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***EDUCATIONAL NOTE***

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**ASSET AND  
MORTGAGE-BACKED SECURITIES  
CHAPTER 5**

**COMMITTEE ON INVESTMENT PRACTICE**

**MARCH 1996**

*Cette note est disponible en français*



Canadian Institute of Actuaries

Institut Canadien des Actuaires

### MEMORANDUM

**To:** All Members of the Canadian Institute of Actuaries  
**From:** R.J. Sharkey, Chairperson  
Committee on Investment Practice  
**Date:** March 29, 1996  
**Subject:** **Educational Note on Asset and Mortgage-Backed Securities**

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This note provides a description of asset, mortgage-backed securities, collateralized mortgage obligations and the mortgage-backed security issue process. It also discusses the nature of prepayment and extension risk for mortgage-backed securities and the factors impacting these risks.

Questions regarding the note can be addressed to me at my *Yearbook* address.

RJS

## CHAPTER 5 – ASSET AND MORTGAGE-BACKED SECURITIES

### *The Issuer Perspective*

A company may be highly leveraged or may be in a transition stage where it is facing steep borrowing costs. Or a company may wish to diversify its funding sources or to source funds at attractive rates. In these situations, securitization may offer a more efficient and profitable method of disposing of assets and sourcing funds than is available through direct sales in the secondary market.

A company may have a risk problem because of an excess of one type of asset and a deficiency of another type. Or within an asset class, there could be a risk problem due to an undesired concentration in a single issuer, sector, location, etc. The risk problem could be related to liquidity, credit, interest rate or diversification. Or it could be related to the inability to meet capital or other regulatory requirements.

If the assets could be sold to reduce the unwanted risk exposure to the asset class or the unwanted concentration, and the proceeds invested in the preferred type assets, then the risk, capital or regulatory problem could be resolved. Unfortunately, the assets owned may be fundamentally illiquid and low quality so that a direct sale at a fair market price is difficult and unlikely. For example, it is difficult to make direct sales of policy loans, office equipment, leases, credit card and health care receivables, franchise, small business, student, auto, mobile home, personal and other consumer loans, mortgages, real estate and junk bonds whose illiquidity and or credit quality makes a direct sale difficult. Securitization makes it possible to sell such assets.

Securitization generally involves the splitting off from an asset portfolio of a pool of similar assets and the sale of the rights to some or all of the cash flows generated by those assets to investors. The certificates of ownership to those cash flows can be readily sold and resold without impacting the assets themselves, much as in the case of units in a segregated or mutual fund.

An important issue to regulators and accountants with respect to assets sold through securitization is to establish those conditions which justify the removal of the assets from the balance sheet. The CICA exposure draft “Financial Instruments” indicated that balance sheet removal required the transfer of substantially all (at least 95% of fair value of risk and rewards) associated risks and rewards. This contrasts with a criteria that might be based on control of the economic benefits.

In July 1994, OSFI issued final guidelines on “Asset Securitization” and “Transfers of Financial Assets with Recourse.” The former deals with capital adequacy issues and the latter with the accounting treatment applicable to transfers of financial assets, such as receivables, by means of securitization, repurchase and reverse repurchase agreements.

### *The Investor Perspective*

Securitization often enables an investor to gain exposure to an asset class that they cannot gain direct access to, at least to the desired extent or in the desired way. Securitization can range from relatively straightforward *pro rata* sharing of the cash flows from the pooled assets to relatively complex arrangements. In the more complex arrangements, the liquidity, credit, prepayment, extension and other risks can vary extensively amongst the different securities backed by the same asset pool. The risks of some securities will be reduced and the risks of other securities will be leveraged. While an enhanced yield is available for the securities that leverage liquidity and/or credit and/or prepayment and extension risks, the appropriate risk premium can be difficult to establish and the potential for loss in adverse markets has been repeatedly underestimated.

The variation in liquidity premium can be illustrated with mortgage derivatives. Mortgage pass-throughs have bid-ask spreads in a good market as little as 1/32 and PACs 1/4 or more depending on the maturity. The riskiest tranches may only have one bid, from the dealer that created the tranche, and the spread is as wide as 5% in normal markets. In abnormal markets, the spread may widen to 10% and there may be no bid at all.

Life insurance companies and commercial banks have been the main investors in asset-backed securities in the U.S., but mutual funds and investment partnerships have been significant investors as well. It is estimated that about 3% of U.S. life insurance bond holdings are asset-backed securities.

Since 1990, U.S. life insurers have invested extensively in MBSs and CMOs as they reduced exposures to mortgages, real estate and junk bonds – a clear tradeoff of interest rate risk for credit risk. Between 1988 and 1993, life insurance companies increased their holdings of MBSs from 9% to 15% (\$81 billion to \$269 billion) of investments and from 100% to 140% of capital, according to ACLI. Investments in agency CMOs increased from \$18 to \$69 billion.

The proportion of U.S. life insurance company bond portfolios invested in loan-backed bonds and CMOs exceeds 30% in many large companies and 50% in some. The proportion of surplus exceeded 300% in many companies, and 500% to over 1000% in some. There are about \$800 billion of CMOs with about \$400 billion issued in 1993.

## 5.1 Asset-Backed Securities

Asset securitization, as distinguished from mortgage-backed securitization, has grown quickly in the United States since 1985 and more recently in Europe. Most of the asset-backed securities are backed by credit card and other forms of consumer loans. In 1993, in the U.S., there were nearly 200 new asset-backed issues sold for \$60 billion, and the market capitalization of real estate investment trusts (REITs) increased by 133% to \$25.6 billion.

In most asset-backed securitizations, a traditional investment or commercial banker acts as agent or manager. A relatively small number of securitizations use boutique or niche firms or others. Just over half are fixed rate and just under half are floating rate.

A typical asset-backed security involves the creation of a trust by a seller/servicer to which a pool of assets is sold with or without recourse. Investors purchase securities issued by the trust and backed by the cash flows generated by the pool of assets held by the trust. A trustee makes the payment of principal and interest to the investors. The seller/servicer receives a servicing fee.

