Relative Value/ Securitization

Global Markets Research

Deutsche Bank

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MBS Research

Guide to Collateralized Mortgage Obligations

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- The U.S. mortgage market is now the largest single bond market in the world, eclipsing the size of the U.S. Treasury market. Collateralized Mortgage Obligations (CMOs) take mortgage pass-throughs and carve principal and interest into specialized tranches for various purposes and investor types. The CMO market accounts for almost half of the U.S. mortgage backed security market now.
- Investors can find more diverse investment choices and cheaper bonds in CMOs than in MBS pass-throughs. There are relatively stable CMO classes (such as PACs) for investors seeking to replace their corporate bond holdings with MBS. Investors willing to take interest rate or credit risk to gain excess return can also find appropriate CMOs.
- The crux of analyzing the CMO market is understanding the different tranche types and how they are structured. Today, CMO deals are rather intricate, with multiple collateral sources and multiple tranche types in a complex array for each CMO deal.
- We cover the different deal types and some techniques to identify and analyze different tranche types. We discuss different types of investors and how they use CMOs. Analysis techniques covered include OAS, creation value, prepayment analysis, and CMO comparison to leveraged collateral.
- We also discuss term structure and prepayment models. Certain types of CMOs are highly sensitive to small changes in models and assumptions.

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Overview

This paper introduces the reader to the U.S. collateralized mortgage obligation (CMO) market. It presupposes a familiarity with mortgage backed security (MBS) pass-throughs, available in Deutsche Bank's "Guide to U.S. Mortgage-Backed Securities" published in 2002. The first section of this paper gives the background of the CMO market and explains the difference between Agency and non-Agency CMOs. The paper then covers all of the major CMO tranche types in terms of structure and analysis, providing practical examples. It also covers information about OAS and prepayment models, and how to use that information to hedge CMOs or determine relative value. While the paper is aimed at the CMO novice or those who need a refresher, some of the analytical techniques covered are appropriate for investors already familiar with the CMO market.

Glossary

Similar to the "Guide to U.S. Mortgage-Backed Securities" published in 2002, we will start this paper with a Glossary. Do not worry if you do not understand the terms here initially — hopefully by the end of the paper, you will. Also, please note that CMO tranche descriptions are relatively brief in the Glossary. Detailed descriptions and diagrams can be found in the CMO Tranche Types section of this paper.

- **Accretion** is the process of adding interest to principal owed to the investor instead of paying the interest as it becomes due. This technique allows the creation of "zero coupon" bonds, known as Z bonds in the CMO universe. During an accretion period, the CMO's factor will rise over time.

- **Actual delay days.** Defined as *delay days* – 31 days. The number of days a payment is actually delayed before the investor receives it.

- **Agency.** While technically, GNMA is the only Agency in the MBS market, colloquially (and in this paper), this term is used to refer collectively to FNMA, FHLMC, and GNMA. Technically, FNMA and FHLMC are not Agencies, but *Government Sponsored Enterprises (GSEs)*. GNMA has the explicit full faith and credit of the US Government backing it. The GSEs do not.

- **Alternative A, or Alt-A.** These are *whole loans* that do not qualify for the best credit/lowest mortgage rate category. Either the borrower has a credit blemish or he simply lacks enough of a U.S. credit history. FNMA and FHLMC may securitize some of this type of loan for a higher guarantee fee.

- **Average life** is the dollar-weighted average time return of principal to the investor. It is sometimes used as a proxy for interest rate risk by comparing MBS average life to Treasury bonds with a similar maturity. However, Option Adjusted Duration (OAD) is a better measure of interest rate risk. CMO spreads to Treasuries are typically quoted by using average life, often using the "I", or interpolated, Treasury curve.

- **Burnout** refers to declining prepayment speeds after the initial peak, as the most rate-sensitive borrowers refinance out of a mortgage pool.

- **CMO**, or collateralized mortgage obligation, is a structured mortgage-backed security. Mortgage pass-throughs are placed in a trust and used as collateral to issue various securities (the CMOs) out of the trust, dividing up the underlying principal and interest cash flows in various manners.

- **Cohort.** All the pass-through pools from a certain Agency, with a specific coupon and issue year, form a cohort (e.g. 2001 production FHLMC Gold 6.5s). Cohorts are often used for prepayment reporting purposes.

- **Collateral** technically refers to the pass-throughs or other bonds (e.g., other CMOs) backing a structured deal, such as a CMO. In practice, many market participants use the term interchangeably with mortgage pass-throughs.

- **Companion, or support bond.** A companion bond is structured to absorb cash flow volatility in a PAC or similar CMO deal. When there is excess principal that PACs are not scheduled to receive, the companion bond receives it. Or, if the PACs need all available principal payments, the companion bond(s) receive no principal that month. This structure makes companion bond average lives highly variable as interest rates change, and imbues companions with more negative convexity than underlying collateral in return for higher yields.

- **Compensating interest** is paid by the servicer, originator or deal sponsor in a non-Agency CMO deal to make up the interest income shortfall due to prepayments before the end of the month, when payments are forwarded to investors. The Agencies[1] pay full compensating interest on their MBS in a manner transparent to investors. Apart from the Agencies, interest payments are usually capped.

- **Conforming loans.** Congress sets the conforming loan limit for FNMA and FHLMC loans each year ($322,700 for 2003). Fannie Mae and Freddie Mac may not purchase or securitize single-family mortgage loans of a higher amount. Those are called "jumbo" mortgages. Conforming loans must also match other Fannie Mae and Freddie Mac specifications for loan documentation, credit information, etc. Note that the Federal Home Loan Banks are allowed to buy jumbo non-conforming loans. Fannie Mae and Freddie Mac can buy some non-conforming loans, but balances must be below the limit.

- **Conventional vs. government loans.** Conventional loans are originated by private lenders for the mortgage market. They are typically conforming (see above) and not guaranteed by any government entity. Government loans are made by U.S. Agencies such as the Federal Housing Administration (FHA) through authorized agents and lenders. These government loans typically get securitized into GNMAs.

- **Convexity.** Intuitively, convexity is a measure of how much a bond's upside in a market rally exceeds its downside in a comparable sell-off. Mortgages, like callable bonds, have negative convexity because of the borrower's option to prepay the loan when interest rates decline.

- **CPR**, or conditional prepayment rate, is an annualized measure of prepayments for a certain time period. For example, 10% CPR for the past month means that 10% (annualized) of a mortgage pool's principal paid off, over and above the scheduled principal paid that month.

[1] GNMA, FNMA, and FHLMC securities all pay compensating interest without a cap.

- **Current coupon.** The pass-through closest to *parity price* is often termed the "current coupon". Many new pass-throughs are typically issued each month with the current coupon. The current coupon rate is a synthetic secondary-market mortgage rate calculated using a weighted average of the two mortgage coupons surrounding the parity price.

- **Delay days.** The amount of time between the start of interest accrual for a month and the date the investor receives the interest payment. Also known as *stated delay*.

- **Dollar roll.** This refers to the simultaneous sale and repurchase of a mortgage pass-through for different settlement dates, effectively financing the pass-through.

- **DTC, or Depository Trust & Clearing Corporation.** The clearing house through which CMOs are settled electronically. The Depository Trust & Clearing Corporation, through its subsidiaries, provides clearance, settlement and information services for equities, corporate and municipal bonds, government and mortgage-backed securities, over-the-counter credit derivatives and emerging market debt trades.[2]

- **Duration** is the dollar-weighted average time of the payment of principal and interest to the investor. For a bullet maturity bond, the duration of the security is a rough approximation of its price sensitivity to a change in interest rates. For MBS, option-adjusted duration (OAD) is used.

- **Expected final maturity** is the day the investor expects to receive the last cash flow from a CMO.

- **Factor.** Initially set at 1.0. It represents, for a CMO tranche or pass-through pool, the amount of bonds remaining as a fraction of the original balance. Note that a factor can increase to over 1.0 if interest is deferred and added to the principal owed, called *accretion*.

- **GSE, or Government Sponsored Enterprise.** This term refers to entities set up by the government but now run as private corporations, such as Fannie Mae and Freddie Mac.

- **Gross WAC.** Also known as the gross coupon, this is the balance-weighted average coupon ("WAC") of a pass-through pool's underlying loans.

- **Guarantee fee.** The Agencies generally charge a 10 to 20 bp annual fee in order to wrap, guarantee, and assign a pool number to a pool of mortgage loans. This fee is charged each month on the balance of the pool before principal payments are deducted.

- **Inverse floater.** A bond where the coupon moves inversely to a market index, typically LIBOR. These bonds typically have OADs much longer than the underlying cash flow.

- **IO, or Interest Only,** "strip" refers to a security receiving only the interest portion of cash flows from a pool of collateral. The principal portion can be sold separately.

[2] From DTCC's web site.

- **IOette** is similar to an IO, but is stripped off of a tranche or tranches from a CMO deal. It may be an even strip, effectively equivalent to an IO, or it may be much more complicated in structure. IOettes can have a small piece of principal attached, giving them very high dollar prices, or no principal, in which case they trade at low prices with a *notional principal* amount.

- **Jumbo.** A jumbo loan's balance exceeds the conforming loan limit for Fannie Mae and Freddie Mac. (See *conforming loan*.) Dealers or originators typically securitize jumbo loans off of their issuance shelves (special purpose vehicles created to hold and securitize loans). Note that the Federal Home Loan Banks (FHLBs) can purchase jumbo loans or CMOs backed by them, but Fannie Mae and Freddie Mac cannot.

- **Legal final maturity** is the last possible day the investor could receive the last cash flow from a CMO tranche, set at the deal's inception and assuming no prepayments.

- **Lockout.** The period of time before a regular CMO starts receiving principal. The time a CMO tranche is "locked out" depends on a deal's structure and prepayment speed experienced by the underlying pool.

- **Mega/Giant/Platinum pool.** These terms all refer to a "pool of pools." GNMA and the GSEs facilitate creation of these pools to consolidate small balance pools, simplify record keeping and reduce custodial fees. Investors or dealers may create these pools for a fee. Note that these pools are not included for the purpose of calculating issuance and prepayment statistics, as that would be double counting.

- **Net WAC.** Also known as the net coupon, is the coupon available to investors after mortgage servicing and guarantee fees are taken out. Coupons in MBS are almost always integer and half coupons (e.g. 6%, 6.5%, 7%). Some quarter coupons exist but these tend to be illiquid.

- **Non-Agency mortgages.** These single-family loans typically comprise either "jumbos" or loans disqualified from purchase by Fannie Mae and Freddie Mac for credit, property, or other reasons. They are often securitized into CMOs, but may also be traded as *whole loans* (i.e. in unsecuritized form).

- **Notional principal.** When an *Interest Only* (IO) tranche is structured without any principal directly attached to the bond, the amount of principal it was stripped from is called the "notional principal" and is used to calculate the factor for the IO tranche. Interest for the IO is paid only on the remaining notional principal.

- **Option-adjusted duration (OAD).** Most US mortgages can be prepaid at par at any time. Thus, a *de facto* call option is "embedded" in the mortgage itself. Because of the embedded options in MBS, OAD is often different from standard duration measures. OAD is typically a better representation of a security's interest rate sensitivity than modified duration or average life.

- **Option-adjusted spread (OAS).** OAS estimates the spread that a security is expected to yield over a benchmark yield curve (say, Treasuries). It effectively values the embedded options in callable securities, such as MBS, and deducts the embedded option cost from the nominal spread. (See *LIBOR OAS*.)

- **PAC, or Planned Amortization Class, or type I PAC, or PAC 1.** A PAC bond is designed to mimic a corporate bond's structure by setting out an amortization schedule that targets a certain average life, much like a corporate bond's maturity date. The PAC bond may in fact pay faster or slower, depending on actual prepayment experience and the CMO deal's structure.

- **PAC 2, or type II PAC.** This bond is typically structured with cash flow priority below type I PACs, but above companion bonds. If the companion bonds are all retired, the PAC 2s effectively become companion bonds, protecting the PAC 1s.

- **PAC band.** PAC bonds are designed to adhere to their amortization schedule, as long as prepayments remain within a specified range, the PAC band (e.g. 100 – 250 PSA). If prepayments are higher or lower than the band for long enough, the bond could deviate from its amortization schedule and lengthen or shorten *vis-à-vis* its scheduled average life. The effective PAC band changes over the life of the security based on the prepayments experienced, known as *PAC band drift*.

- **PACquential.** Similar to a PAC bond, but with the lower end of the PAC band at a higher prepayment speed than usual, thus the PACquential has more extension risk. This feature makes a PACquential look similar to a combination of a PAC and a sequential.

- **Parity price.** The price at which a bond has the same yield, regardless of prepayment speed assumed. For pass throughs, the parity price is typically between $99-00 and $100-00, rather than $100-00 flat, because of the stated delay of cash flows built into the pass-through structure.

- **Pass-through** can refer to an Agency or non-Agency mortgage-backed security. Mortgage principal and interest payments are passed through directly to investors, after mortgage servicing and FNMA, FHLMC, or GNMA guarantee fees are deducted. Multiple investors can own a dollar amount of the same pass-through, each receiving a pro-rata share of principal and interest each month.

- **Payer.** A bond which is currently paying interest. For example, a Z bond will typically accrete interest over time[3], increasing its factor over the initial 1.0. At some point, the Z bond begins to pay interest and principal to the investor. It is then called a *payer*. Any regular CMO tranche currently paying interest to the investor may also be called a *payer*.

- **PO** (Principal Only) "strip" refers to a security receiving only the principal portion of a pool of collateral or from a CMO. POs typically have very long durations, as lower interest rates increase prepayments and hence the value of the PO. POs themselves can be further structured into PAC POs, etc.

- **Pool.** Each pass-through security guaranteed by the Agencies is given a pool number, as well as a CUSIP. All data reporting by the Agencies is done on the individual security, or pool, level. Multiple pools may make up an MBS transaction.

- **Pool factor.** Represents the portion of the original balance remaining in a pool. Even without prepayments, the pool factor declines each month as scheduled principal payments pay down loan balances. Most TBA trades are done on a "current face" basis, meaning based on the current amount outstanding of bonds delivered. To calculate current face, the original face amount of the bonds

[3] That is, not pay coupon interest immediately, but defer it until later.

is multiplied times the factor. Trades for specified pools are often done on "original face" (not using the factor) because the pool factor for future settlement may not be known yet.

