VANDERBILT Ave.
ASSET MANAGEMENT

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INTRODUCTION TO CMOs

Collateralized Mortgage Obligations, or CMOs, have become a major part of the fixed income market with approximately $1 trillion of bonds outstanding. CMOs offer investors the high yields and the superior credit quality associated with mortgage-backed securities. Virtually all CMOs are rated AAA by Standard and Poor's and/or Moody's or have an implicit AAA rating through government agency backing. This AAA rating is based not on the credit of the issuer, but rather on the structure of the CMO and the credit quality of the collateral.

CMOs provide several attractive features not otherwise available in mortgage-backed securities. Among these are **a choice of average lives** ranging from as short as one year to longer than twenty years, and a **limited form of protection from (or excess concentration in) the prepayment risk** associated with mortgage backed securities in general. Because of these features, CMOs have enabled many new investors to realize the yield and credit quality advantages of mortgage-backed securities.

I. MORTGAGE-BACKED SECURITIES

A CMO is a bond which is collateralized by mortgage-backed pass-through securities. Therefore, to understand CMO structures, an investor must first be knowledgeable about mortgage-backed pass-through securities.

A mortgage-backed pass-through security is an undivided interest in a pool of mortgages. Interest on the security is payable monthly. Investors in the security also receive, monthly, a pro-rata share of the principal payments on the mortgages in the pool. These payments include both scheduled and unscheduled principal payments. Unscheduled principal payments, or **pre-payments**, primarily occur for two reasons: First, non-assumable loans must be paid-off when the borrower is selling his/her home, usually using proceeds from the sale. Second, home loan borrowers always have the right to prepay their mortgages. If interest rates decline, they may elect to refinance, that is to prepay the face amount of the existing higher coupon mortgage and to obtain a new one at a lower rate.

The variability of prepayments is the most important aspect of understanding mortgage-backed securities. Changes in prepayment rates may impact yield, total return, and average life. Faster prepayments shorten average life, decrease yield on a premium priced issue, and increase yield on a discount; a slowing of prepayments has the opposite effect. Thus an investor cannot be certain of the yield or average life of his investment.

The three major types of mortgage-backed securities are GNMAs, FNMA MBSs, and FHLMC PCs, which are guaranteed respectively by the Government National Mortgage Association

(GNMA or "Ginnie Mae"), the Federal National Mortgage Association (FNMA or "Fannie Mae"), and the Federal Home Loan Mortgage Corporation (FHLMC or "Freddie Mac"). "MBS" stands for mortgage-backed securities, while "PC" stands for participation certificates.

GNMA is a United States Government agency. GNMA securities are backed by the full faith and credit of the United States Government. GNMA guarantees the timely payment of principal and interest on its securities. The underlying mortgages in a GNMA are either insured by the Federal Housing Authority (FHA) or guaranteed by the Veteran Administration (VA), which adds an additional layer of protection for the investor.

FNMA is a privately owned corporation with total assets of $230 billion and stockholder's equity of $21.2 billion, as of the end of first quarter, 1994. Although it is not a direct United States Government agency, FNMA was chartered by Congress in 1970, and has a $2.25 billion line of credit to the United States Treasury. FNMA guarantees the timely payment of principal and interest on its MBSs.

FHLMC is a corporate instrumentality of the United States, owned by all federally insured savings and loan institutions. FHLMC had total assets of $58 billion and stockholder's equity of $9.2 billion, as of the end of the first quarter, 1994. FHLMC guarantees the timely payment of interest and the eventual payment of principal on its PCs.

II. THE STRUCTURE OF A CMO

The issuer of a CMO is generally a special purpose financing subsidiary set up for the sole purpose of issuing CMOs. The issuer purchases a collection of mortgage-backed pass-through securities and places these securities in a trust, which is administered by an independent trustee. Next, the issuer issues several classes, or **tranches** of bonds whose debt service will be provided by the cashflow from the collection of mortgage-backed pass-through securities in the trust. The collection of mortgage-backed pass-through securities is called the **collateral** and is said to **collateralize the bonds**. The bonds issued are themselves the **Collateralized Mortgage Obligations** or **CMOs**.