Asset-backed security structures depend on the legal opinion that: 1) the trust issuing the security will not be drawn into the bankruptcy of the seller; 2) the transfer of the loans (receivables) from the seller to the trust is a “true sale”; and 3) the investor has a first perfected security interest in the loans. There is legal risk that these opinions will be challenged and challenged successfully.

There is the risk that the bankruptcy/receivership of the servicer may lead to delay of payments. Rapid repayment of principal may cause underperformance.

The rating agencies assign ratings after looking at the quality of the underwriter, servicer and trustee, the quality and diversity of the collateral, including historical pool performance and pool seasoning, legal structure and credit enhancements. The ratings on asset-backed securities do not relate to the timely payment of principal, except that it be paid by the time the trust matures, which is a legal date that may be well after the expected final maturity.

Often the credit of these asset-backed securities is enhanced by placing more assets in the pool than will be needed to meet the payments on the securities backed by the pool, assuming no defaults occur. While enhancing credit, such overcollateralization means the asset-backed securities will tend to be paid back more quickly. An irrevocable letter of credit from a top-rated bank or bond guarantee insurance company may provide for reimbursement of pool loans written off up to some amount such as 5% to 30% of loan balances. To obtain an AAA rating on the basis of a letter of credit, the guarantor would need to be an AAA bank and the guarantee would need to provide coverage against losses at least several times historical loss levels. An issuer may provide a similar guarantee with the security receiving the same rating as the issuer. This form of credit enhancement, however, creates credit exposure to the guarantor.

A cash reserve might be established from the outset. Alternatively, any excess interest earned on the collateral over that paid on the securities plus servicing fees, plus credit enhancement fees, if any, might be set aside to build a credit risk reserve account. This excess spread would revert back to the seller, if and only if, it was not needed to cover credit losses. In this way, the pool assets can experience a degree of credit losses without impacting the payments promised on the securities, and so be rated as high quality by rating agencies.

In certain situations, the cash flows from the asset pools will be stratified into a senior (Class A) security and a subordinated (Class B) security. All losses are absorbed by the subordinated security until it is completely exhausted. The higher quality security will be impacted by credit losses only if they exceed those that can be borne by the lower quality tranche. If the issuer is subject to the Bankruptcy Code and the issuer retains the lower quality tranche, there is a legal concern that, in the event of the issuer's bankruptcy, a court will rule that the pool assets have not been truly sold.

Initially, all prepayments will usually be directed to the higher quality tranche. While this enhances credit quality for the high quality tranche, it increases the prepayment risk of the tranche. The rating agencies may assign an AAA or AA rating to the high quality tranche and a rating of A or lower to the low quality tranche.

### **CARS**

Asset-backed securities backed by a pool(s) of automobile and light truck loans are called CARS. CARS allow issuers, typically banks, automobile finance companies and arbitrageurs, to increase loan volume without increasing their leverage, while passing on or eliminating credit and financing risk. Investors can participate in the profitable automobile loan market without taking on lending and servicing functions. The market has grown rapidly, since the first offering in May 1985.

Loan pools are typically comprised of three-, four- and five-year loans resulting in three- to five-year maturities. Average lives are one to three years as a result of scheduled amortization and prepayment of principal. Multiple class CARS involve securities with various maturities and rates. Most issues are callable at par on any payment date after the pool balance declines to 5-10% of the original balance.

Typically CARS are rated AA or AAA on the basis of letters of credit or other guarantees from entities rated AA or better. CAR ratings reflect loan quality, the pool selection process, the payment structure and the credit support. If the rating derives from a letter of credit (LOC) then the CAR ratings will be impacted by the rating of the LOC provider. Rating downgrades arising from downgrades in the credit support are the primary risk. Consideration should be given to the credit quality of the supporting entity. Loss of principal due to net losses in excess of the credit support is unlikely.

CARS are composed of a great many loans (at least 10,000 to over 150,000) and so provide better

credit and prepayment risk diversification than straight corporate debt. Pool characteristics vary by issuer type. Bank pools tend to contain seasoned loans and up to 30% used car loans. Finance company pools tend to contain more recently originated loans from a wide geographic area. These characteristics impact credit and prepayment rates.

Pass-through CARS give certificate holders an equity interest in a fixed pool of loans. The loans are sold to a grantor trust that issues the CAR. Investors are entitled to all cash flows from the loans. In a pay-through CAR, the originator sells the loans to a limited purpose finance company that issues the CARS notes. The notes are supported by the cash flows from the loans, but do not entitle the note holders to any residual value. The notes are the issuers liability and are nonrecourse to the originator.

The CAR secondary market is becoming increasingly liquid. Liquidity concerns are mitigated by the short life of CARS. Usually investors intend to hold CARS to maturity, however.

CARS are priced to produce an appropriate yield relative to a Treasury issue with a maturity close to the average life arising from a specified prepayment rate. Yields on CARS have generally been higher than on equivalently rated corporate debt and generally provide higher option-adjusted spreads than mortgage-backed securities with similar average life.

Prepayment rates on automobile loans are relatively insensitive to rate changes and so do not present the same negative convexity risks as do mortgage-backed securities. Prepayment rates on CARS are relatively predictable, stable and insensitive to rate changes. The ABS method measures prepayment rates as a percentage of the original number of pool loans. A 1% ABS means that 1% of the original number of pool loans prepay each month. Prepayment of automobile loans are caused by automobile resales and trade-ins. Many consumers buy new cars every two or three years. This leads to slowly rising prepayment rates with pool seasoning. Prepayments also arise from defaults, theft or damage. Even sharp declines in rates provide little incentive to refinance auto loans. Refinancing involves a used car loan which can carry rates up to 2% higher than new car loans. Also the loan amounts and term are relatively short.