- **Prepayment.** Principal returned to the investor because of refinancing, moving, recovery from default, or any reason other than a scheduled principal repayment. Also known as unscheduled principal. Note that a prepayment may be in full or only for part of the loan (known as *curtailment*).

- **Prepayment speed.** Using a specified measure, such as annualized prepayments, prepayment speeds are reported historically or projected for a pool or cohort.

- **PSA**, or prepayment standard assumption, is another convention for expressing mortgage prepayments. The PSA curve uses the age of the underlying mortgages to assign a CPR speed. At 100% PSA, for the first 30 months, loans are assumed to "ramp" up linearly from 0% CPR (at 0 months of age) to 6% CPR. Once loans are 30 months old, they are assumed to be fully seasoned and at that point, 100% PSA is equivalent to 6% CPR.

- **REMIC (real estate mortgage investment conduit).** REMIC is a tax election for a securitized deal that allows creation of structured deals, including CMOs, with various benefits. These benefits include exemption from taxation at the trust level.

- **Residual.** The equity portion of a CMO deal. Residuals have tax implications associated with them and are traded on a physical certificate basis (i.e., they cannot be settled electronically via DTC like CMO bonds can).

- **Scheduled principal.** The fully amortizing structure of U.S. mortgages means that both interest and a small amount of scheduled principal is due each month in order to retire the entire principal balance by its maturity date.

- **Sequential.** A sequential CMO deal typically takes the expected principal cash flows from a pool of collateral and "time tranches" it. The first sequential tranche receives all the scheduled and unscheduled principal from the collateral until the tranche is retired, then the next sequential in line starts receiving principal, etc. until the collateral is exhausted and all the CMOs are paid off.

- **Servicer.** The servicer bills mortgagors, collects mortgage payments and forwards them to investors (or their trustee) in return for earning a servicing fee. The servicer is required to advance mortgage payments on a timely basis (so long as it deems payments recoverable), but the servicer also gets to keep late fee income from the loans. The servicer may also collect money in escrow to pay property tax and/or home insurance premiums.

- **Servicing fee.** The servicer collects a fee from the interest portion of the mortgages. The fee is generally between 25 and 60 bp annually. (See *servicer*.)

- **Support**. Another name for *companion*.

- **TAC**, **or Targeted Amortization Class**, generally has call protection below a certain prepayment speed (PSA) target. Unlike a PAC, the protection from prepayment variability is in one direction (protection from fast speeds). There is generally a fair amount of extension risk embedded in the structure.

- **TBA,** or "to be assigned", refers to pass-through trades where an Agency, maturity, and coupon are specified, but actual pool numbers (and CUSIPs) are not selected until two business days before settlement.

- **Term structure model.** A term structure model takes as inputs a current yield curve, a representation of volatility, and correlations between the two to model future interest rates. In one version, a Monte Carlo implementation, the model will run many different, random interest rate scenarios governed by the model and its inputs. When evaluating MBS, an OAS model will average the results over the different paths of interest rates generated by the term structure model.

- **Tranche.** This term refers to a single bond (with one CUSIP) within a CMO deal.

- **Vanilla or plain vanilla.** Another name for *sequential*.

- **Waterfall.** A waterfall refers to the deterministic rules governing distribution of principal and interest in a CMO.

- **WAM/WALA.** Weighted average maturity (WAM) and weighted average loan age (WALA) should complement each other. That is, a new 30-year mortgage pool will often have WAM+WALA = 30 years. WALA refers to the number of months the loans are aged since origination and WAM is the number of months until maturity. As prepayments are received, the calculated maturity of the pool may be reduced, so WAM+WALA will be less than 30 years.

- **Whole loan** refers to residential mortgages before they are securitized as a pass-through. Whole loans are traded on Wall Street, but are much less liquid and homogenous than Agency pass-throughs. In addition, the investor must bear credit losses on whole loan pools.

- **Window.** A bond's window runs from the date it is first expected to receive principal to the date the bond is expected to retire. Please note that the window is highly dependent upon prepayment speeds for the deal. Certain bonds can have the window open and close again under certain prepayment environments.

- **Z bond.** In the case of a Z bond, initially, interest accrues and is added to principal (this process is called *accretion*). At some point, based on prepayments and the deal structure, the Z starts to pay down interest and principal (called becoming a *payer*). A Z bond can be created from any of the fundamental cash flows.

Introduction to CMOs

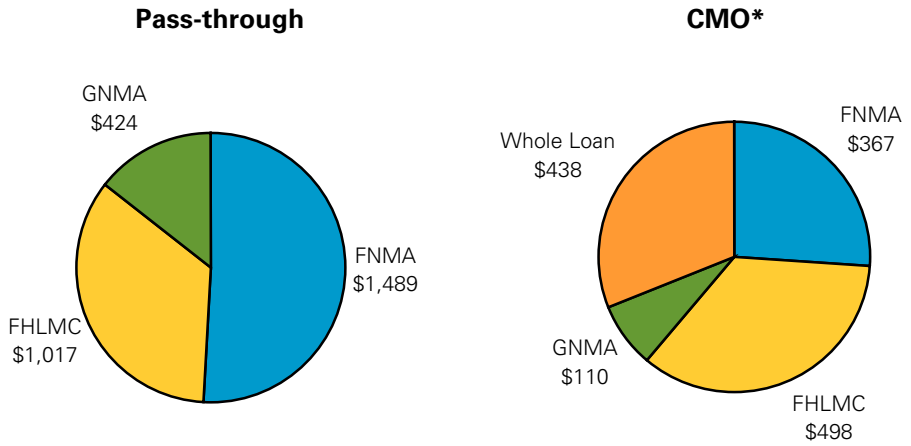
Collateralized Mortgage Obligations (CMOs) take mortgage pass-throughs and carve them into specialized tranches to suit the needs of various investor types. There are more stable CMO classes for investors seeking to replace their corporate bond holdings with MBS, and more volatile CMO classes for investors willing to take risk with the expectation of incremental return.

For those investors not familiar with the mortgage market, we will briefly cover the pass-through market in the U.S. and then introduce CMOs.

The pass-through market

The fixed-rate Agency mortgage-backed security (MBS) market totals $2.9 trillion as of September 2003. The primary issuers are FNMA, FHLMC and GNMA. Each of these acronyms stands for the name of a Government Sponsored Enterprise (GSE) or, in the case of GNMA, Agency of the U.S. government.[4] Their roles will be explained fully in the next section. Figure 1 shows outstanding balances for each Agency, with FNMA being the largest. Note that the pass-through market in this chart is a superset of the CMO market, which is created from pass-throughs.

Figure 1: Outstanding fixed-rate MBS as of September 2003 (billions)



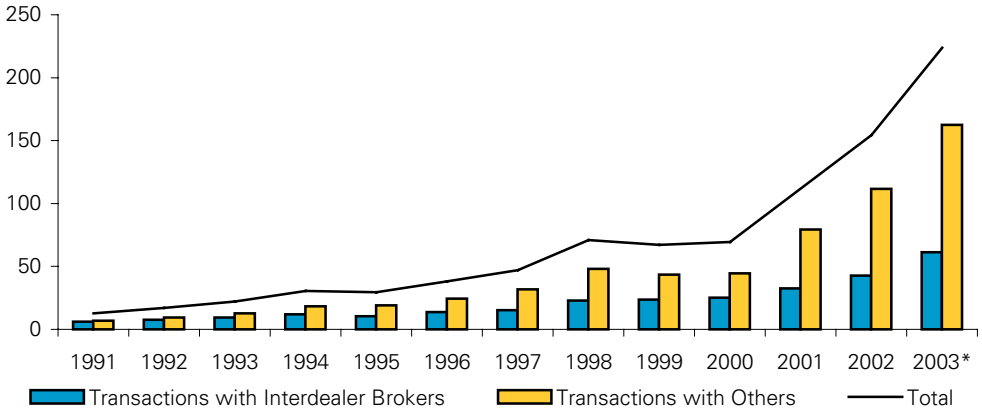
* Includes Re-REMICs

Source: Ginnie Mae, Fannie Mae, Freddie Mac, Bloomberg

The U.S. mortgage market is one of the most liquid in the world, with over $200 billion of bonds trading hands every day. Figure 2 shows mortgage trades reported to the Federal Reserve by primary dealers, which account for approximately 80% of all MBS trades. Bid-ask spreads are generally 1/64th on sizes up to $200 million of the current coupon. At times, up to $1 billion can be traded with a bid-ask spread of only 1/32nd. Liquidity is comparable to the U.S. Treasury market and significantly better than U.S. corporate bonds.

[4] While GNMA is the only Government Agency in the MBS pass-through market, colloquially (and in this paper), this term is used to refer collectively to FNMA, FHLMC, and GNMA. Technically, FNMA and FHLMC are not Agencies, but *Government Sponsored Enterprises*. GNMA has the explicit full faith and credit of the US Government backing it. Fannie Mae and Freddie Mac do not.

Figure 2: Average daily mortgage security trading volume ($billions)



* Preliminary data, through September 2003, does not include entities not registered with the Federal Reserve

Source: Federal Reserve

Desirable for U.S. and Non-U.S. Investors

Mortgages combine many of the characteristics sought by many types of investors: high yield combined with high credit quality. Of course, this comes at a price, represented by MBS unscheduled principal prepayments and corresponding negative convexity, which will be addressed later.

- **High Credit Quality.** Credit quality is extremely good. In the next section, we will cover the details of credit for the Agencies and explain why MBS are a triple-A rated asset. FNMA and FHLMC MBS are 20% risk weight (BIS) for banks, GNMAs 0% risk weight.

- **Attractive Yields.** Coupon income on MBS is typically attractive. The investor receives extra income in return for in essence writing call options to the homeowners, who can typically prepay their mortgage any time at par.

- **Short Durations.** Duration and spread duration of MBS are relatively short (the index typically has a duration between 2 and 5 years). Short durations make mortgages attractive for investors with short-term horizons or limited duration requirements.

- **High Liquidity.** Liquidity of MBS rivals that of U.S. Treasury bonds.

Mortgage Characteristics

Most mortgages securitized in the Agency pass-through market have the following characteristics.

- Mortgages must be on a 1–4 family home.[5]

- Mortgages are generally of 15-year and 30-year maturities, fully amortizing. Limited amounts of 10-year, 20-year and balloon (short maturity, not fully amortizing) mortgages are securitized as well.

- Most mortgages securitized are fixed-rate, although an adjustable rate mortgage (ARM) market does exist. Adjustable rate securities are originated in reasonably large size, but relatively few are securitized (most are held by banks and thrifts). The ARMs market includes "hybrid ARMs" where the rate is fixed for 3, 5, 7, or

[5] There are programs from the Agencies for multifamily mortgages, but they are completely separate from the single-family mortgage market discussed in this paper.

10 years before it starts adjusting. MBS included in the large U.S. bond indices are all fixed-rate.

- Mortgages are almost all monthly-pay, in arrears.
- No prepayment penalties. The vast majority of U.S. mortgagors may pay off all or a portion of their principal balance at any time. Prepayments increase when mortgage rates fall and homeowners refinance into lower-rate loans. Mortgage loans with prepayment penalties securitized by the Agencies make up less than 1% of the stock, and pools of prepay penalty loans are not eligible for TBA delivery.
- Due on sale. The vast majority of mortgages backing FNMA and FHLMC pools are not assumable, meaning the mortgagor must pay off the loan upon sale of the residence.

Mortgages are aggregated and securitized by the Agencies into pass-throughs. For more information on pass-throughs, please see the Deutsche Bank "Guide to U.S. Mortgage-Backed Securities" published in 2002.

The CMO market has existed since the mid-1980s

Start of the CMO market

The CMO market has existed since the mid-1980s. Its original purpose was to allow the creation of MBS that gave investors greater certainty as to when they receive principal from mortgage backed securities. With pass-throughs, principal is received each month throughout the life of a security, often over the full thirty years. In a CMO, the principal is divided up into pieces or "tranches", creating some bonds which receive principal right away (and hence have shorter durations) and bonds that do not, typically resulting in longer durations. The creation of so-called "PAC" or Planned Amortization Class bonds took the CMO a step further, attempting to create a "corporate bond surrogate". PACs could attract some investors who were otherwise uncomfortable with MBS cash flow uncertainty.

Now, the CMO market has exploded into a myriad array of tranches using different types of collateral. The cash-flow priority of tranches can even be dynamic, varying based on the prepayments experienced. The same financial technology used to create CMOs was used to create the domestic ABS and CDO markets and other securitized products markets overseas.

With CMOs, investors have more certainty over when they receive principal from mortgage backed securities

Why do they exist?

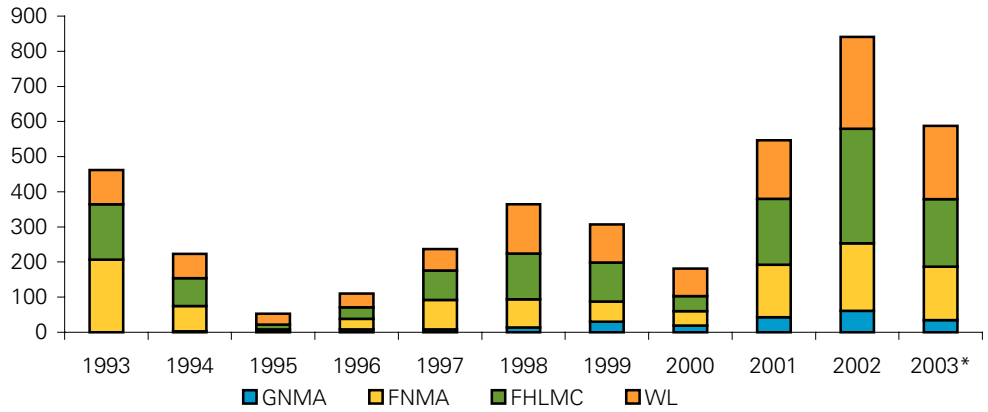
Like any security, CMOs exist because there is a market to buy and sell them. From the demand side, there are investors that still want more certainty over the cash flows from an MBS investment. In addition, the CMO market has developed to such an extent that many other things are possible using the CMO market (such as inverse floaters) than with the MBS pass-through market. From the supply side, dealers will create CMOs as long as they can make a reasonable profit in the business. Often, all of the CMO tranches are not sold right away, which forces the dealer to hold inventory, and thus take risk.

