is then backed by U.S. Treasury securities.

The second difference in structuring is due to the significant difference between commercial and residential mortgages with respect to the role of the servicer when there is a default. With commercial mortgages, the loan can be transferred by the servicer to the *special* servicer when the borrower is in default, imminent default, or in violation of covenants. The key here is that it is transferred when there is an imminent default. The special servicer has the responsibility of modifying the loan terms in the case of an imminent default to reduce the likelihood of default. There is no equivalent feature for a residential mortgage in the case of an imminent default. The particular choice of action that may be taken by the special servicer for a commercial mortgage will generally have different effects on the various bond classes in a CMBS structure. Moreover, there can be a default due to

[2] David P. Jacob, James M. Manzi, and Frank J. Fabozzi, "The Impact of Structuring on CMBS Bond Class Performance," Chapter 51 in Frank J. Fabozzi (ed.), *The Handbook of Mortgage-Backed Securities*, 6th ed. (New York: McGraw-Hill, 2006).

Figure 1 Subordination (Credit Support),[1] Priority of Payment, and Order of Loss Allocation for Banc of America Commercial Mortgage Trust 2006-1



Notes:

(1) *The credit support percentage set forth in this chart shows the aggregate initial class balance of the classes of certificates subordinate to a class or classes as a percentage of the initial aggregate principal balance of the mortgage loans.*

(2) *The Class A-SBFL regular interest has a certain priority with respect to being paid down to its planned principal balance on any distribution date as described in this prospectus supplement.*

(3) *The Class A-1A Certificates generally have a priority entitlement to principal payments received in respect of mortgage loans included in loan group 2. The Class A-1, Class A-2, Class A-3A, Class A-3B and Class A-4 Certificates and the Class A-SBFL regular interest generally have a priority entitlement to principal payments received in respect of mortgage loans included in loan group 1. See "Description of the Certificates—The Available Distribution Amount" in this prospectus supplement.*

(4) *The Class XC and Class XP Certificates will be senior only with respect to payments of interest and will not be entitled to receive any payments in respect of principal.*

No other form of credit enhancement will be available for the benefit of the holders of the offered certificates.

In addition, while mortgage loan losses will not be directly allocated to the Class A-SBFL certificates, mortgage loan losses allocated to the Class A-SBFL regular interest will result in a corresponding decrease in the certificate balance of the Class A-SBFL certificates, and any interest shortfalls suffered by the Class A-SBFL regular interest will reduce the amount of interest distributed on the Class A-SBFL certificates.

Any allocation of a loss to the Class A-SBFL regular interest (and the corresponding Class A-SBFL certificates) will reduce the principal amount of the Class A-SBFL regular interest (and the corresponding Class A-SBFL certificates).

Source: *Prospectus Supplement*

Table 2 Property Types Included in Banc of America Commercial Mortgage Trust 2006-1

Property Type	Number of Mortgaged Properties	Balance	% of Initial Pool Balance
Office	34	$401,697,123	19.7%
Multifamily	45	320,198,140	15.7
Hotel	19	209,246,699	10.3
Other	713	149,625,000	7.3
Self Storage	38	123,898,067	6.1
Industrial	13	94,209,849	4.6
Manufactured Housing	6	63,940,000	3.1
Mixed Use	6	32,283,553	1.6

Source: *Prospectus Supplement*

Table 3 Ten Largest Loans in Banc of America Commercial Mortgage Trust 2006-1

Loan Name	Balance at Cutoff Date	% of Initial Pool Balance	Property Type	Cutoff Date LTV Ratio	DSCR	Mortage Rate
KinderCare Portfolio	$149,625,000	7.3%	Other	40.8%	3.21x	5.24%
Desert Passage	131,883,334	6.5	Retail	72.6	1.28	5.46
Waterfront at Port Chester	110,000,000	5.4	Retail	71.9	1.2	5.46
Fairmont Sonoma Mission Inn & Spa	55,000,000	2.7	Hotel	52.1	1.94	5.4
Torre Mayor	55,000,000	2.7	Office	38.3	1.8	7.55
Medical Mutual Headquarters	52,715,219	2.6	Office	73.2	1.2	5.65
Frandor Shopping Center	39,500,000	1.9	Retail	57	1.53	5.46
Metro Plaza at Jersey City	39,000,000	1.9	Retail	75	1.2	5.73
Plaza Antonio	39,000,000	1.9	Retail	65.7	1.2	6.08
Main Event Portfolio	35,512,892	1.7	Retail	68.6	1.45	5.62
Total/Wtd Avg	**$707,236,445**	**34.7%**		**60.2%**	**1.78x**	**5.64%**

Source: *Prospectus Supplement*

failure to make the balloon payment at the end of the loan term. There can be differences in loans as to how to deal with defaults due to a failure to meet the balloon payment. Thus, balloon risk must be taken into account in structuring a CMBS transaction, which because of the significant size of the payment can have a considerable impact on the cash flow of the structure. Balloon risk is not something that has to be dealt with in structuring an RMBS.