Pool loan characteristics impact prepayment rates. Seasoned, shorter term used car loans prepay faster than new, longer term new car loans. However, the variation in prepayment rates is narrow. The impact of variation in prepayment rates on the average life and yield of CARS is relatively small because scheduled amortization of principal on auto loans is a much larger portion of principal repayment than on mortgages. A pool of newly originated loans is unlikely to experience rates below 1.2% or above 1.6%. Average life and yield vary little within this range. Yield uncertainty can be reduced by purchasing CARS near par.

### **CARDS**

CARDS are asset-backed securities issued by banks and retailers and backed by receivables of credit cards. CARDS were first issued publicly in January 1987. Fixed income investors use CARDS to participate in the huge consumer credit card market.

Credit enhancements mean that senior tranches are rated AAA or AA with subordinated tranches rated A or lower. Credit enhancements for CARDS are designed to provide protection against default rates as much as five to eight times the worst case historical experience.

New issues generally have an average life of two to seven years. CARDS generally have a nonamortization or "lockout" (revolving) period of two to four years followed by a short and relatively predictable amortization period of less than one year or a bullet payment. During the lockout period, principal payments are reinvested in new receivables, thereby maintaining a constant dollar amount of receivables.

CARDS generally have higher yields than comparably rated corporate debt. Prepayment rates are relatively insensitive to rate changes and so cash flows are relatively predictable.

Credit receivables may be general purpose revolving credit cards issued by banks or private label credit card receivables issued by retailers. Such loans have no specific amortization schedule or final maturity date. They are extended and repaid repeatedly over time. The retail category is theoretically of slightly lower quality for several reasons, that are of greater importance, the weaker the retailer.

Card characteristics heavily impact ratings and prepayment risk. The higher delinquency and charge off rates, the higher the interest charges and the minimum monthly payment rates. The percentage of those who pay in full each month is important.

The investor-type certificate typically represents 80% of an issue and is sold publicly. The balance is retained by the seller and is used as a buffer against seasonal fluctuations in outstanding card balances.

The servicer of the credit card receivables (typically the originator) sells specific credit card account balances to a trust or special purpose subsidiary that conveys ownership of the balances to investors through sale of certificates. All new receivables originated from these accounts are sold as created. Accounts are selected so as to be representative of the issuer's eligible pool.

Issuer's counsel must provide a number of legal opinions, for example, that the transfer of receivables is a "true sale," receives accounting treatment as a sale and so on.

In a "hard" bullet structure, a controlled amount of funds is placed monthly into a "principal funding account" earning the certificate rate. If these funds are insufficient to retire all outstanding certificates, a third party guarantor makes up the shortfall up to a specific percentage of the initial offering. However this "maturity guarantee" is costly. A "soft" bullet security has no guarantor, but is structured to make it highly unlikely that the bullet payment is not made. In a controlled amortization structure, principal payments follow an amortization schedule that pays out within a year of when amortization commences and are fairly predictable.

"Early amortization" or "payout" events such as the bankruptcy of the seller, a decline in the yield on the receivables below a certain rate, or a rise in the charge off rate above a certain level trigger a quicker paydown of principal. While this provides credit protection, it does mean CARDS may pay much sooner than expected in a less favourable interest rate environment.

The receivables backing CARDS are unsecured, whereas the receivables backing CARS are secured by new and used autos. Consequently, CARS have far lower delinquency rates and net losses. Credit enhancements make this distinction a non-issue from a credit perspective. The liquidity of CARDS is generally superior to that of CARS because the deals tend to be larger. CARDS allow a wider choice of average lives 1.5 to 10 years versus one to three years for CARS.

The different payout structure of CARS and CARDS have a number of subtle implications. CARS will be more affected by interest rate changes because CARDS have a principle lockout period that makes their cash flows more predictable. The average life of CARDS will decrease more rapidly than that of CARS which benefit CARDS (CARS), when the yield curve is upward sloping (inverted). CARDS have tended to provide a somewhat lower yield than comparable CARS because of their greater liquidity and cash flow certainty. Updated information on existing CARDS may be hard to obtain and CARD holders may have to rely heavily on rating agencies. Banks have a strong incentive to get the receivables off their balance sheets under the new risk-based capital guidelines.

## 5.2 Mortgage-Backed Securities

In order to securitize mortgages, they are first grouped into homogeneous pools in respect of interest rate and maturity date. In Canada, the mortgages in a pool must mature within six months of each other. Each mortgage bears a fixed interest rate and provides for scheduled payments which are fully amortized over their respective amortization period.

### **United States**

Approximately half (\$1.6 trillion) of the \$3.4 trillion U.S. residential mortgage market has been packaged into mortgage-backed securities. This is a large highly liquid market, with insurance companies as major participants. Typically, the residential mortgages are level monthly payment fixed rate mortgages with 30-year terms and 30-year amortizations.

So called "balloon" mortgages provide for a 30-year amortization but with a rate renegotiated after five, seven or 15 years, say. A two-step mortgage is like a balloon mortgage in that the rate resets after some period, but the mortgage does not actually mature at the end of that period. The rate is formula based, and may involve a maximum increase over the initial rate.

A growing equity mortgage (GEM) is a mortgage that begins with the same monthly payment as for the standard level pay mortgage. However, monthly payments gradually increase and the mortgage is paid off early. All the above types of mortgages have been used as CMO collateral. Adjustable rate mortgages have not been used as CMO collateral.

Most U.S. MBS issues are so-called agency issues, since MBS payments are guaranteed by a U.S. government agency. The volume is split about evenly between three agencies. Securities issued by the Government National Mortgage Association (GNMA or Ginnie Mae) are backed by the full faith and credit of the U.S. government through the credit support of the Federal Housing and Veterans Administrations. Securities issued by the Federal National Mortgage Association (FNMA or Fannie Mae) and the Federal Home Loan Mortgage Corporation (FHLMC or Freddie Mac) are guaranteed by FNMA and FLHMC, respectively. There is a much smaller, but rapidly growing non-agency market that includes nonresidential mortgages.