Size of the CMO market

The CMO market eclipsed its issuance record with a banner $800 million year in 2002, (see Figure 3) and now totals $1.4 billion outstanding. By year-end, 2003 will be the year of second highest issuance in CMOs on record. A booming housing

market, low interest rates, a steep yield curve, and bank investor demand for CMOs have been the factors contributing to these record issuance numbers. Issuance of new CMOs dwarfs that in most other markets, including Treasuries and corporate bonds.

Figure 3: CMO Issuance hit an all-time high 2002 ($bn)



* Data as of June 2003

Source: Bloomberg

The liquidity of CMOs is typically less than pass-throughs, but comparable to corporate bonds

Liquidity

The raw size of the CMO market suggests it should have enormous liquidity. However, liquidity is somewhat hampered by lack of homogeneity in the CMO market. Even the most common tranche types, PACs and sequentials, may have subtle differences that need to be examined and valued. (We will discuss this in detail later.) The liquidity of CMOs is typically less than pass-throughs, but comparable to corporate bonds. Even specialized derivatives, such as Interest Only (IO) strips often have relatively tight bid-ask spreads, of around an eighth of a point.

Practical details

In this section, we cover practical details such as typical payment and settlement structure for CMOs. Rules are generally different for CMOs than for corporate bonds. In some cases, rules are different for certain types of CMO tranches than for pass-throughs.

Bond settlement

CMOs usually settle in book entry via DTC (Depository Trust Co.). Primary market CMOs may have delayed settlement, similar to pass-throughs. For example, many new-issue CMOs settle in the month after the trade date. New-issue CMOs usually settle at the end of the month, to allow the dealer time to bring in collateral and finish structuring the deal.

Secondary market CMO transactions are typically for corporate settlement, presently T+3 business days. It is possible to trade CMOs for other settlements, such as cash, if necessary.

Monthly interest and principal payments

CMOs pay interest monthly, similar to the underlying pass-throughs. Tranches eligible to receive principal payments will receive them at the same time as the interest payments. Most CMOs have the same number of delay days as the underlying collateral, for example 55 stated delay days for FNMA pass-throughs. However, certain tranches such as CMO floaters may have reduced delay days to facilitate comparison to corporate bonds. The number of delay days for each tranche is available in the prospectus or from electronic sources. Of course, the number of delay days impacts yield, as interest and principal are returned later (and hence reinvestment interest on that interest and principal is foregone) the longer the delay.

Deal clean-up calls

Some deals may contain clean-up calls, which are triggered when only a small portion of the deal remains. The percentage trigger is typically set between 1% and 10%, inclusive. This feature is typically designed to avoid the burden of high fixed administrative costs for the deal's trustee when a small amount of bonds remains outstanding. We discuss analyzing deal clean-up calls in the "Analyzing Regular CMO Tranches" section.

New issue versus secondary markets

The new issue CMO market typically settles as much as one or two months in the future, allowing the issuer to gather the requisite collateral for the deal and complete structuring. This structuring period also affords the investor the opportunity to buy CMO tranches custom designed to fit his portfolio. Most secondary tranches trade for corporate settlement. While the investor cannot change existing tranches, more information about the tranche, such as historical prepayment speeds, can be valuable to the investor.

The crux of understanding the CMO market is understanding the different tranche types

CMO Tranche Types

The crux of understanding the CMO market is understanding the different tranche types and how they are structured. Today, CMO deals are quite intricate, with multiple collateral sources, multiple tranche types, etc. in a complex array for each CMO deal. It is important to realize that each of these deals is made primarily from two basic flavors.

- **A Planned Amortization Class (PAC) deal**, where the non-PAC (companion) tranches have highly variable cash flows and average lives, while the PAC enjoys relatively stable, prescheduled cash flows.

- **A sequential deal**, where standard sequential tranches have cash flow priority (i.e. absorb most or all of the principal from the deal) in turn until they are all retired.

These types of deals can be altered or dressed up slightly (such as in a PACquential deal), but there are still two basic flavors. Once the PACs and sequentials are created, they can be divided even further (e.g. into a PAC floater and PAC inverse floater). It is also possible to add other tranches with special features, such as a tranche where interest accrues back into the principal, called a Z-bond (i.e. zero coupon). Nevertheless, to understand the structure of CMOs, one must always start with that first question on which deal type it is, then walk through how the individual tranche for analysis was created in order to correctly analyze it.

For each tranche type in this section, we will provide the following:

- Description

- Example

- Yield table

- Methods of analysis

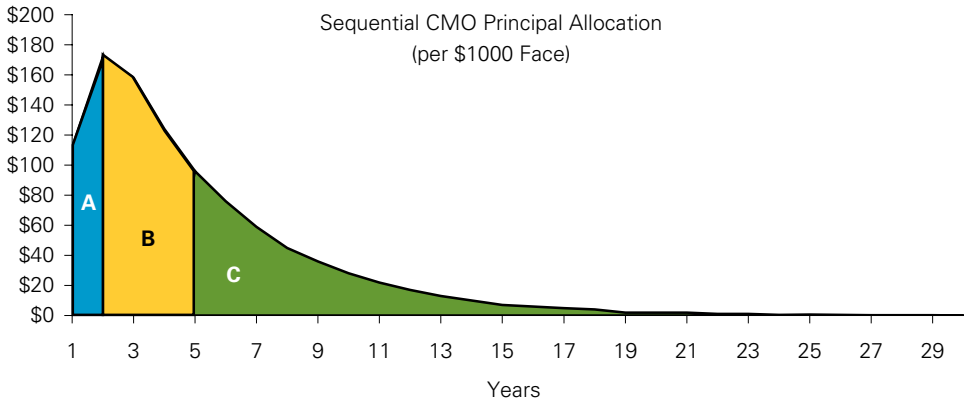
Please note that while we have tried to be as realistic as possible in showing yield table and OAS analysis for CMO tranches, these numbers do not necessarily correspond to anything available in the market currently. These examples have been constructed mainly for learning purposes, not to illustrate relative value or hedging purposes! We also do not identify deal names or CUSIPs on any of these bonds for those reasons.

The first sequential tranche receives all prepaid and scheduled principal from the deal until the tranche is retired

Sequential

A sequential[6] CMO deal typically takes the collateral's principal and "time tranches" it. The first sequential tranche receives all prepaid and scheduled principal from the deal until the tranche is retired, then the next sequential in line starts receiving principal. For example, in a simple three-tranche sequential example, the first sequential could be allocated 30% of the deal's principal. All principal cash flows would pay down the first sequential tranche to a zero balance. Then, the second sequential would receive its principal, and finally the third. The purpose of this structure is twofold. Investors may want a shorter or longer duration than the underlying collateral. In addition, the period of time before which the second sequential receives any principal is known as "lockout". This lockout feature may be valuable to some investors who do not want to receive (and possibly reinvest) principal for some period of time.

Figure 4: Cash flows from a three-tranche sequential deal



Source: DB Global Markets Research

Example

Sequential bonds will have a different duration, average life, and projected cash flow for each prepayment assumption tested. In many respects, they perform like the underlying collateral of the CMO deal. Increase prepayments, and sequentials shorten their average life and duration. A few differences between sequentials and collateral:

- The window of time principal is returned to the investor in a sequential is narrower than that for collateral.
- A sequential can be locked out from prepayments (i.e. the factor remains 1.0) for some period of time. Pass-throughs start to factor down from 1.0 as soon as they are created.
- The coupon on a sequential (or any other bond) can be different from the underlying collateral. Most commonly, the coupon on the sequential is "stripped down" lower than the collateral in order to create bonds that trade at or below par.

[6] Also known as a "vanilla" bond.

When a sequential coupon is stripped down, a portion of the interest from the collateral is diverted elsewhere in the deal

When a sequential coupon is stripped down, a portion of the interest from the collateral is diverted elsewhere in the deal.[7] The purpose of this maneuver is to lower the price of the sequential bond, although typically the yield of the bond will also fall. Nomenclature in the CMO world talks of the tranche coupon versus the collateral coupon. For example, a 5.0/5.5 sequential would be a bond with a 5% coupon in a deal using 5.5% pass-through collateral.

Figure 5 compares the yield tables of a full coupon, 5.5/5.5 sequential with a stripped down 4.0/5.5 sequential. Note that the principal cash flows are essentially the same—the principal cash flows on these bonds reacts in the same way to changes in prepayment rates. However, market performance will likely be quite different, due to the longer duration of the 4.0/5.5 tranche. The 4.0/5.5 tranche has a 5.26 OAD versus a 3.11 OAD for the 5.5/5.5 full coupon sequential in our example. When interest (IO) is removed from a tranche, the negative duration associated with the IO is also removed, extending the duration of the remaining bond.

Figure 5: Comparing the yield tables & OAS of full versus stripped down coupon sequentials

Sequential, 4% on 5.5%					
Scenario	**-200 bp**	**-100 bp**	**0 bp**	**100 bp**	**200 bp**
Prepayment (PSA)	1595	800	225	145	120
Price					
96.625	7.20%	6.03%	4.87%	4.67%	4.61%
97.625	6.20%	5.40%	4.61%	4.47%	4.43%
98.625	5.21%	4.78%	4.35%	4.27%	4.25%
Average Life	1.09	1.76	4.5	6.2	7.05
LIBOR OAS	25				
OAD	5.26				
OAC	-1.36				
Sequential 5.5% on 5.5%					
Scenario	**-200 bp**	**-100 bp**	**0 bp**	**100 bp**	**200 bp**
Prepayment (PSA)	1596	823	223	146	121
Price					
101.9375	3.51%	4.23%	5.00%	5.13%	5.17%
102.9375	2.58%	3.63%	4.75%	4.93%	4.99%
103.9375	1.67%	3.04%	4.50%	4.73%	4.81%
Average Life	1.09	1.73	4.54	6.18	7.01
LIBOR OAS	35				
OAD	3.11				
OAC	-2.27				

Source: DB Global Markets Research

An intuitive way to think about premium and discount CMO durations is callable corporate bonds. As the price of the bond goes over par, it becomes harder for the price to rise given a drop in interest rates because of the call feature (in the case of MBS, faster prepayments). The duration of a high premium callable bond will be close to the call date because it is likely to be called. However, the duration of a deep

[7] Note that the coupon income stripped off these tranches could become an IO/IOette tranche, or could be added to a regular tranche with principal to create a premium tranche, for example a 6% coupon off 5.5% collateral.

discount callable bond is longer, close to the maturity date of the bond, because the bond is unlikely to be called.

Analysis

Analysis of sequentials falls into two broad categories: short and long duration bonds

Analysis of sequentials falls into two broad categories:

- Analysis of short duration sequentials that are currently paying, typically as short duration bonds. They may be compared to short Agencies, ABS, hybrid ARMs, other CMOs etc.
- Longer duration sequentials that are often compared to the underlying collateral. Many characteristics of the sequential and collateral are typically similar: prepayment speeds, duration profile, etc.

For short duration bonds, investors are typically looking at yield and comparing it to similar duration bonds. In addition, investors need to evaluate the extension risk of the sequential to make sure it is not beyond their risk tolerance if interest rates rise, prepayment speeds slow, and the sequential extends.

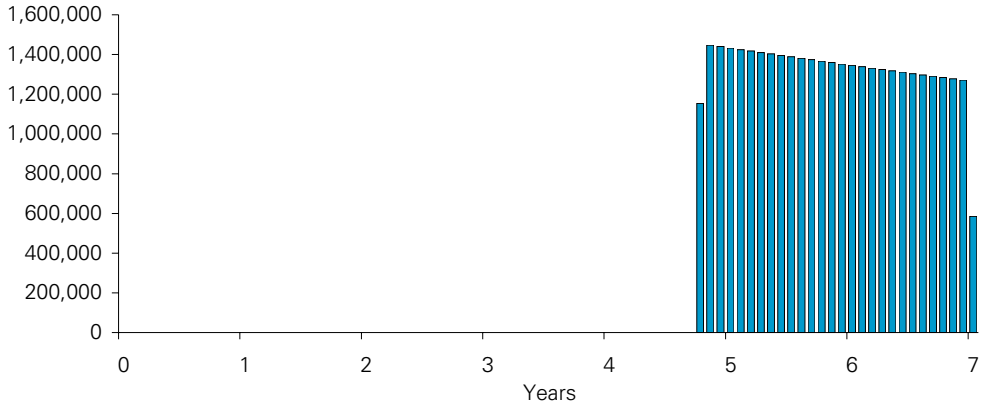
For long duration bonds, comparison to collateral can be made using OAS or yield analysis, plus potentially a total rate of return analysis that compares expected returns of different bonds under different interest rate scenarios.

PAC stands for "planned amortization class" and is one of the most stable classes of CMO

PAC

The second basic type of CMO deal is a PAC/companion structure. PAC stands for "planned amortization class" and is one of the most stable classes of CMO. It is given a pre-set schedule for its principal pay down. If prepayment speeds were to remain at a fixed speed in a specific prepayment band (the "PAC band") for the life of the security, the PAC would adhere to its original schedule and behave similarly to a corporate bond with a pro-rata sinking fund structure. Figure 6 shows the amortization schedule for a hypothetical PAC.

Figure 6: Amortization schedule for a hypothetical PAC



Source: DB Global Markets Research

PAC bonds are designed to adhere to their amortization schedule, as long as prepayments remain within a specified range, the PAC band

PAC Bands, Band Drift and Broken PACs

As mentioned above, each PAC has a band, expressed in PSA terms. If prepayments remained at a level within the PAC band throughout the life of the PAC, it would adhere to its planned amortization schedule and have the expected average life.

Of course, prepayments do not remain constant for one month, let alone the life of a security. Therefore, over time, especially in a fast prepayment environment, the PAC bands on a PAC can drift, generally growing tighter over time (i.e. less advantageous for the investor).