The third difference in structuring between CMBS and RMBS has to do with the role of the buyers when the structure is being created. More specifically, potential buyers of the junior bond classes are typically first sought by the issuer before the deal is structured. The potential buyers first review the proposed pool of mortgage loans, and in the review process, depending on market demand for CMBS products, may request the removal of some loans from the pool. This phase in the structuring process, which one does not find in RMBS transactions, provides an additional layer of security for the senior buyers, particularly because some of the buyers of the junior classes have tended to be knowledgeable real estate investors.

How Commercial Mortgage-Backed Securities Trade in the Market

One might think that because CMBS and RMBS are backed by mortgage loans, they would trade in a similar manner in the marketplace. That is not the case, and the primary reason has to do with the greater prepayment protection afforded investors in CMBS compared to RMBS. We described that protection at the loan level. At the structure level (i.e., when the commercial mortgage loans are pooled to create a CMBS), certain tranches can be created that give even greater prepayment protection. We described how this is done for cert in RMBS tranches in collateralized mortgage obligations. As a result, CMBS trade much like corporate bonds.[3]

Key Points That You Should Understand Before Proceeding

1. A CMBS is a security backed by one or more commercial mortgage loans, the loans being either newly originated or seasoned loans.
2. A CMBS can be issued by Ginnie Mae, Fannie Mae, Freddie Mac, and private entities.
3. A CMBS can be classified by the type of loan pool: CMBS with loans from a single borrower and those with loans from multiple borrowers.
4. The most prevalent form of deal backed by commercial mortgage loans to multiple borrowers is the conduit deal.
5. Fusion or hybrid deals are multiple borrower CMBS deals that combine loans that are included in conduit deals with a large or "mega" loan.
6. In a CMBS transaction, there is usually a master servicer and special servicer, the former responsible for overseeing the deal, verifying that all servicing agreements are being maintained, and facilitating the timely payment of interest and principal.

SUMMARY

Commercial mortgage loans are for income-producing properties. Commercial mortgage loans are nonrecourse loans. Consequently, the lender looks only to the property to generate sufficient cash flow to repay principal and to pay interest and, if there is a default, the lender looks to the proceeds from the sale of the property for repayment.

Two measures that have been found to be important measures of potential credit performance for a commercial mortgage loan are the DSC ratio and the LTV ratio. For commercial mortgage loans, call protection can take one or more of the following forms: prepayment lockout, defeasance, prepayment penalty points, or yield maintenance charges. Commercial mortgage loans are typically balloon loans requiring substantial principal

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[3] See Brian P. Lancaster, "Introduction to Commercial Mortgage-Backed Securities," Chapter 23 in Frank J. Fabozzi (ed.), *The Handbook of Nonagency Mortgage-Backed Securities* (Hoboken, NJ: John Wiley & Sons, 1999).

payment at the end of the balloon term. If the borrower fails to make the balloon payment, the borrower is in default. Balloon risk, also called extension risk, is the risk that a borrower will not be able to make the balloon payment because the borrower either cannot arrange for refinancing at the balloon payment date or cannot sell the property to generate sufficient funds to pay off the balloon balance.

CMBS are issued by Ginnie Mae, Fannie Mae, Freddie Mac, and private entities, with the latter representing the largest part of the market. The structure of a transaction is the same as in a nonagency residential mortgage-backed security, with the typical structure having multiple bond classes with different ratings. There are rules for the distribution of interest and principal to the bond classes and the distribution of losses. However, there are differences in structuring transactions due to prepayment features, the role of the special servicer in the case of imminent default, and the role of potential investors when the deal is being structured.

KEY TERMS

- Balloon risk
- Commercial mortgage-backed security (CMBS)
- Commercial mortgage loans
- Conduit deal
- Debt-to-service coverage (DSC) ratio
- Default interest rate
- Defeasance
- Extension risk
- Fusion deal
- Hybrid deal
- Loan-to-value (LTV) ratio
- Lockout period
- Master servicer
- Net operating income (NOI)
- Nonrecourse loans
- Prepayment lockout
- Prepayment penalty points
- Project loans
- Special servicer
- Yield maintenance charge

QUESTIONS

1. What is a commercial mortgage loan?
2. How is the NOI of a commercial property determined?
3. Why might an investor be skeptical about the LTV ratio for a commercial mortgage loan?
4. What is the underlying principle for a yield maintenance charge?
5. What types of prepayment protection provisions result in a prepayment premium being paid if a borrower prepays?
6. Why is balloon risk referred to as extension risk?
7. What are the major differences in structuring CMBS and RMBS transactions?
8. What are the typical duties of a special servicer?
9. The following statement was made in a special report, *Commercial Mortgage Special Report* (September 19, 2005, p. 2) by Fitch Ratings: "Defeasance of a loan in a CMBS transaction is a positive credit event." Explain why.
10. Explain whether you agree or disagree with each of the following statements:
    a. "The largest sector of the CMBS market is securities issued by agencies and government-sponsored securities."
    b. "Most CMBS deals are backed by newly originated commercial mortgage loans."
    c. "A fusion CMBS deal has only one single large borrower."
11. Why do CMBS trade in the market more like corporate bonds than RMBS?