Although obligations of FNMA and FHLMC are not backed by the full faith and credit of the U.S. government, it is accepted that the U.S. government would not allow these agencies to fail. Their status as a government-sponsored enterprise (GSE) is based on the facts that they are established by acts of Congress, have five presidential appointees on their board of directors; they are exempt from state and local taxes; they may borrow \$2.5 billion from the U.S. Treasury; their debt obligations may be held by federally supervised thrifts, banks and credit unions and by national banks (without limit) and their debt obligations are exempt from SEC provisions. There is a financial regulator within HUD that is responsible for ensuring that FHLMC and FNMA operate soundly and are well-capitalized.

FHLMC was created in 1970 to improve the liquidity of home mortgages and to increase the availability of capital for home purchases. FNMA was created in 1938 to provide liquidity to the mortgage market, especially in the secondary residential market. They provide liquidity to the secondary home mortgage market by purchasing mortgages and issuing participation certificates or mortgage-backed securities. The important economic, political and social functions played by these agencies provide a strong incentive for continued government support.

The residential mortgages securitized by FNMA and FHLMC meet certain underwriting standards and are below a maximum amount (\$203,150 in 1994). Such mortgages are "conforming." Loans that conform except for size are called jumbo loans.



A “fully modified” pass-through guarantees payment of both principal and interest when due. A “modified” pass-through guarantees interest when due, but only guarantees the payment of principal as it is collected but with a maximum delay after it is due. GNMA's, FNMA's and all gold FLHMC Participation Certificates are all fully modified. FHLMC modified pass-throughs provide for payment of principal no later than one year after due.

The first mortgage pass-through (MBS) was done in 1970. In a mortgage pass-through, each security owner receives a *pro rata* share of all pool cash flows after payment of servicing and guarantee fees. Cash flows consist of interest payments, scheduled principal payments, unscheduled principal payments and early prepayment penalties. The first mortgage-backed bond was issued in the mid 1970's.

### **Canada**

The Canadian Parliament established the Canada Mortgage and Housing Corporation (CMHC) in 1946. The CMHC insures first mortgage loans made by private lenders in the housing sector. The CMHC guarantees the timely payment of principal and interest on their due dates as set forth in the loan agreement. Loans guaranteed by the CMHC carry the same credit risk as Agencies of the Government of Canada.

To obtain NHA insurance on a loan, the lender must be approved and the building must conform to construction standards and must be single family dwelling or a rental housing project intended for full occupancy. The lender must confirm that the borrower's equity in the property securing the mortgage arises from the borrower's resources and the borrower's or rental property income must be sufficient to produce an acceptable gross debt to interest service ratio.

Although there is no explicit requirement for the lender to renew the mortgage upon maturity, CMHC practices mean that the lender is, in effect, required to renew performing mortgages or find an alternative lender. The lender must work with CMHC and the borrower to find a resolution in the event of default on payments or taxes, prior to exercising any foreclosure or power of sale proceedings.

In 1984, the National Housing Act (NHA) was amended by parliament to authorize a new activity intended to facilitate the financing of housing, the development of a mature secondary market and the return to longer term lending. The CMHC was authorized to guarantee the timely payment on their due dates of principal and interest on MBS certificates based on securitized pools of NHA insured mortgages.

Under contractual arrangements between the issuer of a pool and CMHC, the issuer is responsible for servicing and administering the mortgages which constitute the pool in accordance with generally accepted practices in the mortgage lending industry. The issuer is liable for ineligible loans where title is defective. The issuer must pay various administrative and processing fees. The issuer must make regular monthly payments to the central paying agent, whether or not the mortgage payments are received from the borrower. The issuer must also pay off the investor at maturity, whether or not the loans have been repaid or recovery made in the event of default.

The amount of each payment to the MBS certificate holder is the scheduled amount plus some adjustments. The primary adjustments are the prepayment penalties and additional unscheduled principal payments or other early or unscheduled recoveries of principal on the pooled mortgage during the preceding month.

There have been some administrative problems with the passing through of penalty interest to the investor, and some investor concern that this aspect has not been adequately monitored. If the issuer waives the prepayment to encourage refinancing, the issuer is required to make the penalty payments to the investor. Some pool issuers retain the prepayment penalty amounts. This can create a conflict of interest, between the issuer, who might mount a campaign to encourage refinancing and the investor, who may stand to lose from refinancing.

The average MBS poolsize in Canada is \$12 million. About 3% of residential housing has been securitized in Canada in comparison with about 50% in the U.S. A primary reason for this is that Canadian banks fund 60-70% of residential housing, and, to date, they have only securitized non-profit social housing mortgages. Banks find the risk/return tradeoff of residential mortgages ideal for retention on their balance sheet as a match to GIC deposits.

The volume of MBS issues grew steadily from its beginning in 1987 to a peak of about \$6.5 billion in 1993. A sharp drop to less than \$4 billion occurred in 1994. After a further expected decline to about \$2.5 billion in 1995, new volume is projected by CMHC to increase to about \$5 billion in 1997 and to remain at the level until 2000. As of February 1995, the MBS market is estimated to be \$17.6 billion of which \$8.9 billion are single family prepayable residential mortgage pools and \$7.6 billion are non-profit housing pools.

Prior to late 1992, MBS spreads were expressed relative to the pool maturity date even though most of the pool mortgages could mature up to six months prior to this date. Also, no unscheduled prepayments were assumed in the pricing. Spreads were subsequently expressed relative to the weighted maturity of the pool mortgages. Pricing assumed all unscheduled principal payments were made at this date. Spreads are now expressed relative to a same duration Canada bond and a prepayment assumption is made. While this is an improvement, it should be recognized that material differences in the timing of expected cash flows and the potential for cash flow variation across interest rate scenarios of otherwise identical, same duration pools can lead to different spreads.

The pool spread off the Canada bond benchmark would depend on whether penalty interest was passing through, whether the pool is priced at a premium or discount and recent MBS spreads.

MBS pools have a pool numbering system that indicates major differences in the underlying mortgages. Non-profit housing mortgages have no prepayment privileges and a pool prefix of 990. Market multi family mortgages relate to rental apartments and nursing homes and have no prepayment privileges and a pool prefix of 966. However, there is the risk of a substantial prepayment of principal due to a single default. Single family open residential mortgages have prefixes of 964 and 967, if they have penalty interest or they do not, respectively. Mixed pools have a prefix of 965.