One example of PAC band drift is in a fast prepayment environment. If approximately one third of a PAC CMO deal is companion bonds and prepayments increase over the top end of the PAC band, at some point, all the companion bonds will be paid off. When the companions are gone, the PACs behave like sequential bonds, and are termed "broken PACs" in the marketplace. In reality, a broken PAC will behave like a sequential bond. However, due to the stigma of being "broken", the broken PAC may trade more cheaply than a similar sequential.

Figure 7, below, shows an example of a new PAC with a band of 100–250 PSA. Note that as interest rates rise, its average life stays around 5.95 years. However, since all MBS are inherently callable in any give month, very fast prepayment speeds engendered by a rallying market cause the PAC to break out of its PAC band and shorten its duration significantly.

Figure 7: Example of a new PAC (Band 100-250 PSA) price/yield table and OAS information

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1665	800	220	143	120
Price					
101.1875	3.99%	4.39%	4.75%	4.75%	4.75%
102.1875	3.30%	3.96%	4.56%	4.56%	4.56%
103.1875	2.62%	3.54%	4.37%	4.37%	4.37%
Average Life	1.5	2.47	5.95	5.95	5.95
LIBOR OAS	41				
OAD	3.65				
OAC	-1.26				
Vol Duration	0.05				

Source: DB Global Markets Research

Figure 8, by contrast, shows a broken PAC originated a few years ago. All the companion bonds in this deal have paid off, so it effectively behaves like a sequential. Note also, that its OAS happens to be higher than the sequential bond analyzed earlier in this section. This can occur in the market if there is a glut of broken PACs. This bond currently does not have a PAC band left, but originally had a band of 100 to 255 PSA.

Figure 8: Example of a broken PAC (no PAC band left) price/yield table and OAS information

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1595	800	225	145	120
Price					
102.9375	0.74%	2.97%	4.57%	4.84%	4.92%
103.9375	-0.74%	2.17%	4.26%	4.61%	4.72%
104.9375	-2.19%	1.38%	3.96%	4.39%	4.53%
Average Life	0.66	1.26	3.52	5.02	5.79
LIBOR OAS	37				
OAD	1.98				
OAC	-4.07				
Vol Duration	0.03				

Source: DB Global Markets Research

PACs versus sequentials

Analysis

The decision to buy PACs over sequentials or pass-throughs involves a couple of questions. First, is there a reason to buy cash flow stability?

- Is cash flow stability cheap via purchasing PACs?
- Is hedging pass-through or sequential cash flows using OTC derivatives expensive or cumbersome from an accounting (FAS 133) perspective?
- Does the investor think the bond market is range-bound or could break out of a range?
- What do implied and actual volatility in the market look like and where are they going?

The answers to these questions can guide an investor towards whether to purchase PAC bonds.

Note that broken PAC analysis will be similar to sequential bond analysis. As mentioned before, often, broken PACs will trade at wider spreads than similar sequentials, creating relative value opportunities.[8]

Like sequentials, PACs can be compared using OAS analysis, yield, total return analysis, etc. to other MBS or even to corporate bonds because of the PACs' stable nature.

The PACs take priority in the cash flow waterfall, followed by the PAC 2s, and finally the companion bonds

PAC 2

In some structures, the effectiveness of PAC classes is enhanced by creating a structure similar to a PACs, but with tighter PAC bands. The PACs take priority in the cash flow waterfall[9], followed by the PAC 2s, and finally the companion bonds. If the companion bonds are retired and PACs remain, then the PAC 2s effectively become the new companion bonds.

[8] Broken PACs tend to trade slightly cheaper than sequentials, whether because of the stigma of the "broken" deal or selling by investors to buy new PACs with intact bands.
[9] A waterfall refers to the deterministic rules governing distribution of principal and interest in a CMO.

In return for the higher cash flow variability of the PAC 2, it will yield more than similar PACs in the same deal. At the same time, in extreme prepayment environments, the PAC 2 will suffer extension or call risk before the PAC. The PAC 2 bond selected for Figure 9 has lost its PAC bond already.

Figure 9: Example of a PAC 2 (no PAC band remaining) price/yield table and OAS information

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1665	800	220	145	120
Price					
97.875	8.05%	7.06%	6.11%	5.97%	5.84%
98.875	6.63%	6.20%	5.80%	5.74%	5.68%
99.875	5.23%	5.36%	5.49%	5.51%	5.53%
Average Life	0.75	1.27	3.81	5.54	8.78
LIBOR OAS	36				
OAD	5.37				
OAC	-2.19				

Source: DB Global Markets Research

Analysis

PAC 2 analysis needs to be very careful, as bonds from this class exhibit much more variability of structure, cash flows and value than the PAC 1 or sequential tranche types. OAS analysis can help an investor make a determination if a bond is attractive. Investors also need to focus on potential duration extension and shortening in radical interest rate scenarios to make sure that duration change is tolerable. In our example bond, duration extension if rates rise is worse than with our example sequential bond.

Companion

The support tranche takes whatever principal is left over each month after the PAC bonds have been paid as closely to schedule as possible

The support tranche takes whatever principal is left over each month after the PAC bonds have been paid as closely to schedule as possible. If prepayment speeds are fast, excess principal will pay down support tranches once planned principal payments to the PACs have been made. On the other hand, if prepayment speeds are very slow, all of the principal may go to the PAC bonds, with the support bonds receiving no principal for that month.

Example

The structuring of the companion bond, with approximately 30% of a deal being companions and the balance PACs, makes for highly variable cash flows and a wide variety of performance characteristics. Because of this, companion bond yields tend to be quite high. Figure 10 shows how the average life of the bond can vary widely.

Figure 10: Example of a companion bond price/yield table and OAS information

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1595	800	225	145	120
Price					
94.375	44.97%	25.96%	9.44%	6.00%	5.98%
95.375	36.95%	21.93%	8.70%	5.92%	5.90%
96.375	29.29%	18.03%	7.97%	5.83%	5.82%
Average Life	0.16	0.3	1.57	23.95	25.66
LIBOR OAS	90				
OAD	11.00				
OAC	-16.04				

Source: DB Global Markets Research

Analysis

Structures are very deal specific, and OAS models can help determine relative value among support bonds. Note however, that OAS and hence relative value will be very sensitive to model assumptions. Discount companions are more popular because they can be sold to retail investors more easily. Figure 10 shows our example companion, with high average life variability, but a big OAS. Note also that the structure and price prevents the yield of the bond from falling much below 6%, even in a rising interest rate environment. The yield can exceed 40% in a dramatic interest rate rally in our example bond.

A TAC is similar to a one-sided PAC, with only call protection

TAC

A TAC is similar to a one-sided PAC. The bond has some call protection in the event prepayment speeds are higher than expected. However, the TAC can have a lot of extension risk if prepayments are lower than expected.

Example

In Figure 11, we see that our example TAC has a lot of extension risk. Even at reasonable, although slow, prepayment speeds, the bond extends out to 20-year-plus durations.

Figure 11: Example of a TAC price/yield table and OAS information

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1595	800	225	145	120
Price					
92.1875	32.71%	20.16%	8.90%	6.33%	6.22%
93.1875	28.78%	18.09%	8.44%	6.22%	6.13%
94.1875	24.97%	16.08%	7.98%	6.12%	6.04%
Average Life	0.32	0.59	2.74	17.94	21.7
LIBOR OAS	44				
OAD	10.11				
OAC	-2.46				

Source: DB Global Markets Research

Analysis

Not all TACs are created equal. Some behave more like PAC bonds, or PAC-2s. Others look more like companion bonds. The defining characteristic of TACs is they do have some call protection. A first cut of analysis of a TAC should involve looking at the range of average lives that can occur under various interest rate and prepayment scenarios. In addition, OAS and perhaps total return analysis may be useful.

While the TAC we have chosen does have a high OAS, it has a large amount of risk if rates rise. The TAC is already at a discount dollar price, and its price could plunge further if prepayments slowed and extended the TAC out to a 20-year average life in a steep yield curve environment.

A PACquential blends characteristics of a PAC and a sequential

PACquential

A PACquential blends characteristics of a PAC and a sequential. While a Type I PAC typically has a lower band of 100 PSA, a PACquential has more extension risk, with a lower band more typically around 150 PSA. Nevertheless, a PACquential does have a PAC band and is supported by its own companion bonds. These features make PACquentials more stable than a standard sequential tranche.

Example

Our example bond has a PAC band of 150 to 360 PSA, within which it has a 5.1-year average life. In this case, the extension risk of the bond down to 120 PSA is minimal. Therefore, the difference between this bond and a regular PAC is not that great.

Figure 12: Example of a PACquential price/yield table and OAS information

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1665	800	220	145	120
Price					
96.75	6.14%	5.26%	4.73%	4.72%	4.65%
97.75	5.42%	4.84%	4.49%	4.48%	4.44%
98.75	4.72%	4.43%	4.26%	4.26%	4.23%
Average Life	1.53	2.7	5.1	5.23	5.85
LIBOR OAS	37				
OAD	4.48				
OAC	-1.38				

Source: DB Global Markets Research

Analysis

Note that PACquentials are not that well standardized in the market, and so each bond must be carefully examined on its own merits. One factor to pay special attention to is extension risk of the PACquential below its PAC band, and down to as low as 100 PSA (we do not think speeds below 100 PSA are likely). Beyond that, all the standard analytical tools apply: OAS, average life variability, and total return analysis.

In the case of a Z-bond, interest accrues and is added to principal initially

Z-Bond

A bond can have different cash flow characteristics (PAC, sequential, PACquential). Also, it can have different interest payment features. In the case of a Z-bond, initially

interest accretes and is added to the principal balance. At some point, the Z starts to pay down both interest and principal. The suspension of paying current interest for some period of time extends the duration of the Z bond. A Z bond can be created from any of the fundamental cash flows. Note that the accreted interest that would otherwise have been paid to the Z bond can be used to pay down principal on another CMO tranche. This technique can be used to create CMO tranches with a short legal-final maturity[10], Very Accurately Defined Maturity (VADM) bonds.

Example

The companion Z bond we have chosen for our example has a deep discount dollar price, giving it PO-like characteristics, including convexity that is not that negative, and pretty close to zero. Note the wide variation in average lives under different interest rate and prepayment scenarios.

Figure 13: Example of a Z Bond price/yield table and OAS information

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1595	800	223	145	120
Price					
84	12.58%	8.75%	6.64%	6.45%	6.39%
85	12.09%	8.36%	6.57%	6.39%	6.34%
86	11.61%	8.16%	6.49%	6.33%	6.28%
Average Life	2.57	6.05	17.36	21.03	22.28
LIBOR OAS	53				
OAD	19.47				
OAC	-0.09				

Source: DB Global Markets Research

Analysis

There are a few main differences when analyzing a Z bond versus a regular tranche of the same variety.

- Is the Z bond currently a payer? If not, the audience of investors may be reduced.
- The OAD of the Z bond can experience extreme swings in different interest rate scenarios because of its ability to accrete interest payments into principal.
- The OAD can be much longer than OAD of the collateral.

Standard OAS or TRR analysis should take these factors into account. On our example bond, the OAD is extremely long, almost 19.5 years. The fundamental question to ask is whether an investor would prefer to own this bond or a zero-coupon Treasury bond. The two can best be compared using TRR (total rate of return) analysis.

Note also that these bonds will be extremely sensitive to small changes in prepayment model assumptions. Different models will almost certainly give a wide range of OAS valuations.

[10] A legal final maturity is the last possible day the investor could receive the last cash flow from a CMO tranche, set at the deal's inception and assuming no prepayments.

VADM bonds are structured to have short final maturities

VADM

VADM (Very Accurately Defined Maturity, pronounced "vah-dim") bonds are structured to have short final maturities. The accreted interest that would otherwise be paid to the Z bonds is used to pay off VADM principal (see Z bond). In general, the average life of a VADM bond is more stable than a comparable duration sequential bond. They are especially resistant to extension risk, as the short final maturity of the bonds is guaranteed even if prepayments drop to zero, a highly unlikely event.

Example

Our example bond shows a 5.95 year average life. Even if prepayments drop to zero, the bond will have a 5.96 average life (although this slow a speed is not included in our yield table). Note however, that the premium price exposes the bond to significant risk if interest rates drop and prepayments speed up.

Figure 14: Example of a VADM price/yield table and OAS information

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1595	800	225	145	120
Price					
103.5	3.44%	4.26%	4.81%	4.81%	4.81%
104.5	2.89%	3.92%	4.61%	4.61%	4.61%
105.5	2.34%	3.59%	4.41%	4.41%	4.41%
Average Life	1.85	3.13	5.95	5.96	5.96
LIBOR OAS	56				
OAD	3.56				
OAC	-1.20				

Source: DB Global Markets Research

Analysis

Investors should purchase VADMs primarily if they absolutely need the guaranteed final maturity—such as in certain mutual funds or in other investor situations. Check that the VADM maturity does in fact fit the requirements. In addition, analyze the magnitude of the call risk of the bond, which can vary widely among VADMs.

Floaters are generally tied to LIBOR and have a cap and floor on the coupon paid

Floater

Not only do CMOs have different types of principal cash flows, the interest may also be paid in different ways. Most tranches have fixed-rate cash flows, as most collateral for CMOs is fixed rate. However, it is possible to construct floating rate tranches, generally tied to LIBOR, though conceptually the floater could be indexed to any market interest rate. One possibility is to use an interest rate swap to create a floating-rate bond. However, more likely, a CMO floater is created by the division of a fixed-rate tranche into two tranches, one a "floater" and one an "inverse floater". The inverse floater's coupon moves down as the floater's moves up (see *Inverse Floater*).

Key components for a floater include:

- The index, such as LIBOR. Other indices used are Constant Maturity Treasury[11] indices, such as 10Y CMT.
- The margin, or spread over the index paid to the investor.
- Caps and floors on the interest rate for the bond. Note that these caps and floors are stated inclusive of the margin paid over the index.

Example

Our example bond is a companion floater. The average life is highly variable. The major issue with such a CMO would be the difficulty in hedging the risk of the embedded cap. One could purchase a very long maturity cap to hedge the risk at 120 PSA, but this might be prohibitively expensive, and unnecessary if prepayments come in faster than 120 PSA. This floater has a formula of one-month LIBOR + 130 bp, a cap of 7.5% and a floor of 1.3%.