Although the mortgage-backed collateral has monthly payments, payments of principal and interest on the CMO bonds can be semiannual, quarterly, or most commonly, monthly. Payments received from the collateral are reinvested short term by the trustee between payment dates on the CMO. On the CMO payment dates, the cashflow from the collateral plus reinvestment income is applied first to pay interest on the bonds, and then to repay principal. The bonds are retired according to rules of paydown which are unique to that deal. In a sequential structure, only after the first tranche is entirely retired, do principal payments commence on the second tranche. The process continues in this sequence until all tranches are retired.

The last tranche of a CMO is usually a "**deferred interest bond**" or **accrual tranche**, or **Z-bond**. While the earlier tranches are still outstanding, **no interest is paid** on an accrual tranche. The cashflow is used instead to retire bonds in the earlier outstanding tranches.

Figure 1 illustrates how principal is repaid on a simple four tranche CMO. At first, as principal is paid on the first tranche, the balance of that tranche is reduced (Frame 1). While the first tranche is being reduced, the balance remains constant on the second and third tranches and the balance of the deferred interest bond tranche actually increases. After the first tranche is retired, the second tranche starts being repaid (Frame 2), while the balance of the third tranche remains constant and the balance of the deferred interest bond continues to increase. Upon the complete retirement of the second tranche, principal reduction of the third tranche commences (Frame 3), with the deferred interest bond balance still increasing. After all of the first three tranches are repaid, the then current principal balance of the deferred interest bond (increased by the accruals while the earlier tranches were outstanding) is reduced (Frame 4), eventually to zero.