### **5.3 Prepayment (Contraction) and Extension Risks**

The underlying securitized residential mortgages can be paid early with no, or very little, penalty. Early payment can arise from the sale of a home due to a move or the purchase of a more expensive home, an insured catastrophe, a death or divorce, payment default resulting in sale, a desire by the borrower to pay off part or all of the mortgage balance or to refinance the mortgage.

As rates drop, the economic incentive to prepay (refinance) increases, and, as they rise, it decreases. The former is prepayment risk, the latter is extension risk. Both risks can produce material financial loss far exceeding that on an initially comparable duration noncallable bond. The early prepayment and extension risk is very difficult to analyze, depending as it does on the dynamic interaction of borrower behaviour and circumstances, investor behaviour, mortgage broker behaviour and interest rates.

Whereas the duration of a noncallable bond increases (decreases) with a decrease (increase) in rates, the duration of the MBS decreases (increases). The former has positive convexity and the latter negative. Buying mortgage-backed securities below par can provide some compensation for more rapid than expected prepayments. The return is enhanced relative to what it would otherwise have been, because the greater than expected principal is prepaid at par even though it was bought at a discount. The impact of having to reinvest the unexpected principal repayments at a lower rate than the yield expected to be earned on the mortgage-backed security at purchase may far outweigh this benefit, however.

The relation through time between current mortgage rates and the average coupon on the mortgage pool affects prepayment rates. The more that current rates fall below the mortgage rate, the more incentive there is to refinance. The longer the term remaining on the fixed rate and the lower the absolute level of the mortgage rate, the greater the dollar impact for a given mortgage balance and interest differential. The larger the mortgage balance, the more dollars at stake and the less impact of fixed refinancing costs such as application fees and legal expenses. GNMA MBS pools typically have a small average mortgage size and so the prepayment rate is likely to be somewhat less than for other pools.

The path that interest rates take to get to the current interest rate environment can influence prepayment rates. Refinancing burnout refers to the fact that there may be relatively few borrowers left to take advantage of a current opportunity to profitably refinance, if this opportunity has existed for some time on prior occasions. A relatively greater rate of refinancing can be expected in response to a current opportunity to refinance profitably, if it is the first opportunity (i.e., if there is no, or little, refinancing burnout).

Quantifying path dependency of prepayment rates is complex. A useful, relatively simple approach uses a ratio called the pool factor. The pool factor is the ratio of the current outstanding balances to the original balances for the pool of mortgages. The lower the pool factor, the greater the refinancing that is assumed to have already occurred, and, hence, the greater the refinancing burnout.

Mortgages subject to higher default rates, such as those to low income families, will have higher prepayment rates due to higher default rates.

Basic housing turnover rates have averaged 5-6% per year. However, a strong housing market implies a higher turnover rate and a weak housing market, a lower turnover rate, all else being equal. Thus, prepayment rate models based solely on interest rate trends and expectations may overstate or understate prepayment rates.

The level of rates, demographic trends such as the number of 18-34 year olds and economic conditions influence the amount of first time home buying and "trading up." For example, higher rates will increase the effective price of houses and higher consumer debt levels, and unemployment and lower wage increases will decrease affordability, resulting in lower turnover. Models can be developed to reflect macroeconomic and demographic forces impacting turnover rates.

A drop in property values can prevent prepayment, since refinancing is prevented. However, any subsequent increase in property values may result in a sudden surge of prepayments. This phenomena needs to be considered carefully, for it can lead to unexpected and apparently anomalous results. Suppose there is a large drop in rates accompanied by a large drop in values followed by a modest increase in rates and a large increase in values. Prepayments may not accelerate much during the period when rates are falling. And they may accelerate during the subsequent increase in rates. Prepayment rates are, thus, a function of property values.

Mortgages that collateralize GNMA's allow borrowers to transfer their loan to new buyers of the mortgaged property intact. When rates rise, the rate at which mortgages are assumed by new buyers increases, since they are, in effect, taking over a below market rate mortgage. The impact of assumability decreases the greater the gap between the property value and the mortgage balance. Conventional mortgages are paid off to the lender on sale of the property and so although increasing rates might inhibit property sales and hence result in slower prepayment rates, they would not be subject to the "double wammy" of GNMA collateral due to its "assumability."

A drop in refinancing costs may occur during a period of declining rates because of competitive pressures to retain old business and attract new business. If expected prepayments were projected

on a 200 basis point refinancing cost and refinancing costs shrink to 50 basis points or less, these expectations can grossly underestimate the actual prepayments. Prepayment rates are, thus, a function of refinancing costs.

An unexpectedly and persistently steep yield curve can also lead to more rapid refinancing as people refinance simply to move down the curve to shorter term mortgages and much lower yields. Prepayment rates are, thus, a function of the shape of the yield curve.

Prepayment risk can be reduced by utilizing collateral backed by 15-, seven-, and five-year term balloon mortgages, the shorter the term the better, or mortgages with current or below current coupon rates, the lower the rate the better. Prepayment rates are, thus, a function of the average term and amortization period and average rate of the mortgage pool. The seasoning or average time since issue is also an important factor in assessing prepayment rates, as is the time of year and the level of home owner equity. In a typical mortgage pool, the prepayment rate is initially low, increases over time, reaches a peak and then remains level. Home buying and hence prepayment rates increase in the spring, peaks in late summer and declines in the fall and winter. Prepayment rates can also vary by mortgage issuer (underwriting, etc.), geographical location (local economy, etc.) and other factors.

Penalties paid to the lender at the time of prepayment are not allowed on U.S. residential mortgages. Traditionally, an up-front fee of about 2% of the mortgage balance provided some compensation for prepayment losses and disincentive to refinance.

