Innovations and increasing complexity in mortgage-backed securities warrant a thorough understanding of the nuances behind these securities. This article will provide a background for modeling and analyzing mortgage-backed securities. In particular, the three most popular structures used in today’s markets to issue mortgage-backed securities will be discussed. Reference is made to Norwest Asset Securities Corporation (“NASCOR”) 1998-28 Trust and Structured Asset Securities Corporation (“SASCO”), Series 1998-3 in the context of “shifting interest” and “senior subordinate over-collateralized” structures, respectively.

I. BACKGROUND

Credit risk analysis of mortgage loans in a mortgage securitization is performed to assess the probability of default of the underlying mortgage loans. Credit rating agencies such as Standard & Poor’s, Moody’s, Fitch IBCA and Duff & Phelps, assist issuers of mortgage-backed securities (“MBS”) to determine the optimal credit enhancement levels, and thus the credit rating, for securities based on (a) the default risk assessment and (b) the nature of cash flows to MBS. The primary factors that are considered in assigning a credit rating to MBS (and hence assessing the probability of timely payment of interest and principal) are as follows: the type, term, size, age, loan-to-value ratio of the underlying mortgage loans; and the dispersion of certain factors such as property location. All these factors converge into one single concept called credit enhancement. In the late 1980s and early 1990s, this credit enhancement was provided by third party corporate guarantees, letters of credit, reserve funds and pool insurance (external credit enhancement). However, their use has declined over time in favor of internal credit enhancement because of the inherent risk of reliance on the credit rating (subject to possible downgrades over time) of the third party. The internal credit enhancement is provided by prioritizing cash flows from a pool of mortgages to support certain classes of MBS.

In this article, certain concepts and techniques of mortgage loan securitization will be explored. Specifically, the ideas behind prepayment and default analysis on mortgage loans are discussed to assess the final impact on MBS. The discussion will focus first on mortgage loans, and second on the three most popular MBS structures: shifting interest, monoline-wrapped (insured) and senior subordinate over-collateralized. One might ask which structures are generally better performing? The class B certificate in a shifting interest deal or the class B certificate in an over-collateralized deal? There is no straightforward answer to this question. It depends on many factors including, but not limited to: (a) the issuer’s historical prepayment and default performance, (b) the quality of the underlying mortgage loans (such as loan-to-value ratio and geographic
concentration) and (c) investor preferences. This article is not intended to suggest the relative value of one class of MBS over the other. Instead, it is intended to set forth some concepts and techniques, so readers may make their own assessment of value in MBS.

II. MORTGAGE LOANS

The building blocks of MBS are the mortgage loans secured by residential properties. The interest rate on mortgages is typically higher than that of comparable U.S. Treasuries, to reflect the uncertainty of cash flows, poorer liquidity, borrowers’ ability to prepay and costs associated with liquidating a loan in the event of default. Over a period of time, many different types of mortgage products have evolved. Among them are fixed rate mortgages (“FRMs”), adjustable rate mortgages (“ARMs”), balloon mortgages and graduated payment mortgages (“GPMs”). Each mortgage loan in a MBS may have a different interest rate, because its tenor may be different (e.g. 15 years versus 30 years) or the borrower characteristics may be different (e.g. more creditworthy borrowers with higher credit scores may receive lower interest rates) and so on. All mortgages produce a stream of monthly payments that include the monthly interest and scheduled principal repayment. The next few sections describe the essential cash flow characteristics of mortgages.

A. Amortization Schedules

The monthly payment (Pmt) of a fixed rate mortgage loan is calculated to fully amortize the borrowed amount by maturity (equation 1), except for balloon loans where the monthly payment is smaller than the amount required to fully amortize the loan. This smaller payment in balloons slows amortization and increases the risk in a securitization arising from a borrower’s potential inability to refinance a mortgage at the end of the balloon term.

\[
Pmt = \frac{PV \cdot i/12 \cdot (1 + i/12)^n}{(1 + i/12)^n - 1}
\]

The monthly payment is first allocated to the interest on the outstanding balance and then to the scheduled principal to reduce the outstanding balance of the mortgage loan. The allocation of the scheduled principal and the interest components of the monthly payment is shown in Exhibit 1.