FIGURE 1
Principal Balances of the Tranches of a Typical CMO

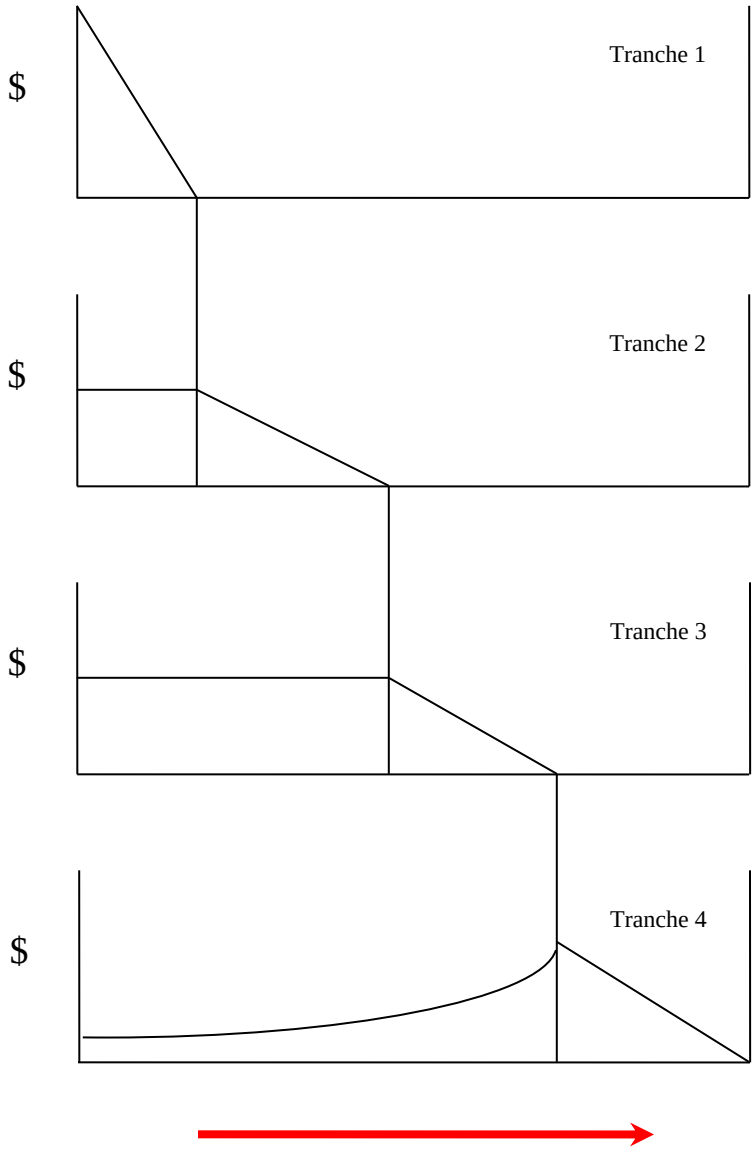
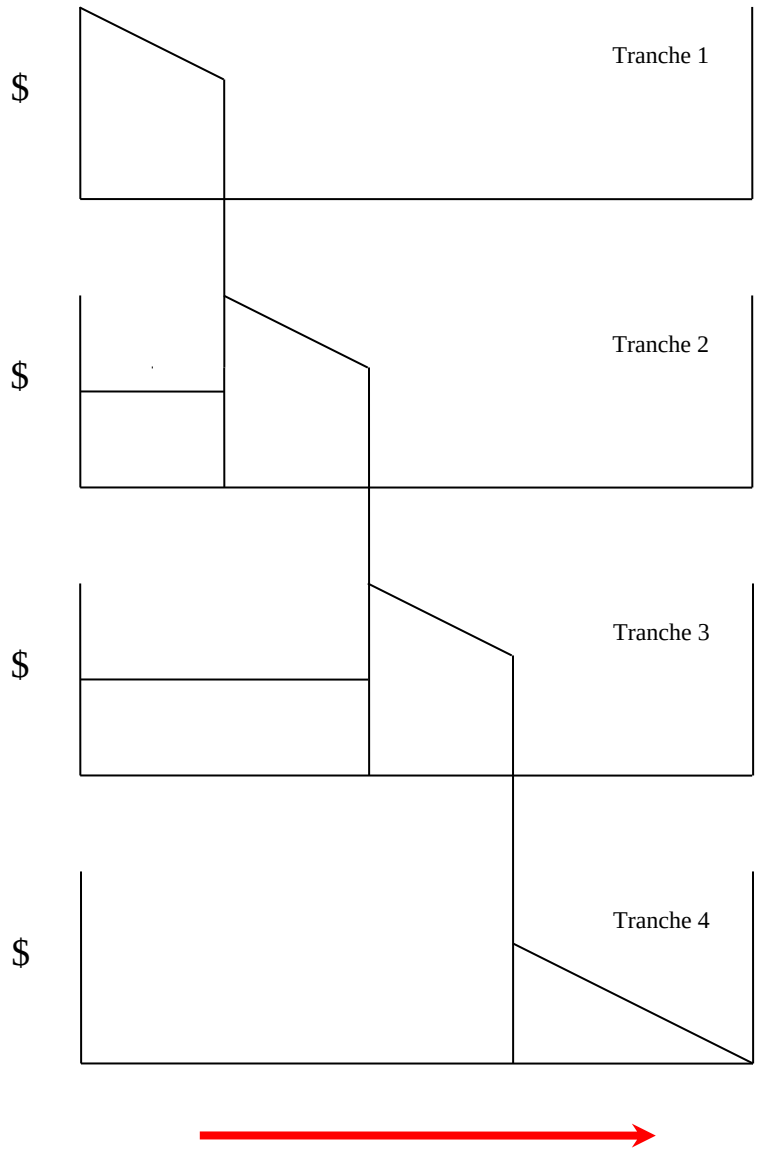


Figure 2 illustrates the cashflow for the same CMO. The first tranche, with all its cashflow concentrated in the early years, is a short term investment, typically with an average life of 2-3 years. The second and third tranches are both intermediate term investments, with average lives typically in the 5-10 year range. These classes initially receive only interest, and then, after the classes in front of them have paid off, they begin to receive principal payments. Naturally the third tranche has a longer life than the second tranche. The fourth tranche has a very long life, receiving no cashflow until the first three tranches have been paid off.