Many prepayment models used in the U.S. in the 1991-93 period were based on the 1985-87 experience. This led to serious underestimation of prepayments in the 1991-93 period, when aggressive pursuit of refinancing by mortgage brokers had virtually eliminated both economic (up-front fees) and inconvenience disincentives to refinancing. Also, models generally failed to take account of the fact that refinancing to shorten the mortgage term was very attractive to borrowers in a steep yield curve, even when there was little or no actual change in rates.

In a Canadian NHA single family residential mortgage MBS (pool prefix of 964 or 967), the underlying mortgages will typically have a term of five years with no prepayment rights in the first year. A penalty based on the greater of a market value adjustment and one month of penalty interest will typically apply, if prepaid in full in the first three years. Non-profit housing mortgages have no prepayment privileges. The maximum penalty legally allowed on all single family NHA MBSs is three months of interest, if prepaid after three years.

Unscheduled full prepayment of NHA insured single family residential mortgages should be negligible in the first year, since full prepayment is not allowed. A surge of full prepayments can be anticipated just after the third year, when penalties are capped at three months interest. Prepayment experience will vary considerably depending on what phase the pool is in.

Typically, residential mortgages provide for partial prepayments without penalty. For example, the borrower may be able to prepay 10% of the original loan once a year without penalty. The borrower may be able to pay up to double the normal monthly payment each month without penalty. The borrower may be able to prepay without penalty under certain circumstances in the event that the mortgaged property is sold.

In the past it has been typical for dealers to assume that a new NHA single family residential MBS issue will have partial prepayments at a rate of 1% annually and full prepayments at a rate of 4% annually, until maturity. Prepayments should be adjusted to take account of housing activity, pool prepayment history and pool characteristics such as the weighted average coupon, the time to maturity, geographical location and concentration. Also, the exact prepayment terms and conditions and the prepayment experience vary considerably by issuer.

The longer term of the typical U.S. residential mortgage compared to the typical Canadian mortgage and the absence of prepayment penalties on U.S. mortgages makes the prepayment and risk extension of U.S. MBSs very much greater than that of Canadian.

### ***Collateralized Mortgage Obligations***

The first U.S. collateralized mortgage obligations (CMOs) was issued in 1982. The collateral for a CMO can be one or more pass-throughs or a pool of mortgages. The great innovation of CMOs arises from the fact that the pooled cash flows can be carved up into tranches that meet the investment needs of a wide range of investors, thus attracting wide interest in securitized mortgages. This gave a huge boost to the securitized mortgage market. In 1993, there were \$271 billion of CMOs issued. Today, about three quarters of the agency MBS issues are turned into CMOs.

Initially, CMOs were issued as sequential tranches. While all tranches received interest payments, all principle payments were initially directed to the first tranche. Principle payments to the next tranche would kick in when the cash flow entitlements of all the preceding tranches were exhausted. The first tranche is a shorter term security than the second and so on. Typically, there were only five to seven tranches with the final tranche referred to as the Z tranche or accrual bond. In the case of the Z tranche, interest accrues on tranches until the payments are completed on all preceding tranches. Any difference between the total cash flow generated by the pool of mortgages and the payments to the various tranches due to differences in coupon rates between tranches, over collateralization, reinvestment of income prior to payout, is paid to the "residual tranche."

In the prospectus for each agency-guaranteed pool, there are tables listing each tranche showing examples of how cash flows from each tranche change under a wide range of interest rate and prepayment scenarios. Under a zero prepayment assumption, a tranche could have an average life of 30 years. The same tranche could have an average life of six months, if prepayments were several times the standard rate.

The first Canadian CMO issue was in April 1993. A total of 12 NHA CMO issues have been done to the end of 1994. The CMOs typically use several MBS issues as collateral, resulting in good issue size and diversification. The first seven CMOs were done as private placements. Subsequent CMOs have received exemptions from private placement status due to the NHA MBS security. There has only been one non-NHA residential CMO to date. The additional complexities and increased investor risk concerns with non-NHA are likely to mean that few non-NHA CMOs are likely to be issued.

The shorter term of the typical Canadian residential mortgage lends itself to a much simpler CMO structure than that in the U.S. The typical structure has only a few tranches. One tranche receives all prepayments until a level of 10% of principal prepayments has been reached, say. A second tranche is then allocated all subsequent principal prepayments, until they reach 20%, say. A third tranche would be allocated any principal prepayments beyond this level, if any. A fourth "residual" tranche would be interest only and receive any difference between the total amount of interest paid on the underlying MBS and the total interest paid on the other three tranches. This structure leverages the prepayment risk to the earlier tranches leaving virtually none to be borne by the third tranche. Only one issue has involved a single principal-only tranche.

Penalty payments for early prepayment could be included in fourth tranche, could be sold as a separate tranche or could be allocated to the first three tranches as prepayments are incurred by them. All Canadian CMOs to date have passed penalty interest through to the residual tranche.

### **Planned Amortization Class (PAC)**

The Tax Reform Act of 1986 made possible a new trust vehicle, the Real Estate Mortgage Investment Conduit (REMIC), which made possible the issuance of CMOs with multiple bondholder classes without adverse tax consequences. In 1986, the first CMO planned amortization class (PAC) was issued. A CMO involving PACs can have 70 or more tranches.

A PAC is designed to give more protection from both prepayment and extension risk than available through a sequential CMO or even a straight MBS. The Public Securities Association has defined a standard prepayment rate referred to as 100% PSA. The constant prepayment rate (CPR) is the annualized rate of unscheduled prepayments per month. The standard rate is defined to be .2% CPR in the first month increasing by .2% per month for 29 months to 6% CPR after 30 months. A CPR of 6% means that the prepayment for month  $t$  equals  $(1 - (1 - .06)^{t/12})$  times the mortgage balance at the beginning of the month reduced by the scheduled principal payments.

The average seasoned 30-year conventional mortgage with current coupon has prepaid around 125% to 140% PSA depending on whether the mortgage is assumable or not. Falling rates cause a significant increase with rates as high as 1300% PSA experienced on some CMOs in 1993. Rising rates cause a significant slowing in rates that is especially pronounced, if the loan is assumable and housing prices have appreciated little since origination. These "ballpark" rates are subject to much variation due to the many factors other than general rate level that impact prepayment rates that have been previously noted.