Figure 15: Example of a Floater price/yield table and OAS information (LIBOR constant)

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1665	800	220	145	120
Price					
98	6.84%	5.12%	2.74%	2.53%	2.52%
99	2.47%	2.47%	2.56%	3.64%	4.42%
100	2.04%	2.19%	2.39%	2.41%	2.41%
Average Life	0.42	0.70	7.05	21.34	23.56
LIBOR OAS	19		Formula	L+130 bp	
OAD	2.58		Floor	1.3%	
OAC	-2.82		Cap	7.5%	

Source: DB Global Markets Research

Analysis

Floating-rate bond analysis is similar to fixed-rate analysis in terms of examining cash flows and the bond's OAS. However, the floater has the additional complexity of having embedded caps and floors which have to be valued (even if the floor is 0%). It is especially important to make sure that the term structure model[12] employed correctly values caps and floors. Additionally, an investor can price out an actual cap or floor (available in the market) for the expected average life of the security to evaluate if the package of floater plus hedge makes sense relative to Agency debenture[13] floaters or other money-market alternatives.

Discount margin refers to the effective spread over the index once the bond's price and a prepayment assumption are factored in. The discount margin is the nominal

[11] These indices are released by the US Treasury and try to capture the yield of a hypothetical Treasury bond with a constant maturity equal to 2,5,10, or 30 years, for example.
[12] A term structure model takes as inputs a current yield curve, a representation of volatility, and correlations between the two to model future interest rates
[13] Agency debenture floaters refers to unsercuritized debt of an agency or GSE rather than the securitized debt, such as MBS.

spread to the index. An investor would look at discount margin as well as OAS to determine value in a floater.

Note that floater analysis (if uncapped) is effectively limited to the combination of index and index reset (frequency with which the index, and hence the floater coupon, changes. Most of the duration of the floater would be due to the duration from the cap.

An inverse floater is typically created by dividing a fixed-rate tranche into a floating-rate portion and the inverse floater

Inverse Floater

An inverse floater is typically created by dividing a fixed-rate tranche into two tranches, a floating-rate portion and an inverse floater. The key understanding is that the sum of the parts (floater and inverse floater) must equal the whole (the underlying tranche) in terms of both interest and principal payments. Please see discussion of "creation value" below.

A typical coupon formula for an inverse floater might be 17.05% — 2.75 x 1-month LIBOR. As the market interest rate rises, the coupon falls. The number multiplied times the index rate is known as the "leverage" of the inverse floater. The higher the leverage, the longer the OAD of the inverse floater, and the more risk to the owner of the bond if interest rates rise more quickly than expected.

Example

Our example is a discount, companion inverse floater. These bonds have a lot of duration and so are often used as substitutes for POs. Our example has a highly variable average life, but also high expected yields across interest rate scenarios.

Figure 16: Example of an Inverse Floater price/yield table and OAS information (LIBOR constant)

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1665	800	220	145	120
Price					
84.3125	60.38%	41.89%	19.84%	17.08%	17.04%
85.3125	56.69%	39.75%	19.41%	16.87%	16.83%
86.3125	53.09%	37.66%	18.98%	16.66%	16.63%
Average Life	0.42	0.7	7.05	21.34	23.56
LIBOR OAS	696		Formula	17.05-2.75*L	
OAD	28.80		Floor	0%	
OAC	-12.45		Cap	17.05%	

Source: DB Global Markets Research

An inverse floater's OAD is increased linearly by the leverage of its coupon formula

Analysis

An inverse floater's OAD is increased linearly by the leverage of its coupon formula. In our example bond, the underlying tranche has an OAD of 9.57 and the inverse floater's leverage is 2.75. If the floater had a duration of 0, then the inverse floater's OAD is roughly equivalent to[14]:

[14] To the extent the floater has an OAD over 0, it reduces the OAD of the inverse floater compared to this formula. In our example, the floater has a duration over 2 years, so the actual OAD of the inverse floater is much less than this formula would suggest.

(1 + leverage) x (underlying tranche's OAD)

or

(1+2.75) x (9.57) = 35.89

OAS analysis is important for analyzing inverse floaters, and as with floaters, inverse floaters have embedded caps and floors. Therefore, the term structure model is important for evaluation. Also, the prepayment model used to evaluate the inverse floater is critical. As market rates fall, the inverse floater's coupon rises, but faster prepayments (and hence principal pay downs) may erode the value of this higher coupon to the bondholder. Effectively, the inverse floater buyer is leveraged to prepayments, and thus must be careful to examine the effect of variations in prepayment assumptions on bond valuation.

Inverse floater versus leveraged collateral

Does OAS analysis work? One way to check is to compare inverse floaters to leveraged collateral positions. While at first glance, it may appear that one should simply buy the bond with the highest OAS, in reality, the duration (or OAD) of the two assets being compared also matters significantly. To correctly compare inverse floaters to collateral, the collateral must be implicitly levered (by borrowing money) to the same duration as the inverse floater for the comparison to be fair. (The comparison is still not completely fair because leveraged collateral probably has more liquidity and is easier to fund than the inverse floater.)

In Figure 17, we look at the inverse floater versus a leveraged collateral position. The first line shows the position of the collateral outright – the OAS and OAD, as well as the price. The last line shows the inverse floater by itself. The problem is that the OAS numbers are not directly comparable because the inverse floater's leverage makes its duration substantially longer than that of the collateral. To make the comparison closer, we can compare the inverse floater to a leveraged position of collateral. The idea is to invest the same amount of cash in the floater and the inverse floater, but then to borrow additional money to buy more pass-throughs, until the pass-through position is similar in risk characteristics to the inverse floater. Then, we can compare the OAS of the leveraged collateral position with the inverse floater.

In this example, we have borrowed money equivalent to the 2.75 times leverage of the inverse floater. We have turned our original $100 million position of 30Y 5.5s into a $375 million position, investing $100 million of capital and borrowing money at LIBOR – 5 bp for the balance. We should earn the difference between the 5 bp LOAS on the collateral and the LIBOR – 5 bp funding assumed, or 10 bp on what collateral we borrow. Therefore, the leveraged OAS of our investment should be:

[(100 x 5 bp) + 275 x (LIBOR + 5 bp – (LIBOR – 5 bp)]/100 = 32.5 bp LOAS

The leveraged OAD is simply found by multiplying the total amount times the OAD and dividing by the cash invested in the trade:

(375 x 4.7) / 100 = 17.5 OAD

The duration of the leveraged collateral is still slightly shorter than the inverse floater, but is close enough. We can see in Figure 17 that Deutsche Bank's OAS model still prefers the inverse floater over a position of leveraged collateral.

Figure 17: Comparing leveraged collateral versus an inverse floater

Proceeds Amount	Type	Security	Price	LOAS	OAD
$100 MM	Inverse floater collateral	FNMA 5.5%	100.578125	5	4.7
$375 MM	Leveraged collateral stats	FNMA 5.5% leveraged	2.75 times lvg.	**33**	17.5
$100 MM	Inverse floater	(See Figure 16)	85.31	**696**	28.8

Source: DB Global Markets Research

Given the floater and underlying tranche prices, the arbitrage-free creation value of the inverse floater can be determined

Creation value is another method used to analyze inverse floaters. The value of floaters is relatively easy to determine, as they are relatively liquid and easy to price. Likewise, the underlying tranche for the floater/inverse combination is typically easy to price. Given those two prices, the arbitrage-free creation value of the inverse floater can be determined. In Figure 18, we show how an inverse floater and a floater can be compared to the original companion bond they were created from. In the first line, we show how the par amount (principal) of the floater and inverse floater must sum to that of the underlying tranche. Since the underlying companion bond has a fixed coupon of 5.5%, the total coupon amount paid to the inverse floater and the floater combined has to total exactly the following each month:

5.5% x current face / 12 months = 5.5% x $100,000,000 / 12 = $458,333

Effectively, the balance weighted average coupon of the floater and inverse floater must always equal 5.5% and the total monthly interest paid must be exactly $458,333. If we assume the lowest that LIBOR can go is 0%, then the floor on the floater coupon is its margin of 130 bp (from its coupon formula of LIBOR + 130 bp). This floor in turn sets the inverse floater's maximum rate, or cap, because we only have a certain amount of coupon to spend each month. In this case, the cap on the inverse floater coupon is 17.05%, which we can calculate by plugging a LIBOR of 0 into the inverse floater's coupon formula:

17.05% – (2.75 x LIBOR) = 17.05% - (2.75 x 0) = 17.05%

However, the crux of creation value analysis is examining the prices of the inverse floater, the floater, and the underlying companion bond. Investors prefer to purchase inverse floaters at or below creation value. Bonds may trade below creation value in the secondary market because they have lost liquidity or become undesirable in the marketplace.

On the other hand, if the price of the floater and inverse floater add up to more than the value of the underlying companion bond, that would demonstrate the possibility of arbitrage profit. In Figure 18, that would be demonstrated by the value of the floater and the inverse floater being more than that of the underlying companion bond.

Figure 18: Floater + Inverse Floater = Underlying Companion Bond

	A Floater	+ B Inverse Floater	= C Underlying Companion	Notes
Amount issued	$25,626,350	$9,318,674	$34,945,024	Amount issued of the floater plus the inverse must total to the amount of the underlying
Coupon	1M L + 130bp	17.05 – 2.75 x 1M L	5.50	Floater and inverse floater coupons must add up to 5.5%
Cap	7.50%	17.05%		LIBOR at 0% in this case sets the floor for the floater and cap for the inverse
Floor	1.30%	0%		The inverse floater's floor sets the cap for the floater
Price	99.00	85.31	95.35	In this case, we have forced the weighted average price of the floater and inverse to equal the underlying companion
Yield	2.60%	19.41%	7.08%	Yield is a function of the prices, above
OAS	19	696	199	Note the inverse floater appears to leverage the cheapness of the underlying companion bond
OAD	2.58	28.80	9.57	The inverse floater also has a much longer duration than the floater
OAC	-2.82	-12.45	-5.39	And the inverse has most of the negative convexity as well

Source: DB Global Markets Research

Trade against forward rates. Some investors buy inverse floaters as a trade against forward rates rising as fast as the market would suggest. For example, the yield of our inverse floater at unchanged rates and 220 PSA is 19.41%. The yield assuming this prepayment speed but forward rates is 18.4%. If rates rise more slowly than forward rates suggest, the true yield of the bond will be somewhere in between the two numbers.

Analyzing inverse floaters is complex and can be done in many different ways. They are not as liquid as regular tranches. However, investors can discover some extraordinary values in these bonds, or take advantage of specific views on the market.

Most IO and PO trades occur in the "Trust" IO and PO market

IOs/POs

Interest-only tranches (IOs) come in several forms. The primary one we will discuss is "trust IOs", where collateral is contributed to an IO/PO deal by dealers, Fannie Mae or Freddie Mac charges a small fee, and IO and PO tranches are returned to the dealers involved, in proportion to their collateral contribution. This type of structure gets its own unique IO/PO Trust number, hence the name. An IO can also be created

by stripping interest off a CMO tranche or in other ways, which typically result in CMO tranches with IO characteristics. Trust IOs tend to have the most liquidity, as they are large size deals that trade on broker screens, while smaller deals have less price transparency.

IOs typically have negative duration. If rates rise, prepayment speeds tend to slow. Slower speeds benefit the IO holder, who wants the collateral factor to stay as high for as long as possible. Once loans prepay, they stop paying interest beyond the month in which prepayment occurs. An IO investor wants prepayments to be as slow as possible to maximize the dollar amount of interest cash flow from the pool of mortgages. In the most extremely negative case, an investor could buy an IO and discover that the entire tranche has paid off in that month, reported in the following month. The IO would receive one interest cash flow and then be worthless.

The PO (principal only) is the complement of the IO. Because the PO pays no interest and returns only the principal portion of the pass-through, a PO holder would prefer prepayments to be extremely fast. Under a dollar price of approximately $85-00 (which is typical), POs have positive convexity. This makes them useful for hedging purposes, for example hedging mortgage servicing rights.

Example

Figure 19 shows an example of an IO. Since Trust IO and PO pricing is relatively liquid, most of the analysis for IOs and POs will be driven by an investor's view of prepayments or interest rates versus the market's view (as represented by IO/PO pricing). Nevertheless, IO/PO prices can also fluctuate due to technicals, including short squeezes on certain tranches. Note how the IO below has a high negative duration and high negative convexity.

Figure 19: Example of an IO price/yield table and OAS information

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1665	800	325	150	125
Price					
24.53125	-104.60%	-59.38%	2.13%	12.50%	13.94%
25.53125	-106.20%	-60.62%	1.13%	11.52%	12.96%
26.53125	-107.70%	-61.78%	0.21%	10.61%	12.05%
Average Life	1.12	1.55	4.93	8.71	9.69
LIBOR OAS	328				
OAD	-24.11				
OAC	-17.02				

Source: DB Global Markets Research

Some investors buy POs for prepayment protection or positive convexity, but others buy them simply to add duration to their mortgage portfolio

Figure 20 shows an example PO from the same Trust deal. Some investors buy POs for prepayment protection or positive convexity, but others buy them simply to add duration to their mortgage portfolio. As interest rates drop, observe that the PO yield rises significantly, due to increased prepayments. Often, as in our hypothetical example, the PO will have a negative OAS in return for its positive convexity. Effectively, when they buy a PO, an investor is paying a premium to buy call options.

Figure 20: Example of a PO price/yield table and OAS information

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1665	1200	325	150	125
Price					
74.9375	28.69%	20.71%	6.58%	3.66%	3.27%
75.9375	27.23%	19.66%	6.24%	3.47%	3.10%
76.9375	25.81%	18.63%	5.91%	3.29%	2.94%
Average Life	1.12	1.55	4.93	8.71	9.69
LIBOR OAS	-132				
OAD	14.71				
OAC	2.78				

Source: DB Global Markets Research

For Trust IOs and POs, at first the combination typically trades at a small premium above collateral

Analysis

IO/PO analysis using OAS models or other techniques is complex, and the market can be subject to technical squeezes. As IOs and POs are hyper sensitive to even small changes in prepayment assumptions, one must be very careful to examine the model used to calculate OASs. Prepayment modeling variables such as seasoning and refinancing burnout[15] are magnified many times in analyzing the IO/PO derivative versus analyzing the collateral.