FIGURE 2
Cash Flow of the Tranches of a Typical CMO



Thus, as a result of the tranching of collateral cashflows, CMOs offer an investor a choice of average life. Consequently, because of their structure, CMOs enable an investor to enjoy the yield and credit quality advantages of mortgage-backed securities and at the same time to satisfy specific average life and duration requirements. A holder of a mortgage-backed pass-through security will begin to receive principal repayments at the beginning of their investment, but will not receive the last payments for almost 30 years; in between, an irregular and unpredictable stream of payments will be received. In contrast, by investing in a CMO, an investor can limit the time span over which principal payments are received and target a desired average life. **Furthermore, the availability of a shorter term mortgage-backed security (i.e., the first or second tranche of CMOs) and floating-rate CMOs has afforded short term investors the opportunity to enjoy the benefits of investing in mortgage-backed securities.**

As noted in the introduction, virtually all CMOs are rated AAA. To qualify for this rating, a CMO is always structured so that even under the most conservative prepayment and reinvestment assumptions, the cashflow from the collateral will always meet or exceed the cashflow obligations of all the tranches of the CMO. Additionally, the CMO issuer is a special purpose corporation whose only business is the issuance of CMOs and which has no debt other than the CMOs themselves. Finally, the **pledge of the collateral to the trustee is protected against claims in the event of bankruptcy of the parent of the issuer**. Thus the investor is looking directly to the collateral for creditworthiness, and, even in the event of the insolvency of the issuer's parent, can still expect to be paid.

III. IMPACT OF THE COLLATERAL

The composition of the collateral affects the creditworthiness, the universe of potential buyers, the yield spread to Treasuries, and the prepayment assumption of a CMO. The main variables concerning the collateral are type (GNMA, FNMA, FHLMC, Whole Loan), coupon, and age.

Some investors are constrained to buy only certain types of collateral. Because of the full faith and credit guarantee on the underlying collateral, GNMA-collateralized CMOs appeal to the broadest class of investors and hence tend to trade at the lowest yields.

The higher the interest rates on the mortgages underlying the collateral, the faster the collateral will generally prepay. Rates lower than current interest rates provide the best protection against prepayment risk. A quick measure of coupons in the collateral is the weighted average coupon, or **WAC**, which is defined as the average of all the coupons on the pools in the collateral, weighted by the sizes of the pools.

IV. PREPAYMENTS

The speed at which the mortgage collateral prepays affects the maturity and average life of all the tranches of a CMO as well as the price/yield relationship. Therefore it is important to understand how the prepayment speed is measured. The two prepayment models in use today are the **CPR** (Constant Prepayment Rate) model and the **PSA** (Public Securities Association) model.

In the CPR model, a specified percentage of the remaining mortgage in a pool is assumed to prepay per year. For example, if a pool initially contained mortgages with a total original

balance of $10 million, then, under a 10% CPR assumption, at the end of one year, mortgages with a total original balance of $9 million would remain ($1 million original balance, or 10% of $10 million prepays). During the second year, 10% of $9 million (the original balance of the **remaining** mortgages), or $900,000 original balance of mortgages is assumed to prepay, leaving mortgages with an original balance of $8.1 million.

Historical experience indicates that mortgages do not prepay according to the CPR model; the PSA model is constructed to reflect the assumption that at first a pool of mortgages will hardly prepay at all, gradually they increase their prepayments, and then, after about 30 months, prepayments level off. Figure 3 illustrates how the PSA model works. For example a 100% PSA assumption means that, between 0 and 30 months, the CPR increases linearly from 0% to 6%. After 30 months, the mortgages prepay at a 6% CPR. For a different PSA assumption, multiply all the above numbers by the ratio of the PSA assumption to 100%. For example, for a 200% PSA, the CPR increases from 0% to 12% and levels off at 12% after 30 months. Note that when collateral is more than 2 ½ years old, the PSA model and the CPR model coincide (i.e., 100% PSA = 6% CPR).

CMOs are priced using a given prepayment assumption which is based on recent historical prepayments as well as current prepayment projections for the collateral backing the CMO. It is important to realize that the prepayment assumption is not guaranteed and that changes in prepayment rates will have an impact on yield, total return, average life and projected final maturity. Therefore, it is important to be able to project prepayment speeds for a CMO, or to check whether the prepayment assumption used in pricing a CMO is reasonable. To do this, an investor should consider the characteristics of the collateral, recent prepayment experience for comparable collateral (i.e., of the same type, coupon, and age), and the interest rate environment during the period used for current projections for interest rates. In addition, investors should take into account such special factors as seasonal prepayment patterns (prepayments tend to be faster in late spring and summer), size of the underlying loans, limits of the origination industry's capacity to process new mortgages, and legislative changes in the insurance, guarantee, and issuing authority of FHA, VA and GNMA respectively.