Adjustable rate mortgage loans are amortized as described above except that the interest rates are subject to certain caps and floors. Generally, interest rates on ARMs reset periodically (monthly, semi-annually, annually... based on an index plus a margin. Typical indices are COFI, Prime, LIBOR and Treasury. Payments also reset periodically, although the periodicity of the payment adjustment may not be the same as that of the interest adjustment. There are four constraints on ARMs: (a) lifetime cap, (b) lifetime floor, (c) periodic cap and (d) payment cap. Lifetime caps and floors set a maximum and minimum interest rate over the life of the mortgage loan irrespective of current index levels. The periodic cap limits the change in the coupon from one period to the next on specified dates called “interest rate adjustment dates.” In most cases, depending on the underlying index on which ARMs reset, the periodic cap is 1.00%, 1.50% or 2.00%. A payment cap, usually 7.5%, is the maximum percentage by which the monthly payment can change. Another point to keep in mind about ARMs is negative amortization. The payment caps
together with unequal frequency of adjustment of interest rates and monthly payments can give rise to negative amortization, which means that the monthly payment is not enough to cover interest for that month, let alone scheduled principal. In this case, the portion of accrued and unpaid interest is added to the principal balance of the mortgage loan.

GPMs are characterized by escalating monthly payments. This product was introduced to serve borrowers who could not afford a high monthly payment associated with a FRM. Borrowers are allowed to make a smaller payment for the first few years, after which the payment is gradually increased every year for some time. Both ARMs and GPMs are of concern for MBS investors because they are frequently made to less creditworthy borrowers.

B. Prepayment Modeling

Because most borrowers are allowed to prepay their mortgage balance in full or in part at any time, MBS are priced with certain prepayment assumptions on the underlying mortgage loans. How does one forecast prepayments for MBS? The estimation of prepayments has become increasingly important to determine the appropriate market valuation of MBS. The historic prepayment experience of an issuer’s pool of mortgages impacts current prepayment estimates, which further affect the investment characteristics of the securities such as average life, duration, convexity, etc. through contracting (“Call risk”) or extending (“Extension risk”) the term of MBS. At pricing, a certain prepayment rate is assumed and, in the future, if the prepayment rate falls below such assumed rate, extension risk arises; the average life of the MBS becomes longer than previously anticipated. Defaults and subsequent liquidations also constitute a form of prepayments—albeit involuntary. The prepayments that are passed through to MBS in a securitization transaction generally result from (i) “voluntarily prepaid amounts” which include “fully” or “partially” paid principal amounts, (ii) liquidation amounts arising from foreclosure and subsequent sale of the properties and (iii) “disqualified loan” amounts. It is important to keep in mind that most prepayments are “full” prepayments and are generally a result of “refinancings” by borrowers, which are caused by low interest rates in the economy. Other causes of full prepayments include “turnovers” due to personal reasons such as moving to a different location, moving to a bigger house, divorce, etc. Partial prepayments may be caused by a variety of reasons such as a borrower having some extra cash. However, because of the insignificant nature of most partial prepayments, they are generally embodied in the prepayment rate assumptions so as not to change the amortization schedules.

The end result of the prepayment analysis is to come up with expected prepayments in a unit of measurement that investors understand and can use to compare different underlying pools of collateral. There are at least two prepayment models that are used for mortgage related securitizations: (a) constant prepayment rate (“CPR” used for FRMs and ARMs) and (b) Public Securities Association (“PSA” used for FRMs). Inherent in each model are the following very important assumptions for the purpose of projecting cash flows: (a) prepayments are principal payments made in full, (b) prepayments are made at the end of the month and (c) there are no “prepayment interest shortfalls.”

CPR is the most commonly used unit of measurement for prepayments. It is an annualized prepayment rate. A prepayment speed is expressed annually, therefore, it has to be converted to a monthly equivalent called single
monthly mortality rate ("SMM"). SMM is the percentage of mortgage loans outstanding that are ready to be prepaid at the end of a period. Equation (2) shows the link between SMM and CPR.

\[
SMM = 1 - (1 - CPR)^{1/12} \tag{2}
\]

Note that SMM is not equal to CPR/12 because the balance (Bal) to apply the prepayment rate to is the balance after scheduled amortization (Sch), which is decreasing with time. This point is stated in equation 3.

\[
Prepays = (Bal_n - Sch_n) \times (SMM_n) \tag{3}
\]

Exhibit 2 displays the principal and interest payments from a mortgage loan at 15% CPR. Note that the principal payments at 15% CPR are front loaded as compared to 0% CPR.