Creation value can also be used to analyze IOs and POs, similar to the analysis of inverse floater/floater combinations. For Trust IOs and POs, at first the combination (combo) typically trades at a small premium above collateral. The combination cannot trade significantly below the price of collateral, because otherwise they could be recombined into collateral (for a small fee) and sold. However, the combination may trade at a price significantly above TBA collateral for a number of reasons:

- The underlying collateral is valuable, for example it has seasoning worth a pay-up to TBA collateral.
- There is a squeeze or scarcity of the IO or PO, which raises the price of the combination in turn. Sometimes POs get restructured in other deals, potentially leaving them dear.

Historical analysis of IO and PO OAS numbers may be somewhat useful, but ends up being highly prepayment-model and OAS-model dependent.

Premium tranche/IO arbitrage is another way to compare relative value of IOs versus regular classes of CMOs. For example, a PAC IO plus a stripped down PAC should equal the value of the full coupon PAC, or there is an arbitrage. This is similar to the recombination value of an inverse floater. In practice, since many investors are willing to accept tighter spreads in return for lower dollar price PAC bonds, we can see arbitrage opportunities occur during deal pricings which make the restructuring of a premium PAC tranche, into a stripped-down coupon PAC and a PAC IO, attractive.

Some investors may use POs to hedge other assets, such as mortgage servicing rights (MSR). In that case, all the above analysis may be performed, but the investor

[15] Burnout refers to declining prepayment speeds after the initial peak, as the most rate-sensitive borrowers refinance out of a mortgage pool.

probably also wants to check how well correlated changes in the price of the PO will match changes in the item being hedged. Since the PO is an asset, not off-balance-sheet, FAS 133 does not apply to POs.

Unusual features

Note that IOs can be stripped off of any CMO type, for example PACs, creating PAC IOs. This class of bond will behave like a high yielding PAC within the band, but if prepayments speed up, it will pay off quickly, perhaps creating a loss for the investor. Other non-Trust IOs must be examined carefully as to the nature of their cash flows.

Exotics

We describe below a number of exotic CMOs for the sake of completeness, but will not discuss individual examples.

Inverse IOs

Inverse IOs are created by stripping the premium portion off an inverse floater. In some respects, they behave as an interest rate floor. At times, their pricing has been described in relation to floor prices. However, they are more like "knockout" floors because if interest rates fall enough, prepayment rates will speed up and pay down the notional principal of the tranche, reducing the remainder of the investment to zero. Because of their illiquidity, these bonds are difficult to hedge and value — even more so than trust IOs.

Inverse IOs are highly levered to one's interest rate scenario and prepayment forecast. It is important to analyze how small variations in prepayment or interest rate assumptions change the potential value of the bond.

Jump Zs

A jump Z is a type of Z bond. A jump Z reacts to fast prepayments (i.e. above a certain trigger level) by suddenly shifting from accrual to paying interest and principal (becoming a "payer"). This option can be of great value to the investor if the Z bond is at a discount price. Note also that some Jump Zs are sticky, meaning once the "payer" trigger has been pulled, they continue to pay even if prepayment rates subsequently drop below the trigger level.

Structured POs

POs themselves can be structured into TAC POs, Super POs (companion POs), etc. Analysis is similar to that for PO analysis, except the bonds will probably be even more sensitive to slight changes in prepayment assumptions.

Certain investors cannot participate in the non-Agency CMO market

Agency versus non-Agency CMOs

While most investors who can buy Agency pass-throughs are also allowed to buy Agency CMOs, certain investors cannot participate in the non-Agency CMO market. Here, we will describe some of the differences between the two markets (see Figure 21 for a synopsis) and then address some specific non-Agency CMO issues.

Figure 21: Agency versus Non-Agency CMO Differences

	Agency CMOs	Non-Agency CMOs
Credit support	Agency guarantee, underlying mortgages, primary mortgage insurance	Credit enhancement (e.g. subordination and excess spread), underlying mortgages, primary mortgage insurance
Actual delay days	Variable: 0,14, 24	Variable: 0,24
BIS risk weighting	0% for GNMA, otherwise 20%	For AAA-rated tranches, 20%
Collateral types	Agency pass-throughs, conforming Alt-A loans	Jumbo or other non-conforming pass-throughs, re-performing loans, Alt-A loans
Prepayment model	Agency prepayment model	Specialized model based on collateral
Subject to interest shortfall	No, compensating interest paid by the Agencies	Compensating interest may be paid or not, or paid up to a specified limit

Source: DB Global Markets Research

Agency CMO analysis tends to be simpler than for Non-Agency CMOs because of more, established prepayment models and minimal credit risk

Agency CMOs

Agency CMO analysis tends to be simpler than for Non-Agency CMOs because of more, established prepayment models and minimal credit risk. Collateral information disclosure on non-Agency CMOs tends to be slightly better, but in general the information gap is marginal for new deals. On the other hand, older Agency CMO deals may not have information such as mortgagors' credit scores (e.g., FICO) or owner-occupied status available.

Agency CMOs are generally structured by a dealer, who takes all the risk on the deal. They will approach an Agency to "wrap" the deal for a fee.[16] Occasionally, the Agency will also purchase some of the CMO tranches in a deal. Fannie Mae and Freddie Mac do exert some control over the new issue CMO market, because at times they hand out quotas for the amount of collateral that can be structured into CMOs according to coupon. This restriction is to prevent a squeeze, or even a shortfall of collateral for deals pricing in the same month.

[16] The underlying pass-throughs are guaranteed by an Agency. However, the trust set up to hold the collateral for the CMO cannot have a Agency name on it unless it is specifically wrapped by a Agency. Without the FNMA, FHLMC, or GNMA name, a CMO would probably have less liquidity despite the fact it only contained only Agency pass-throughs. Having the wrap also obligates FNMA/FHLMC/GNMA to step in if there is a problem with the CMO deal's trustee, or some other unforeseen matter, and make the CMO investor whole.

The investor is required to do a significant amount of extra work for non-Agency CMOs

Non-Agency CMOs

The investor is required to do a significant amount of extra work for non-Agency CMOs. Beyond the need to analyze the structure of the deals, the first point to make is that the whole loans backing these non-Agency CMOs do not trade lockstep with Agency collateral. In general, jumbo loans are perceived to have greater prepayment risk, as well as greater credit risk (due to the lack of an Agency guarantee). Therefore, jumbo whole loan packages typically trade behind similar Agency collateral by $0-24 to $1-08 as compensation.

Non-Agency CMO credit risk

The senior Non-Agency CMO investor is taking direct mortgage credit risk, albeit typically on Aaa/AAA rated bonds. The Agency CMO buyer has a negligible credit risk, similar to holding Agency pass-throughs. Non-Agency CMOs typically are created from collateral that is non-conforming for the Agencies. More often than not, this consists of so-called "jumbo" loans that are over the loan ceiling for the Fannie Mae and Freddie Mac, for 2003 set at $322,700. Originators typically originate and pool these jumbo loans together and then sell them to Wall Street broker/dealers. Loans can be sold as "whole loans" without structuring, but, more often that not, the originator gets better execution[17] by using a dealer to structure and sell them in CMO form. In this case, the deal is typically sold off an issuance shelf of the broker/dealer or the originator, pursuant to SEC Rule 415[18], and the Agencies do not wrap the deal.

Non-Agency CMO Credit Enhancement

Typically, whole loans are not credit enhanced. The buyer takes credit risk on the loans. Non-Agency CMOs are usually structured into senior securities with a Aaa/AAA rating using some form of credit support. This enhancement to Aaa/AAA can take various forms. Subordination is currently far and away the most popular form. There are other methods that have been used in the past, but are typically not seen in non-Agency CMO deals in the U.S. today. One exception is deals securitized by lower quality loans, which still may use over-collateralization and/or excess spread (see below for definitions).

Here, we divide credit enhancements into internal, subject primarily to collateral credit performance, and external, subject to potential upgrades/downgrades of third parties. Most investors prefer "internal" credit enhancement.

Internal credit enhancements:

- **Subordination**. In this case, losses are leveraged into a small subordinated tranche (or tranches) of the CMO deal. The structure allocates losses first to the most subordinated tranche. If losses were sufficient to extinguish a subordinated class, the next most senior class would then stand in line to absorb losses. If all the subordinated bonds were extinguished, the senior Aaa/AAA tranche would theoretically have to take losses. Subordination may be combined with other

[17] Sells the loans at a higher "all in" price.

[18] SEC Rule 415 speeds the issuance of securities to market. It allows issuers to register sales of securities up to two years in advance, as long as the size registered for can reasonably be expected to be used. This is known as "shelf registration". When securities are issued under this rule, the typical 30-day cooling off period is typically waived by the SEC based on this shelf registration. Given that the arbitrage (potential profit) for creating a CMO may only exist for a brief period of time, shelf registration or exemption from SEC registration is essential in the new-issue CMO business.

methods of credit enhancement, most typically excess spread or reserve funds (see below for definitions).

- **Excess spread**. Interest income on the loans absorbs losses before any other credit enhancement is used. On a monthly basis, additional interest income may go to a reserve fund or back to the originator.

- **Reserve fund**. Cash is placed in an escrow account and is used to absorb loan losses. Often employed in concert with excess spread.

- **Over-collateralization**. In this case, excess collateral backs the deal. Therefore, defaults and losses on the collateral must "eat through" the excess collateral before there is imminent risk to the bonds. Any excess collateral when the CMO is called or matures is typically returned to the originator.

External credit enhancements:

- **Parent guarantee**. The issuer (dealer or originator of the loans) guarantees against credit losses. This makes the CMO vulnerable to an issuer's credit downgrade, which explains this structure's lack of popularity in the Non-Agency CMO market. (Note that this is effectively the method used for Agency CMO deals, although the wrap is by an Agency or GSE.)

- **Letter of credit**. A financial institution provides a guarantee to cover losses up to a certain dollar amount. This type of CMO is vulnerable to a downgrade of the letter of credit provider as well as collateral underperformance.

Subordination is the credit enhancement of choice today, as it lets the issuer transfer credit risk on the collateral completely to the market, in the form of subordinated tranche buyers. Although senior-subordinated enhanced CMO deals are at risk for downgrade, it is because the collateral or deal is performing poorly. There is minimal downgrade risk outside of poor collateral performance.[19]

Subordination is the main vehicle used to credit enhance Non-Agency CMOs today

Subordinated tranches

In this section, we briefly discuss subordinated tranches. While some are suitable only for sophisticated mortgage investors, others may offer better cash flow stability than many other available MBS, in return for a credit rating below AAA. While subordinated tranches can run the gamut from unrated tranches to AAA "mezzanine" tranches, there are a few rules of thumb.

For tranches rated single-A and higher, the cash flow characteristics of the tranche are arguably more important than credit characteristics. Often, a subordinated tranche has better convexity than even Agency PAC bonds. Subordinates are prohibited from receiving principal for some period of time (for credit enhancement purposes), and also have relatively strict schedules for return of principal. These schedules are designed to prevent subordination levels from falling too low and risking a credit downgrade on the deal.

Subordinated bonds protect the senior bonds in a number of ways:

[19] One exception where an internally credit enhanced CMO deal could be downgraded on an outside event is the bankruptcy of the originator/servicer of the loans. If loans were then found to be fraudulent, loan documentation was inadequate to service the loans, etc., then a CMO deal could be downgraded based on servicing risk, although this is unlikely. Note that the rating agencies grade almost all servicers.

- Senior bonds are paid principal before any is paid to the subordinated bonds. Senior bonds also have interest priority over subordinated bonds.

- Senior bonds are not allocated losses until and unless subordinated bonds are exhausted.

- The percentage of subordinate bonds in the deal is managed over time through a set of formulas shifting the percentage of principal that gets paid to the senior and subordinated bonds. This is known as "shifting interest".

For example, at first very little principal is allocated to the subordinated bonds, because mortgage delinquencies and losses tend to mount in the first four years of loans' lives. The dollar amount of subordinate bonds is thus built up as a percentage of the deal, de-levering the risk of the non-Agency CMO. Later, after peak defaults have passed, more principal can be allocated to subordinated bonds.

Figure 22 shows an example of a shifting interest subordinate. Note the very good call protection versus most MBS. Even at 800 PSA, the subordinate still has a 6.44 average life, relatively long for a CMO under that fast a prepayment speed.

Figure 22: Example of Shifting Interest Subordinate

Scenario	-200 bp	-100 bp	0 bp	100 bp	200 bp
Prepayment (PSA)	1665	800	325	150	125
Price					
98.78125	5.94%	5.65%	5.61%	5.61%	5.62%
99.78125	5.40%	5.46%	5.48%	5.49%	5.49%
100.78125	4.87%	5.27%	5.33%	5.36%	5.33%
Average Life	2.03	6.44	9.12	11.68	12.27
LIBOR OAS	62				
OAD	5.32				
OAC	-2.46				

Note that OAS statistics were run using an Agency prepayment model, and thus may not truly reflect the option cost of this bond. Instantaneous yield curve shift.

Source: DB Global Markets Research

For tranches rated BBB and lower, the credit characteristics of the collateral and deal tend to be more important than cash flow characteristics. The risk of downgrades if losses exceed expectations is relatively high in these tranche types, so care must be taken to examine the collateral and the underwriter carefully. Note also that these bonds have much smaller sizes and are less liquid than the higher rated subordinated tranches.

Note that, whether or not it is sold to the public, most non-Agency CMO deals include an unrated, first loss tranche. The issuer often retains this unrated tranche as a sign of their faith in their loans and the CMO structure.

Certain special collateral types have prepayment characteristics superior to jumbo whole loans

Special collateral types

There are a number of special collateral types we will discuss briefly in this section. In most cases, their prepayment characteristics are superior to typical jumbo whole loans. In turn, originators typically expect to be paid a premium over the price of typical jumbo whole loans for these collateral types.