V. MEASURING MATURITY

There are several different measures relating to the term of a given tranche of a CMO.

Stated Maturity. This is the theoretically latest date by which the bonds would be completely repaid. This is computed assuming no prepayments. Since the mortgage collateral will most certainly have some prepayments, the stated maturity is longer than the investment will actually be outstanding and is therefore not a realistic measure of the maturity of the investment. However, the stated maturity can be important to an investor, especially for regulatory purposes. In particular, agency-issued CMOs with a stated maturity of less than 5 years can qualify as "liquid assests" for federal savings and loan associations, federal savings banks, and other Federal Home Loan Bank members. Because of the guaranteed minimum payment schedule on it CMOs, agency CMOs have been structured so that many of the early tranches do have a maturity of less than 5 years.

Projected Maturity. This is the date by which the bonds would be completely retired assuming the collateral pays down at a given prepayment speed (i.e., 200% PSA). This is a more realistic estimate of final maturity than the stated maturity.

First Paydown Date. This is the date on which principal paydowns commence on a given CMO tranche assuming a given prepayment speed.

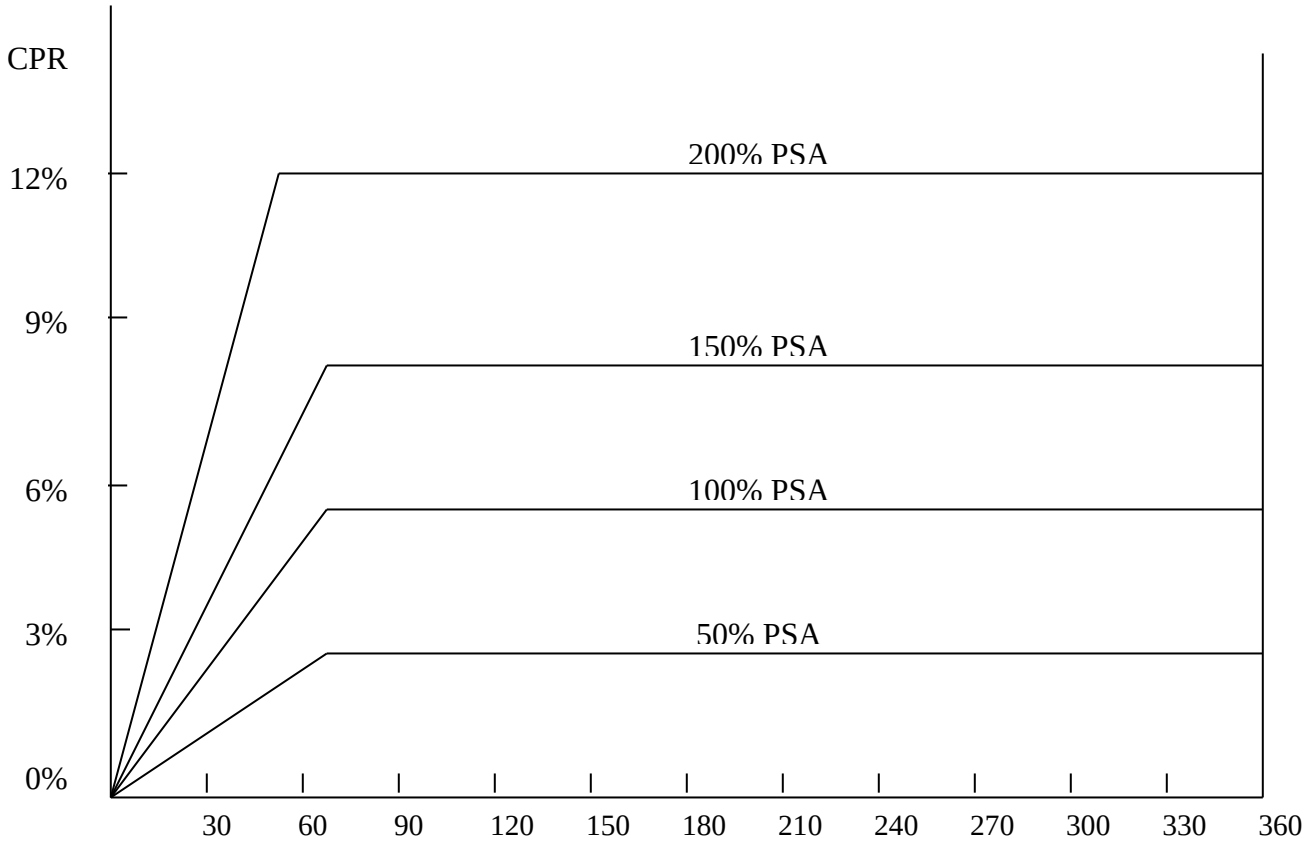
Average Life. The average life is the average time to the receipt of principal weighted by the size of each principal payment, for a given CMO tranche assuming a given prepayment speed. This measure is used as the maturity indicator for CMOs, especially for use in pricing CMOs using the Treasury yield curve as a benchmark (i.e., a CMO with an average life of about 7 years is priced to yield a given spread over the 7-year Treasury issue).