The payments to an investor from a PAC are fixed (based on some prepayment rate such as 160% PSA), as long as prepayments are neither excessively rapid nor excessively slow. The protection provided by the PAC is expressed in terms of a band of PSA percentages such as 80% PSA to 300% PSA. The PAC will receive exactly the scheduled payments, provided that the prepayment rate is a fixed percentage of the PSA rate and this rate lies within the band. The wider the band, the greater is the protection at origination. However, the effective protection on a seasoned PAC can be much greater than or much less than the PAC bands at origination as discussed below.

The PAC tranches receive protection at the expense of non-PAC tranches referred to as support or companion bonds. Support bonds bear leveraged prepayment and extension risk. A typical "long companion" bond has cash flow variation under a range of interest rate scenarios that is similar to that of a 30-year bond, callable in one year. Support bonds must absorb all prepayments in excess of those required to meet the fixed PAC payments. If prepayment is too rapid, the principal on the companion bonds is entirely paid off and the PAC must absorb all further principal payments. If the prepayment protection is breached in this way, the PAC is said to be busted. If prepayment is too slow, the support tranche will receive no principal payments and the PAC may receive less than the scheduled principal payments.

Support tranches make up 25% or more of a pool. A single pool may have 10 or more PACs with different terms and sequenced schedules of principal payments and with varying degrees of protection. In this situation, the shorter the term of the PAC (i.e., the earlier it is in the sequence of PACs), the more protection it has against fast prepayment. Even when prepayment is more rapid than the upper bound of protection on the earlier PAC tranches, the relatively shorter term PAC may still receive payment as per schedule. The reason for this is that all the support bonds established for all the PACs must be paid off before the earlier PAC tranches must begin absorbing excess principal prepayments.

If a PAC has an upper band of 300% PSA, there are sufficient support bonds to absorb all principal payments made should they be made at the level of 300% PSA from the outset and throughout the term of the PAC. The fact that prepayments are at a rate of 500% PSA for a while does not necessarily mean that the PAC will receive unscheduled principal payments. Unscheduled payments will be borne by the PAC only if the principal payments of the support bonds have been entirely paid off.

Should prepayments persist from the outset at a level materially below the 300% PSA level, the protection afforded by the support bonds effectively rises above the 300% PSA level, since materially fewer principal payments than allowed for have been made and these are available to absorb future prepayments above the 300% PSA level.

The initial bands of PAC protection do not provide a good indicator of the effective protection available to a seasoned PAC. A wider original band on a seasoned PAC does not necessarily mean greater protection. A PAC with a narrower band may have substantially greater effective protection from rapid prepayment than indicated by the upper band, since prepayment rates substantially below the upper bound may have prevailed for a long period of time. An extended period of prepayments slower than the lower bound of the PAC will raise the effective lower limit of the PAC.

If the prepayment rate is always a constant percentage of the PSA and the percentage is within the bands, the payment schedule can be met. However, it is possible for the schedule not to be met and the PSA never to fall outside the band. This could happen if the PSA rate varied. A long period at or near the upper bound of the PSA band raises the effective lower bound above the initial lower bound. Should the PSA rate fall below the effective lower bound while remaining above the initial lower bound, the principal payments would be less than scheduled even though the original band range is never violated.

### ***Varieties of CMOs***

There is a virtually unlimited variety of types of CMO securities: principal-only (PO), interest-only (IO), super POs (POs carved out of support tranches), super IOs, targeted amortization class TACs, very accurately determined maturity VADM, floaters, inverse floaters, super PO inverse floaters, IOettes, inverse floating IOs, tier-two PACS, etc. When the collateral for a CMO are themselves securities such as POs, IOs and other CMOs, the CMO is called a "kitchen sink" bond.

In 1987, stripped MBSs were first issued by allocating all interest to one class (IO) and all principal to another (PO). IOs and POs can be created from any CMO tranche. The PO is sold at a substantial discount. The yield on the PO is higher, the faster the prepayment, and vice versa. Falling interest rates increase the price of POs, since prepayments increase with falling rates.

When interest rates drop, principal payments accelerate; the outstanding balance decreases; the interest earned declines and the price of the IO declines. When the interest rates increase, the price of the IO increases for the converse reason. This pricing behaviour is the opposite to normal fixed income investments.

In 1986, floating rate CMOs, which reset the interest rate monthly, usually at the one-month interbank rate, were first issued. A floating rate CMO may receive interest at a rate higher than the fixed rate on the mortgages collateral as a result of increases in the floating index rate. Such excess interest can be paid out of any excess of interest paid on the total collateral over the interest paid on all other tranches. If this were the only source of excess interest, however, the floating rate would need to be capped at a relatively low level which would make it considerably less attractive to floating rate investors. A higher cap can be established by including an inverse-floating rate bond tranche, whose rate floats monthly, inversely to the one-month interbank rate. The principal balance of the floating and inverse floating rate bonds declines as principal is paid down on the tranche or tranches from which they are carved out.

The price of inverse floaters increases (decreases) with dropping (rising) rates because of the normal increase in value associated with fixed rate investments in a dropping rate environment and because the rate earned by the inverse floater actually increases. Conversely, the price of inverse floaters decreases rapidly in a rising interest rate environment.

An inverse floater will often be leveraged to the floating rate index. A coupon leverage of three means that a change in the index of 10 basis points has a 30 basis point impact on the inverse floater coupon payment. A superfloater is a floating rate CMO whose coupon leverage is greater than one.

An inverse IO receives interest based on the outstanding balance of a PO tranche, but the coupon rate varies inversely with a floating rate index. Inverse IOs decline in value as interest rates drop because of a decline in the balance on which interest is paid due to an acceleration of prepayments and increase in value as interest rates drop because the interest rate increases. Some investors concluded that these offsetting factors made inverse IOs naturally self-hedging. However, in a rapidly rising interest rate environment, the decline in value due to the drop in the inverse IO rate is far greater than the increase in value due to an unexpectedly high balance on which the principal is paid.