- **Re-performing FHA/VA loans**. Most often, these loans were first originated by a government Agency. These loans can be culled from GNMA pools or sold by FHA/VA. In general, they are loans that were seriously delinquent that have since been rehabilitated or modified. The underlying credit issues with the loans typically cause them to be less reactive to interest rate moves, and hence desirable to investors from a cash flow analysis standpoint.

- **VA Vendee**. These loans are typically made at very high LTVs (up to 100%) to non-VA borrowers purchasing real estate owned by the VA (typically acquired through foreclosure). As these homeowners have started with a below-market interest rate and a very high LTV, they are also less sensitive to an interest rate rally in terms of refinancing.

- **Alt-A loans**. The Alt-A label has been applied to a broad swath of mortgage types. In general, we would characterize these loans as slightly below top-credit mortgages. These loans are primarily classified as "limited documentation", where the borrower is missing a standard credit history, documented source of income, or some other standard input used in credit scoring models. In general, Alt-A mortgage rates are higher than market, so they are also less sensitive to a rally in interest rates. Note that, overall, Alt-A prepayments may be higher over time, as the borrowers "cure" their credit problems. In most cases, the homeowner will find it advantageous to then refinance into a conforming loan at a lower rate. The important factor is that this credit curing is not necessarily correlated with interest rates, thus the collateral is considered more valuable than standard jumbo loans.

While lower credit quality loans have been securitized, in general this is a very small market, primarily dominated by the so-called "Home Equity" originators (typically, subprime credit quality mortgages). Please see the *Securitized Monthly* and *Home Equity Loan Monthly* from Deutsche Bank Securitization Research for more information on this sector.

There are a number of issues that differentiate Non-Agency CMOs from Agency CMOs

Other Non-Agency CMO Issues

Besides collateral credit quality, there are a few other issues with non-Agency CMOs that differentiate them from Agency CMOs. While CMO collateral is structured to be "bankruptcy remote" from the issuer and originator, there can be servicing risk if the servicer has financial problems. Jumbo mortgage prepayments tend to behave differently than Agency mortgage prepayments. In addition, there are other details that exist in Non-Agency CMOs and not in Agency CMOs, such as compensating interest.

Compensating interest

In a non-Agency CMO deal, prepayments received before the end of the month result in an interest shortfall for the deal. The borrower is not obligated to pay interest for the balance of the month once the loan is paid off, yet the CMO deal is structured to pay interest on that balance through the end of the month. In Agency deals, this shortfall is made up by the Agencies themselves on the underlying pass-throughs. In non-Agency deals, there are several ways that this problem can be solved.

- Compensating interest is paid by the servicer, originator or deal sponsor to make up the interest income shortfall due to prepayments. Often, the amount of interest in a single month is limited to the fees the servicer receives on the deal,

effectively capping the risk to the compensating interest provider and raising a small risk to the investor.

- Create a regular CMO tranche or tranches which absorb the risk of the interest rate shortfall.

- Create a WAC IO, similar to a regular IO/IOette off a CMO deal, except the coupon varies slightly to absorb interest shortfalls.

Servicer and bankruptcy risk

While CMO collateral is structured to be "bankruptcy remote" from the issuer and originator, there can be servicing risk if the servicer has financial problems. While securitization structures are designed to insulate investors from the impacts of a seller/servicer bankruptcy (primarily by legally isolating the mortgage loan collateral), the potential bankruptcy of a seller/servicer in a Non-Agency CMO does pose some risks.

- Assuming the seller/servicer's bankruptcy makes them an undesirable party to continue to servie the loans, it may be difficult for investors to remove the seller/servicer.

- A transfer of servicing to another (presumably superior) party, though contemplated in and facilitated by the deal documents and structure, may be disruptive.

In the case of an Agency CMO, the Agency would be responsible for solving this problem, in addition to shouldering the financial risk by guaranteeing timely payments of principal and interest. Moreover, if the servicing fee is too small, the trustee may have to extract payment from bondholders in some fashion. The servicing industry has consolidated into a smaller number of large, sophisticated servicers and there is less risk that any one of them having problems would cause a widespread problem.

Jumbo prepayments

Jumbo mortgage prepayments tend to behave differently than Agency mortgage prepayments, primarily because the larger loan size of the jumbos makes refinancing more economical, even for smaller interest rate incentives. The fixed costs of refinancing (filing fees, lawyer's fees, etc.) for a jumbo loan are balanced against a larger present value of interest rate savings because of the larger loan amount. Large loan size hence tends to increase refinancing efficiency, and hence raise the option cost to the investor. Higher yields are designed to compensate for this heightened prepayment risk, as well as for the lack of Agency backing.

CMO deals are typically PAC, sequential, or the newer PACquential structure.

CMO Analysis

The following section looks at how investors analyze and use CMOs. We also cover term structure and prepayment models briefly.

Analysis for regular CMO tranches

CMO analysis depends upon investor needs. While relative value may seem to be one answer, one rule does not necessarily hold for all investors. The definition of relative value can be different for different investors. Other investors have portfolio constraints. For example, an insurance company may need assets that closely match liabilities, even if interest rates were to move dramatically.

Investor goals and constraints

Investors can have many goals and constraints when purchasing CMOs. For example:

- Insurance companies and banks sometimes have yield levels ("bogies") below which they may not purchase bonds.
- Relative value investors may require a certain OAS, or OAS pickup versus collateral.
- Hedge funds may require a certain amount of liquidity in purchases they make, both for bonds and potential hedges (such as cancelable swaps). If liquidity in the bond or the hedges in insufficient, they may decline to do an otherwise attractive trade.
- Funded investors may need to issue debt or raise equity before adding MBS. If the environment is not amenable to such issuance, then CMO purchases may be delayed.
- A bank may require CMOs to pass FFIEC, a test initially set up by U.S. bank regulators. Regulators no longer require banks to limit purchases to CMOs that pass FFIEC, but some banks still employ these tests.
- Individual or institutional investors may have a top dollar price limit, above which they will not purchase bonds.

Perhaps the varying needs of investors explains why there are so many different kinds of CMOs, some unique. Different requirements and views are what makes a market…

Cash flow analysis

For most regular tranche types, cash flow analysis consists of testing various prepayment models and static prepayment assumptions to determine the sensitivity of a bond's cash flows to changes in interest rates. This analysis would include a comparison of the negative convexity of different CMO bonds.

For some investors, cash flow analysis becomes more detailed, as they may be trying to hedge their own stream of liabilities, or perhaps they are hedging the CMO itself with an amortizing swap.

Finally, for non-standard tranches, it pays to examine the cash flow waterfall and test various interest rate scenarios, examining the results in terms of cash flow streams. There are certain red flags that would be cause for concern to investors:

- A bond with a longer-than-expected final maturity.
- A bond whose window is interrupted by a period receiving no principal pay downs.
- A bond whose average life profile changes sharply at a particular prepayment speed.

For most regular CMO tranches, OAS analysis is relatively useful

OAS analysis

For most regular CMO tranches, OAS analysis is relatively useful. For similar tranches off similar collateral, it is easy to use OAS to determine relative value of bonds. In addition, comparing OAS numbers for CMOs versus underlying collateral also is straightforward. The more difficult issue is how to compare OAS numbers of tranches of different durations. For example, often longer dated tranches are at higher OAS numbers than similar shorter dated tranches. This structural issue makes it difficult to evaluate relative value of longer versus shorter dated CMOs. Our suggestion is to compare CMOs to similar duration collateral to determine relative value. For CMOs with very long durations, such as inverse floaters, CMO tranches can be compared to Treasury bonds, Agency debentures, or leveraged collateral positions.

Hedging

For normal CMO tranches, OADs are an acceptable way to calculate how to hedge. However, wide window sequentials may require hedging on multiple points along the yield curve to avoid yield curve risk, similar to hedging the yield curve in the underlying collateral. Figure 23 shows how the bulk of duration risk may be in the 10Y area for a specific bond, but hedging in 2Y, 5Y, and 30Y would help reduce yield curve risk. Note how only 55% of the hedging of this sequential is in the 10Y area, the rest is spread among the 2Y, 5Y, and 30Y points on the yield curve.

Figure 23: Partial durations of a 5Y wide-window sequential

Yield Curve Point	2Y	5Y	10Y	30Y
Partial Duration	0.6	1.5	2.7	0.1
Percent of hedge	12%	30%	55%	3%
OAD	4.9			

Source: DB Global Markets Research

The term structure model has become equally as important as the prepayment model

Issues in OAS analysis

The goal of OAS analysis is to answer what the investor needs to know: the value of the bond versus a benchmark, its risks, and how to hedge it. The OAS number itself tries to represent the spread of the mortgage backed security, ex- option cost, versus a benchmark such as swaps. A number of factors arise in deciding whether OAS achieves this goal. While in the 1980s and early 1990s, the primary variable differentiating OAS numbers was the prepayment model, at this point in the technology, the term structure model has become equally as important. We cover a number of other issues in this section, such as deal call risk, and variations among prepayment models.

OTC derivatives and MBS need to be evaluated using the same term structure model and the same assumptions

Term structure model

A term structure model takes as inputs a current yield curve, a representation of volatility, and correlations between the two to model future interest rates. In one version, a Monte Carlo implementation, the model will run many different, random interest rate scenarios governed by the model and its inputs. When evaluating MBS, an OAS model will average the results over the different paths of interest rates generated by the term structure model.

As mortgages have linked more tightly over time with the OTC derivatives markets (swaps and swaptions), modeling the relationship between these two markets has become critical. OTC derivatives and MBS need to be evaluated using the same term structure model and the same assumptions, if not, different — and perhaps erroneous — results can be obtained.

While a one-factor interest rate model was used in the past and may work reasonably for pass-throughs, it is not enough if an investor is looking at ARMs, floaters, or inverse floaters of any kind. More degrees of freedom for modeling the yield curve are needed. Therefore, in order to keep analysis consistent among different types of MBS tranches and derivatives, it appears critical to use the least common denominator of term structure models that will accommodate all possible tranche types and analysis, and not succumb to using different models for different types of bonds or situations.

Advances in term structure modeling have placed the following features into the hands of mortgage analysts:

- Multiple knots on the yield curve.
- Correct pricing of OTC derivatives using the model.
- Pricing in a volatility "skew" (i.e. options not stuck at-the-money may be priced at a different volatility than standard at-the-money options).
- Sophisticated simulation of future mortgage interest rates based on the swaps curve and volatility.

A term structure model that does not do these things opens up arbitrage opportunities relative to investors who do use such a model. In an extreme case, flaws in the term structure model will misstate value and risk numbers associated with a CMO.

Forward curve bias

Despite all the care being put into term structure models, and their freedom from arbitrage, it is important also for investors to recognize the forward curve bias in these models, which creates a paradox.

- In order to remain "arbitrage-free", the term structure model must use the forward yield curve as its base case.
- In practice, the forward yield curve is usually wrong.

How can we reconcile these two facts?

The short answer is that we should use the forward yield curve, because if we do not believe something that it is predicting, we can trade against it and make money if we are correct. At times, the second point becomes plainly obvious. For example, when the yield curve is extremely steep, forward rates predict massive flattening of the yield curve over a short period of time. If the Fed appears to be on hold during this time, are we likely to get the full amount of the yield curve flattening? Probably not. However, even if we hold this view, it may be easier to trade on this view directly in the derivatives or futures market rather than trying to implement it in the mortgage market.

Prepayment model

The prepayment model is still a very important component of mortgage analysis and OAS. Over time, prepayments have become more efficient. This trend appears to be continuing into the future, bolstered by competition among servicers. While most prepayment models address the standard issues of age, relative coupon, etc. there are now various subtleties that a model must take into account:

- Does the model account for "credit impaired" mortgages issued at above market rates?
- How does prepayment "burnout" work in the model, and can burnout be erased over time?

A prepayment model that is out of date or incorrect, even if only with regard to a small segment of the market (e.g., high premium mortgages) can have a large impact on an OAS. OAS models tend to generate some interest rate paths with very high and very low interest rates — testing the boundaries of prepayment models and their ability to generate reasonable prepayment forecasts at out-of-sample interest rates.

The parts can be worth more than the whole, as creation value analysis can show

Why A+B can be greater than C…

One of the last topics we will cover in this section is why, in CMOs, A + B > C, even if A and B are made up of the component cash flows of C. This topic is known as creation value analysis. Here are some factors.

- **A and B are unique and more cannot be created.** For example, once a Trust IO/PO deal is closed, additional collateral cannot be added later to increase the size of the deal. Thereafter, a squeeze in A or B will increase their price in relation to C, which is simply TBA collateral. A+B can never be less than (C – transaction cost) for long, as this would create a recombination arbitrage.[20]
- **A or B is getting "squeezed".** One of the risks in the IO/PO market is that bonds can be re-securitized and hence lost to the possibility of recombination. For example, if virtually all of the POs in a Trust deal are re-securitized, the remaining POs will be in very high demand to hedge the remaining IO tranches. In addition, trust IO/PO sizes can be small enough that one dealer or investors can potentially squeeze the market in one of these bonds, making A + B > C.

[20] Typically, an IO and a PO from the same trust can be recombined to form the underlying collateral for a 1/32nd fee and resold as collateral. While this is virtually unheard of in practice, it creates an arbitrage floor for the IO and PO prices, which is important from a liquidity and pricing standpoint. This is much harder to do for floaters and inverse floaters, as both sides of the combination in that case may be harder to find and less liquid, as most inverse floaters do not trade on broker screens, as Trust IOs and POs do.

- **The underlying collateral is valuable.** Sometimes A + B may be compared to the "wrong" C. For example, comparing a Trust IO and PO to TBA collateral may be appropriate most of the time. However, after the deal is seasoned for a while, the underlying collateral itself may be worth a pay-up to TBAs (seasoned collateral typically commands a premium price to TBAs).

Examining deal call risk

A feature in many CMO deals, but not discussed often and sometimes not modeled is the embedded call (the "clean-up call". Originally conceived as a way to limit ongoing fixed expenses for deal trustees on CMOs that have shrunk to a very small size, the implications for investors can be significant. For example, the last cash flow holder will typically be exposed to the call. A call that sounds small for an entire deal (say, 1%), may actually make up a large portion of the last tranche remaining in a CMO deal. For a tranche that was only 5% of the deal's original principal, a 1% cleanup call is exercisable when 20% of the last tranche is remaining. The impact for investors of other tranches is de minimus, but obviously the impact can be large for the last cash flow holder.