To illustrate the concept of average life, suppose that a $1,000 bond repays its principal as follows: $200 in year 1, $300 in year 2, and $500 in year 3. Then the average life would be computed as:

$$\frac{(1 \times \$200) + (2 \times \$300) + (3 \times \$500)}{\$1000} = 2.3 \text{ years}$$

Note that the average life will be between the first paydown date and the projected maturity.

FIGURE 3
The PSA Mode



VI. YIELD CALCULATIONS

The yield on a given tranche of a CMO is calculated as follows: **Using a particular prepayment assumption** for the collateral, a computer program calculates the cash flows for each tranche of the CMO. Then, **given a price** on a CMO tranche, one can compute the Internal Rate of Return (IRR), or **Cash Flow Yield**. This is the rate at which the cashflow must be discounted at to have a present value equal to the assumed price. All yield calculations are done on a semiannual compounding, or **bond-equivalent basis (even if the cash flow on the CMO is quarterly or monthly). Therefore, quoted CMO yields are directly comparable to Treasury and corporate bond yields. Because this process is complex, it is not possible to compute CMO yields on an ordinary bond yield calculator. Instead, analytical models are used to model the CMO's cashflows, compute yields and do scenario analysis. These tables show the CMO yields at various prices under several different prepayment assumptions**.

FIGURE 4
Example of a CMO Yield Table

FHLMC Series 1390, Class F (312912QF8)

COUPON: 7.30%
STATED MATURITY: 12/15/20
COLLATERAL: FGOLD 7.5%, 8.10 Gross WAC, 330 WAM

Settlement Date: 5/19/94

Price 32 (wds)	0% PSA Yield	100% PSA Yield	150% PSA Yield	275% PSA Yield	450% PSA Yield
92-31	8.076	8.332	8.447	8.679	9.303
93-3	8.063	8.314	8.427	8.654	9.266
93-7	8.050	8.296	8.407	8.630	9.230
93-11	8.037	8.278	8.387	8.605	9.193
93-15	8.024	8.260	8.367	8.581	9.157
93-19	8.011	8.243	8.347	8.557	9.120
93-23	7.998	8.225	8.327	8.532	9.084
Average Life:	22.66	11.93	9.94	7.49	4.53
Mod. Dur.:	10.34	7.50	6.68	5.46	3.66
First Payment:	10/15	5/04	8/02	6/00	1/98
Last Payment:	3/18	6/08	4/06	8/03	12/99

Figure 4 shows a yield table for FHLMC Series 1390, Class F. Note that each column corresponds to a given PSA prepayment assumption, while each line corresponds to a particular price, which is listed on the left side of the page. At the bottom of each column one finds the average life, first payment date, and projected maturity corresponding to that prepayment assumption. For example, at 150% PSA, the average life is seen to be 9.9 years, the first payment date is on 8/15/02, and the projected maturity, or "last payment," is 4/15/06. Note that these numbers do not depend on the price. In the body of the table are listed the yields corresponding to a given price and PSA assumption. For example, at 150% PSA and a price of 93-11/32, the yield is seen to be 8.387%.

Vanderbilt Research Team