The PSA curve is a series of annualized prepayment rates and is dependent on the seasoning of the mortgage loans, whereas the CPR model is a constant rate at any time. The PSA curve assumes that the prepayments will be slow in the beginning, then increase on a straight-line basis until month 30 and, thereafter, stay constant at 6.0% CPR. 100% PSA means 0.20% CPR in the first month of the mortgage loan following the origination, 0.40% CPR in the second month and so on until the prepayment rate peaks at 6.00% CPR as shown in Exhibit 3.

Exhibit 2 also displays principal payments at 250% PSA for comparison purposes. Note the upward curve indicating increasing prepayments up to month 30.

Exhibit 4 shows the structure of NASCOR 1998-28 and Exhibit 5 shows the cash flows at a prepayment speed of 375% PSA. Note that "assumed mortgage loans" were used to project the cash flows, which is typical with most issuers and underwriters. The entire mortgage loan pool is condensed into a few "representative mortgage loans" popularly known as "rep lines." These representative lines of collateral are produced very categorically starting with the type of mortgage loan (e.g., one-year Treasury, and LIBOR ARMs and FRMs) followed by groupings of the stated maturity of each mortgage loan.

C. Default Modeling

Before a loss on a mortgage loan is actually incurred and transferred to the MBS holder, the mortgage loan is classified into four different categories.

Current -> Delinquent (30, 60 & 90 days) -> In foreclosure -> In liquidation

During the delinquency period the borrower is not making any scheduled mortgage payments. This period can last a few months, after which the servicer is usually required to initiate the foreclosure process. The exact timing of foreclosure is dependent upon the laws of the state in which the property is located. As time progresses and the mortgage loans become seasoned, borrowers generally have less incentive to be delinquent, because they have built substantial equity in the property and would stand to lose significantly if the mortgage loan goes into a foreclosure. In addition, foreclosure and eviction carry financial and social stigma that a long-term homeowner attempts to avoid.

Exhibit 6 shows equity build-up in NASCOR 1998-28. If the borrowers are in financial distress in the third or seventh year of the loan, they may be better off protecting their equity of 23% or 27% by any means available to...
**Exhibit 4. NASCOR 98-28 Deal Structure**

<table>
<thead>
<tr>
<th>Class</th>
<th>Balance</th>
<th>Coupon</th>
<th>Subordination</th>
<th>Avg. Life</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seniors</td>
<td>$503,688,100</td>
<td>6.000%</td>
<td>97.000%</td>
<td>4.56</td>
<td>*</td>
</tr>
<tr>
<td>A-PO</td>
<td>$312,347</td>
<td>0.000%</td>
<td>97.000%</td>
<td>4.76</td>
<td>*</td>
</tr>
<tr>
<td>B-1</td>
<td>$5,716,000</td>
<td>6.000%</td>
<td>3.000%</td>
<td>9.64</td>
<td>94.75</td>
</tr>
<tr>
<td>B-2</td>
<td>$5,975,000</td>
<td>6.000%</td>
<td>1.900%</td>
<td>9.64</td>
<td>93.50</td>
</tr>
<tr>
<td>B-3</td>
<td>$1,299,000</td>
<td>6.000%</td>
<td>0.750%</td>
<td>9.64</td>
<td>90.50</td>
</tr>
<tr>
<td>B-4</td>
<td>$1,299,000</td>
<td>6.000%</td>
<td>0.500%</td>
<td>9.64</td>
<td>70.00</td>
</tr>
<tr>
<td>B-5</td>
<td>$79,000</td>
<td>6.000%</td>
<td>0.250%</td>
<td>9.64</td>
<td>59.00</td>
</tr>
<tr>
<td>B-6</td>
<td>$520,231</td>
<td>6.000%</td>
<td>0.100%</td>
<td>9.64</td>
<td>30.00</td>
</tr>
</tbody>
</table>