An IOette receives only interest and either a nominal amount of principal (for REMIC tax compliance purposes) or no principal. The interest derives from the so-called coupon differential (i.e., the difference between the interest actually paid to all the bond classes and the interest payments based on the highest coupon of all the bond classes).

A targeted amortization class (TAC) is like a PAC in that it has a schedule of payments that is protected from rapid prepayment. A support tranche absorbs principal payments in excess of those required to meet the TAC schedule. However, no protection is provided for slower prepayments.

Very accurately determined maturity VADM bonds have very stable cash flows. The only cash flow they receive derives from the accrual of interest on a Z tranche.

Once a tranche has been defined, it is possible to apply the same structures initially applied to carve up the pool, to the carving up of the tranche. Thus it is possible to take a PAC and to carve it into accrual bonds, floaters, inverse floaters, interest-only and principal-only and so to get PAC floaters, PAC inverse floaters, PAC IOs, etc. It is also possible to carve up support bonds in the same way. A principal-only or interest-only bond created from a support bond is a super PO or super IO. A PAC created from a support bond is a PAC II bond. It will have somewhat greater protection than other support bonds, but less protection than PAC I bonds. In particular, all PAC II bonds would be paid off before extra payments of principal would be allocated to PAC I bonds. This process can be applied again and again, once a new bond class has been created.

### ***The Flux Measure Of Relative Cash Flow Variability***

The NAIC has recently introduced the Flux score as a measure of prepayment risk for CMOs, to assist regulators in identifying those insurers whose holdings may need special attention. The flux score is a relative measure of cash flow variability. The score is calculated using a base interest rate scenario and five other scenarios. Differences in the cash flows and the present value of the cash flows are calculated in each scenario relative to the base scenario and the flux formula applied to get the flux score.

The flux score is duration neutral in the sense that a greater duration does not entail a higher flux score. A higher score implies greater variability, but a score that is twice as high does not imply twice the variability. Scores generally fall in a range from 0-30. The flux system is under development and it is not yet clear what constitutes a problematic score.

Flux scores vary considerably from one prepayment model to another. It is also possible for one prepayment model to produce a different ordering of CMO flux scores relative to another model.



## 5.4 The Mortgage-Backed Security (MBS) Issue Process

An insurance company with an interest rate risk problem determines that it can effectively reduce the problem by selling a pool of CMHC insured mortgages with a book value of \$20 million and a book yield of 11% through the MBS process. It approaches a dealer that agrees on February 15 to price the MBS issue to yield 10% to the company. The MBS issue is sold by the dealer at a discount to investors effective March 1 with a coupon of 9.50% and a yield of 9.95%. The dealer pays the insurance company \$19.8 million on March 15.

The insurance company receives the April 1 mortgage payment of principal and interest and makes the first MBS payment of principal and interest to the MBS investors on April 15. Subsequent amounts are received by the MBS issuer on the first of each month and paid to the MBS investor on the fifteenth of each month. The amounts paid to the MBS investor increase slightly each month due to the combined flow-through of an increasing principal amount from the scheduled principal repayments of the securitized mortgages and a decline of interest each month on the outstanding mortgage balance.

The present value of the amount paid by the dealer to the company equals the present value of the payments made by the company on the MBS issue assuming no unscheduled prepayment of principal, on the securitized mortgages, where the value is determined on March 1 and the discount rate is 10%. The dealer has bought the MBS cash flow stream to yield 10%. It sells this same stream of cash flows to yield 9.95%. This five basis point spread is about \$140,000 and equals the difference between the amount paid by investors to the dealer and the smaller amount paid by the dealer to the company.

For the \$140,000, the dealer takes all interest rate risk commencing on February 15, when it committed to the issue to yield 10%. It buys the deal, guaranteeing the sale to the company, and finds the needed investors through its distribution system. The insurance company incurs a number of issue expenses amounting to about \$30,000 and continues to incur administrative costs for the mortgages.

The MBS investor receives interest at 9.50% on the outstanding mortgage balance together with scheduled and prepaid principal amounts. The MBS investor may or may not be entitled to some or all of any prepayment penalties paid by the mortgage borrower. However, the MBS investor bears the prepayment risk.

The purchase of the issue at a discount is some compensation to the MBS investor for bearing the early prepayment risk, since an early prepayment of principal will result in an early realization of a proportionate share of the discount and hence an increase in yield. If the investor did not bear this prepayment risk, the arrangement would not likely be accepted as an actual divestment of the mortgages for financial reporting purposes.

The insurance company records a loss on the sale of the mortgages of \$230,000 (\$200,000 discount to book value plus \$30,000 expenses) even though the book yield of 11% exceeds the effective sale yield of 10%. This loss is amortized over the remaining term of the mortgages in accordance with Canadian insurance company accounting. The loss brought into income each accounting period is more than offset each accounting period by the income received on the mortgages at 11% and the payout of the MBS interest at 9.50%. In this way, the income from the sale is accounted for only as it is earned. Other less conservative accounting procedures, which capitalize some of the expected spread income, may be acceptable, especially in noninsurance financial companies.

The expected income from the spread between the mortgage rate and the MBS coupon will be reduced if there are unscheduled prepayments of principal. In the event of default, this entire spread is lost for the remaining term of the mortgage, even though the mortgage is CMHC insured.

The fourth class of exotic options involves the value of multiple assets at more than one date. An average rate basket option, averaged across multiple currencies, would be an example. This could be useful for a company that has relatively uniform cash flows in many countries that it will convert back to home currency dollars on receipt. It would be especially useful in the context of a number of different foreign subsidiaries, where it was desirable to hedge their earnings back to U.S. dollars.

The price of an option on a basket of currencies can be materially less than the price of a set of options on each currency because the volatility of the basket will be less. In particular, the price of the basket option will decrease as the correlation between the basket currencies declines.