The good news is that clean-up calls are exercised most of the time, because the fixed costs of the deal tend to be large enough that the trustee wants to exercise the call whenever possible. This assumption makes analysis easy. However, if the price of the collateral is significantly below par, calling the deal costs the trustee money. For such deals, analysis of the probability of exercise of the call is difficult. Therefore, the bond holder may want to analyze the bond both with and without the call to assess its possible impact.

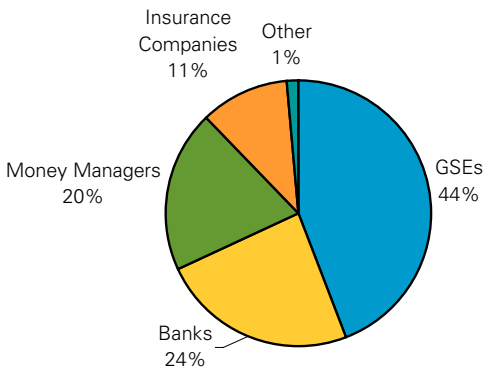
Investor types and behavior

In this section, we examine different types of investors, such as commercial banks. Our goal is to cover the following information for each:

- Types of CMOs typically purchased by these institutions.
- Methods potentially used by these institutions for bond selection.

Figure 24 shows that the GSEs and banks are the two largest holders of MBS. These investors also hold large amounts of CMOs.

Figure 24: Estimated MBS holdings as of year-end 2002



Source: Deutsche Bank Global Markets Research, Fannie Mae, Freddie Mac, FHLB, Sheshunoff, Russell-Mellon, Federal Reserve

Banks tend to buy shorter average life CMOs

Banks

Banks are large consumers of the CMO product. For many banks, the longer duration (and possible duration extension) characteristic of pass-throughs does not match their liabilities adequately. Additionally, with the addition of FAS 133 (accounting rules for derivatives), hedging pass-throughs with derivatives and achieving "hedge accounting" treatment is difficult. Therefore, rather than hedging, it is easier for many banks to achieve the desired shorter duration security or reduced extension risk by buying appropriately structured CMO bonds. Banks are typically "buy-and-hold" investors in CMOs, although some bonds may be placed in the bank's trading account.

In general, banks focus on shorter duration CMOs. A 10Y bond typically does not fit the liability structure of a bank. A two-year sequential CMO is a typical purchase for a bank. In general, banks will accept some prepayment and convexity risk in order to earn a higher spread. Therefore, banks tend to prefer sequentials over PAC bonds. Banks do very little hedging of their negative convexity using the options market, although they may delta hedge[21] their mortgage position as its duration changes.

CMO selection at banks generally comes down to a few things: yield bogey, duration, OAS, and perhaps FFIEC eligibility[22]. In general, a bank will have a target net interest margin over their cost of funds in order to purchase a security. This target may be translated into a yield, or spread bogey over a market rate. Also, a bank may not want to take too much duration risk, so the duration of the security must fit the asset-liability framework of the bank, or the bank must be prepared to hedge the duration of the CMO. Some banks use OAS to determine relative value among tranches, but in general asset-liability and liquidity concerns tend to dominate their CMO purchase decisions. Although regulators no longer require bonds to be FFIEC eligible, some bank boards or portfolio managers may restrict themselves to bonds that meet the FFIEC tests as a general test of "prudence".

Note also that banks are the largest consumer of mortgage "whole loans", or mortgages that are not securitized. These whole loans are mostly those that are ineligible for Agency securitization, or they are ARMs or hybrid ARMs.

Banks: The FFIEC test

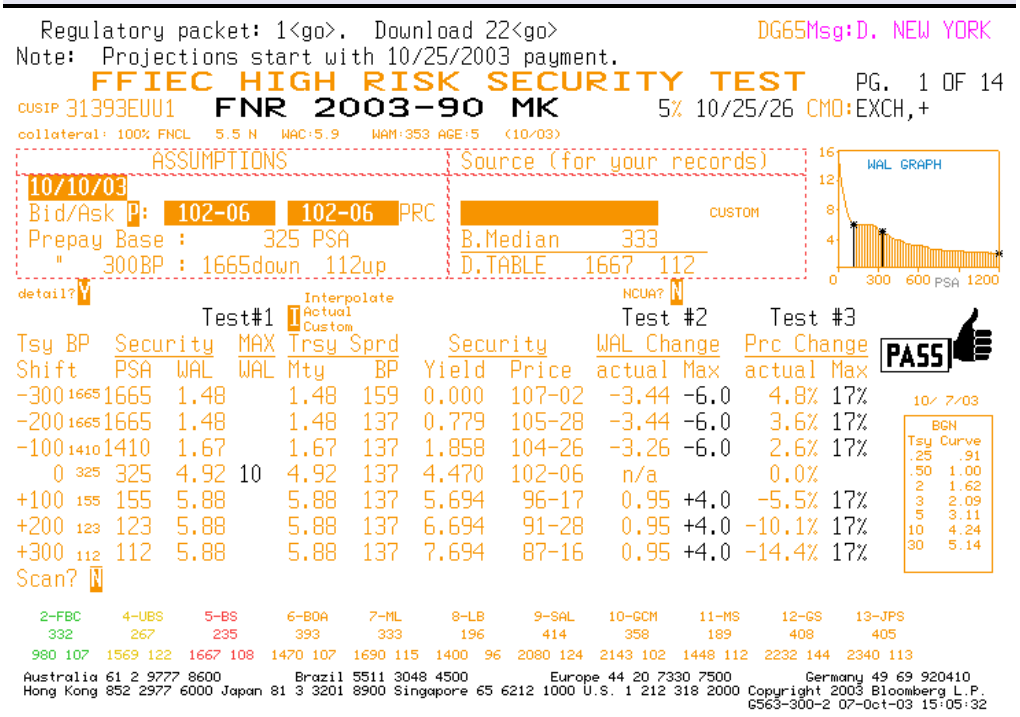
For a while in the 1990s, banks were restricted from buying CMOs with significantly more convexity risk than pass-throughs. This rule was enforced by applying the so-called "FFIEC test" to a CMO. The rule results in a pass/fail result. This function is currently available on Bloomberg using the FMED <Go> command, as shown in Figure 25.

Essentially the test limits the acceptable CMO average life variablility and also limits estimated potential price changes in +/- 300 bp parallel interest rate shocks. The CMO passes if its value changes by less than 17%. In addition, the starting average life could not be longer than 10 years, the bond could extend b no more than 4 years nor shorten by more than 6 years. Even thought the test is no longer applied by the regulators, some investors feel it still provides a suitable benchmark of whether a CMO is "risky" or not.

[21] Please see Deutsche Bank's *Guide to US Mortgage-Backed Securities*, p.42, Alexander Crawford, January 2002 for more information on delta hedging.

[22] Please see page 46 for a discussion on the FFIEC test. Note that although it no longer is applied by regulators to bank CMO portfolios, some bank investors still use it as a general guideline to make sure they are not buying bonds that are too volatile.

Figure 25: FFIEC test



Source: Bloomberg

The GSEs will buy bonds that look attractive on their OAS models

GSEs

"There is no such thing as a bad bond, only a bad price." The housing GSEs (Fannie Mae and Freddie Mac) are sophisticated investors that will buy and hedge almost any CMO, as long as it is cheap enough. They may use OAS or comparisons to collateral to determine value. They may buy CMOs off certain collateral when the underlying collateral is hard to find. They can hedge using derivatives or issue debt (including callable debt) against CMOs that they purchase for their portfolios. They are, in general, buy-and-hold investors, although some CMOs may be placed in the available-for-sale account rather than the held-to-maturity account.

Because of the housing GSEs' relative value framework, OAS is typically very important. They rely on OAS models not only to determine value, but also to determine the correct hedge. While OAS is important, it is not the only thing GSEs look at. Some GSEs (such as the twelve FHLBs) have the ability to buy non-Agency MBS. The FHLBs operate more like a bank in some cases, caring as much about yield, net interest margin and average life profile as they do about relative value in an OAS framework.

Life insurance companies are looking for well structured bonds to match against their liabilities

Insurance companies

Insurance companies buy CMOs across the spectrum of "regular" tranches—PACs, sequentials, PACquentials. Property and casualty companies tend to buy shorter maturity tranches, such as 2 year sequentials. Life insurance companies are looking for more structure and a match against their long liabilities and thus are more likely to purchase longer duration bonds, such as 10Y PACs. While MBS are a break from the credit risk that insurance companies typically take on the corporate bonds in their investment portfolio that credit quality comes at the expense of negative convexity. In 1995, S&P devised a "convexity test" that penalized insurance companies for

having negative convexity in their portfolios. This served primarily to reduce mortgage holdings at some particularly large "outlier" firms that held unusually high percentages of MBS, but has also generally reduced MBS holdings over time at insurance companies.

In general, insurance companies may have restrictions on selling CMOs because of gain or loss constraints. Property and casualty companies may sell bonds against claims (after a hurricane, for example).

Some money managers are active in the CMO derivatives market, but many are not

Money managers

Money managers vary in sophistication. They generally are not subject to gain/loss constraints because they mark-to-market daily, unless they are managing a separate account for a financial institution. Some money managers are active in the CMO derivatives market, but many are not. Most money managers are benchmarked against an index which contains pass-throughs. Therefore, any CMO is effectively an "out of index" bet for them. They will typically be comparing that CMO either to collateral, or perhaps, for certain types of CMOs, to Treasuries/Agencies. OAS analysis tends to be an important tool for money managers.

Liquidity tends to be a bigger issuer for money managers than for insurance companies. The money manager may need to be able to shift assets around quickly, and thus is prepared to give up something in order to have better liquidity. Most money managers own many more pass-throughs than CMOs because of this fact. In addition, pass-throughs have the opportunity to finance special (via the dollar roll market). Income from special financing can be a windfall for money managers, as this income is typically not included in the mortgage index returns against which the money managers are benchmarked.

Money managers frequently take long-term views about strategy in mortgages. One type of view is to have a portfolio that has better (or worse) convexity than their benchmark index. A money manager can typically get better convexity by buying PAC bonds, or give up convexity by buying companion bonds or certain types of sequentials or broken PACs.

Pension funds

Pension funds in some ways operate similarly to money managers. However, ERISA (pension fund law) or investor considerations sometimes prohibit them from investing in mortgage derivatives. Similar to life insurance companies, they are often interested in longer duration tranches at times.

Certain hedge funds specialize in mortgage derivatives

Hedge funds

Hedge funds can operate in a manner similar to money managers, but at times they enter into more complex trades involving OTC derivatives. For example, they might buy a CMO and try to hedge its cash flows over time using swaps and options, netting a positive spread which they hope to earn over time.

Certain hedge funds specialize in mortgage derivatives: inverse floaters, IOs, POs, inverse IOs, etc. They use sophisticated models to value these tranches, purchase them, and hedge them. One of the main issues for these funds will be pricing of their inventory (as individual bonds may not trade for months) and liquidity.

Retail Investors/Regional Dealers

Many CMOs, including CMO derivatives such as inverse floaters, end up in the hands of regional dealers. In turn, these regional dealers may sell those bonds to retail clients. In general, yield tends to be the focus of these buyers, and thus companion bonds are often sold via this channel.

Note that any broker that sells CMOs to retail investors must include a special series of special disclaimers mandated by the NASD.

Lessons from the past

In past cycles, investors in MBS, and especially in derivative MBS, have suffered such severe price movements as to put them out of business. In a crisis, while the mortgage market may continue to trade via pass-throughs, the liquidity of the CMO market can dry up, especially for derivatives. Investors should be prepared for all risks, including the risk of illiquidity and radical changes in pricing due to such illiquidity. Dealers must make sure they "know their customer" and that the customer is buying bonds appropriate for their goals.

Conclusions

Investors can find more diverse investment choices and cheaper bonds in CMOs than in MBS pass-throughs. There are relatively stable CMO classes (such as PACs) for investors seeking to replace their corporate bond holdings with MBS. Investors willing to take interest rate or credit risk to gain excess return can also find appropriate CMOs, such as mortgage derivatives or companion bonds.

The CMO market is now a huge market in its own right, and investors need to pay attention to it as well as the MBS pass-through market to get the full view of US Mortgage Backed Securities.

Appendix: Using Bloomberg

A CMO can be pulled up via a CUSIP or a ticker

Pulling up a CMO

A CMO can be pulled up via a CUSIP or a ticker. The Bloomberg ticker is generally FNR or FHR (for Fannie Mae or Freddie Mac REMIC), followed by a space, the deal number, another space, and the tranche letter(s). This must be followed by the <Mtge> key and <Go> to pull the bond up. Please note that most CMO prices in Bloomberg are inaccurate, despite different pricing sources available. The alphabetical list of useful commands follows.

Alphabetical list of some useful Bloomberg commands for CMOs

All of the following commands can be executed after pulling up a CMO in Bloomberg. Simply type the command and hit the <Go> key. Please note that we do not recommend using OAS functions on Bloomberg, as the term structure and prepayment models available are not state-of-the-art. Bloomberg is more useful for examining tranche types, getting Bloomberg street median prepayment forecasts, and calculating yield tables or pricing out a tranche for purchase or sale.

CAMP – New and outstanding CMOs, total

CAV – Collateral availability

CFT – Cash flow table

CLASS – Description of class types

CLC – Collateral composition

CMOR - Displays recent CMO deals

DES – Provides tranche description

DES2 – Provides CMO collateral description

FMED – Run the FFIEC test on a tranche (user must input correct bond price)

HPF – Historical prepayment forecasts

ICMO - Displays aggregated CMO issuance

SPA – Structure view

VAC – View all classes – allows the user to look at all the tranches in a deal

VALL – Dealer prepayment forecasts

VMED – View Bloomberg median prepayment speed

WALG – Weighted average life graph.

YT – Yield table

Notes:

Notes:

Certifications

The views expressed in this report accurately reflect the personal views of the undersigned lead analyst(s) about the subject issuer and the securities of the issuer. In addition, the undersigned lead analyst(s) has not and will not receive any compensation for providing a specific recommendation or view in this report.

Alexander Crawford

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