**Exhibit 5. Amortization Schedule at 375% PSA (NASCOR 98-28)**

<table>
<thead>
<tr>
<th>Month</th>
<th>Balance</th>
<th>Interest</th>
<th>Scheduled Principal</th>
<th>Prepaid Principal</th>
<th>Total Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>519,588,678</td>
<td>2,822,156</td>
<td>450,118</td>
<td>971,452</td>
<td>4,243,726</td>
</tr>
<tr>
<td>2</td>
<td>518,167,109</td>
<td>2,814,430</td>
<td>451,816</td>
<td>1,300,257</td>
<td>4,566,503</td>
</tr>
<tr>
<td>3</td>
<td>516,415,035</td>
<td>2,804,908</td>
<td>453,230</td>
<td>1,628,549</td>
<td>4,886,686</td>
</tr>
<tr>
<td>4</td>
<td>514,333,257</td>
<td>2,793,596</td>
<td>454,354</td>
<td>1,955,701</td>
<td>5,203,650</td>
</tr>
<tr>
<td>5</td>
<td>511,923,203</td>
<td>2,780,500</td>
<td>455,170</td>
<td>2,281,086</td>
<td>5,516,770</td>
</tr>
<tr>
<td>6</td>
<td>509,186,933</td>
<td>2,765,633</td>
<td>455,716</td>
<td>2,604,072</td>
<td>5,825,422</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Period</th>
<th>Balance</th>
<th>Interest</th>
<th>Scheduled Principal</th>
<th>Prepaid Principal</th>
<th>Total Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>355</td>
<td>9,690</td>
<td>53</td>
<td>2,381</td>
<td>154</td>
<td>2,587</td>
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<tr>
<td>356</td>
<td>7,155</td>
<td>39</td>
<td>2,344</td>
<td>101</td>
<td>2,484</td>
</tr>
<tr>
<td>357</td>
<td>4,710</td>
<td>26</td>
<td>2,308</td>
<td>50</td>
<td>2,384</td>
</tr>
<tr>
<td>358</td>
<td>2,352</td>
<td>13</td>
<td>2,272</td>
<td>2</td>
<td>2,286</td>
</tr>
<tr>
<td>359</td>
<td>78</td>
<td>0</td>
<td>78</td>
<td>-</td>
<td>78</td>
</tr>
<tr>
<td>360</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Exhibit 6. Equity Build-up (NASCOR 98-28)**
them rather than allow the servicer to liquidate the mortgage loans at what might be fire-sale prices. In any case, if the mortgage loan is liquidated and assuming the property value did not decline, there would have to be significant losses on the sale to affect the investors in MBS in those later years. Empirical research shows that most losses occur between years 2-7. ARMs and GPMs show the worst results because borrowers are more prone to rate and payment increase shocks and are therefore more vulnerable to defaults.

Like prepayments, there is no single way to forecast and project defaults. Different issuers and underwriters account for defaults in different ways based on their modeling capabilities and their views of the mortgage market. The Standard Default Assumption (“SDA”) model was developed by The Bond Market Association to provide a standard primarily for 30-year fully amortizing FRMs. SDA was not designed to be used for balloon mortgages, ARMs or 15-year FRMs. However, many analysts do use SDA for these types of mortgage products for lack of better models. SDA assumes that the default rate will be 0.02% per annum of the outstanding balance of the mortgage loans in the first month after origination and will increase at a rate of 0.02% per annum per month until it reaches 0.60% per annum in the thirtieth month. The default rate tends to be low in the early years because if the borrower were not “qualified” he would not have been approved for a mortgage loan. And “qualified” borrowers are not expected to default immediately. The default rate stays constant until the sixtieth month. After sixty months, it starts to decline at the rate of 0.0095% per annum per month until it reaches 0.03% per annum when it stays constant for the remainder of its life. Exhibit 7 depicts the variation of default rates with the age of the mortgage loans in a pool.

Another measure of defaults is Constant Default Rate (“CDR”) which is expressed as an annualized percentage of mortgage loans that go bad in a pool. The concept is the same as that of CPR for prepayments. A point to note is that when a mortgage loan goes into default, it takes several months for the servicer to actually foreclose on the property and liquidate the mortgage. For analytical purposes, it is generally assumed that the time to liquidation is 12 months for residential mortgages. During the recovery period for such loans, it is often assumed that the servicer will advance the scheduled principal and interest payments on the defaulted loans. A loss severity percentage, which is equal to the percentage of the outstanding balance of the loan which is not recovered, is assumed to have taken into account all costs associated with the foreclosure as well as the repayment of advances as described below.

D. Compensating Interest and Servicer Advances

Another factor that needs attention is the compensating interest. The scheduled mortgage payments include 30 days of interest on the previous month’s balance. However, if borrowers were to prepay fully on the 16th, they are obligated to pay only 15 days of interest, resulting in a shortfall of interest to MBS. This shortfall is usually allocated in a pre-determined priority in multi-class MBS structures. Some issuers require the servicer to cover such interest shortfall, but only up to an amount equal to the aggregate servicing fee due that period. Curtailments (partial prepayments) also result in interest shortfall that is generally allocated to MBS. The servicer does not have to cover such shortfalls in all cases. Some issuers such as Countrywide, IndyMac and General Electric Capital (“GE Cap”) will require the servicer to compensate for such shortfalls while others such as NASCOR and Residential Funding Corporation...
In addition to compensating interest, servicers are also required to advance scheduled payments of principal and interest for delinquent mortgage loans until they are cured or until foreclosure procedures begin. Some discretion is allowed. The servicer essentially loans money from its own account to the trust. When the delinquent mortgage loan is eventually foreclosed, the servicer is reimbursed from the liquidation proceeds before any funds are remitted to the trust. The forms of advancing vary from “mandatory” to “optional.” Most transactions do have some form of advancing. The servicer can exercise some discretion in advancing funds, in that if it deems the funds will be unrecoverable, it may not advance. The effect of advancing is to smooth out the cash flows to the MBS. Some issuers who require mandatory advancing are Countrywide, IndyMac, NASCOR, SASCO, and RFC. In transactions where a master servicer is present, it will often act as a back-up servicer for advancing.

III. CREDIT TRANCHING

Most MBS carry a credit rating from one or more of the top four rating agencies. The credit rating on an MBS indicates the likely protection investors in such MBS have from losses on the underlying mortgage loans. A good rating also implies an expectation of timely payment of interest and principal on the MBS. If one has a pool of mortgage loans, it is very unlikely that such pool will be “AAA” rated in its entirety. How can one be creative enough to carve out a portion from this pool of assets to make that piece likely to receive timely interest and principal payments (at the expense of the other portion)? Both rating agencies and issuers work towards the goal of carving out the maximum amount of such pieces by analyzing the quality of the collateral and specifically studying the historical losses of similar pools of mortgage loans. The result is the creation of many securities with credit grades ranging from “AAA,” “AA” and “A” to the unrated first-loss piece. In this way, “AAA” is credit enhanced by “AA” and “AA” is credit enhanced by “A” and so on. Any losses are first borne by the lowest rated security.

In the mid 1980s, a self-enhanced (internal credit enhancement) structure to prioritize cash flows was developed and was appropriately named the “Senior-Subordinate” (“Sr-Sub”) structure. The Sr-Sub structure creates at least two classes of securities. The senior class, which is generally “AAA” or “AA” rated, has priority in payment of interest and principal over the subordinate class. The subordinate class, also referred to as the “first-loss” piece, absorbs any losses arising from defaults. Because of the priority of distributions over the subordinate class, the senior class receives a higher credit rating. It is important to note that the level of subordination alone does not determine the credit rating of the senior class. Primarily, it is the “quality” of the underlying mortgage loans that sets the precedence for a credit rating. For example, for a high quality pool of mortgage loans, one might obtain a 96% “AAA” senior class, whereas from a poorer quality pool one might only obtain 70%. The subordination provides protection in addition to the “natural” protection against losses provided by the quality of the mortgage loans.

The Sr-Sub structure, with certain twists such as shifting interest and over-collateralization, allocates a disproportionate amount of principal to the senior class. In such structures, the principal cash flows are prioritized for the senior class to provide it with increased protection. In a 96%/4% Sr-Sub ratio, if 2% of the principal was returned and allocated entirely to the senior class, the new split after such allocation becomes 95.9%/4.1%, resulting in the addition of 0.1% more credit support from the previous period. Why is there a shift devised in the context of MBS? This is best explained by the fact that most of the “good” mortgage loans in a pool prepay in the early part of their life whereas the “bad” mortgage loans representing higher credit risk in a pool continue to pay only the contractual payments. Borrowers backing bad mortgage loans perhaps cannot raise more cash to prepay or do not have the ability to refinance in a declining interest rate environment. The accelerated reduction in the pool balance caused by mere prepayments does not actually reduce the credit risk. In fact, on a percentage basis it increases such risk for the senior class. In order to compensate for the increased percentage of “bad” mortgage loans in the pool, principal cash flows are moved away from the subordinate class to the senior class, which receives all or a disproportionate share of the principal collections. Taking this concept further in time somewhat changes the story. All mortgage loans in a “seasoned” pool might be considered to be “good” mortgage loans because the borrowers have already made a series of regular monthly payments and have built significant equity in the property (and therefore have less incentive to default).

The following three sections describe three popular structures for mortgage securitizations.

A. Shifting Interest Structure

This is one of the classic structures that were devised to “credit tranche” a securitization. In this structure, the subordinate class’ share of prepayments is allocated to the
senior class. The scheduled principal payments are allocated pro-rata between the two classes. The theory behind disproportionate allocation of principal was explained earlier. The term “shifting interest” is actually a misnomer. It is not the interest collected that is shifted away from the subordinate class but rather principal during times of increasing credit risk in the mortgage pool. This shifts the subordinate’s “percentage owned” in the principal cash flow.

The most often used shifting interest structure allocates to the senior class, the senior class’ share of unscheduled principal (voluntary prepayments and involuntary liquidations) and a certain percentage of the subordinate class’ share of unscheduled principal (which percentage is stepped down with time as shown in Exhibit 8). The scheduled principal is paid pro-rata to the two classes. Note that after year 10 (for FRMs) and year 15 (for ARMs), if certain conditions are met, both classes are paid their pro-rata share of scheduled and unscheduled principal, so the subsequent ratio of the senior class to the subordinate class remains constant (absent losses allocated to the subordinate class).

Consider the structure for NASCOR 1998-28 in Exhibit 4 with a Sr-Sub ratio of 97 to 3. The senior percentage includes the ratio-stripped class A-PO. Since class A-PO is rated “AAA,” it has priority of principal payments from the discount loans. The principal payments from (a) the premium loans and (b) the non-PO portion of the discount loans are made available to the other classes. The non-PO principal distribution amount (“PDA”) is calculated as follows:

\[
\text{SrPDA} = \left( \frac{\text{Sch}}{n} + \frac{\text{USch}}{n} \right) \times \left( 1 - \text{Sr(non-PO})\% \right) \times \text{Shift\%} \\
+ \frac{\text{USch}}{n} \times \left( 1 - \text{Sr(non-PO})\% \right) \times \text{Shift\%} \\
\]

\[
\text{SubPDA} = \frac{\text{Sch}}{n} + \frac{\text{USch}}{n} - \text{SrPDA} \\
\]

Exhibit 9 shows how the subordination level is built at different prepayment levels both with and without losses. The next step is to understand how losses are allocated to these securities. But first let’s recap the fact that credit support afforded to the senior class comes in three forms: (i) each period the senior class is given priority to receive interest and principal, (ii) principal prepayments are allocated disproportionately in favor of the senior class and (iii) losses from foreclosures are allocated first to the subordinate class. It would appear that issuers would like to maximize the issuance of the senior class, and rating agencies would like to maximize the issuance of the subordinate class so that the ratings of the senior class are always as good as at issuance. The whole idea in the structural analysis is generally to favor senior securities. However, there are at least two instances where the subordinate class may get added priority. The first case is when the subordinate class’ percentage share in the mortgage pool becomes twice that at issuance, in which case the step down or shifting percentage is allowed to fall to a lower level. The second case is when there is no
interest subordination. Typically, the senior class is structured to receive prioritized interest and principal before any cash is distributed to the subordinate class (interest subordination). However, a handful of mortgage securitizations are structured to prioritize interest to the subordinate class before distributing any principal to the senior class. The order of priority of interest and principal can determine the potential return to the investors in the lower-rated subordinate classes. In essence, there are two types of priorities: (a) interest to seniors, interest to subordinates, principal to seniors and principal to subordinates (“IIPP”) and (b) interest to seniors, principal to seniors, interest to subordinates and principal to subordinates (“IPIP”). If the loss allocation is limited by the recoveries (or a fraction thereof), the cash flows to the subordinate class are practically undisturbed in both IIPP and IPIP methodologies. However, the loss allocation based on the liquidated balance (or a fraction thereof) coupled with the IPIP payment priority can cause severe cash flow shortfall to the subordinate class. NASCOR 1998-28 is based on IPIP methodology. If it were based on IIPP, the yield to maturity of subordinate classes would be impacted in certain scenarios as shown in Exhibit 10. The difference is minimal to the higher rated classes.

Irrespective of the type of structure, it makes sense to protect the senior class or the next higher rated class from any losses. The senior class is protected from shortfalls and losses at the expense of the subordinate class. So the losses, when realized, are allocated to the subordinate class or the lowest rated class outstanding at the time. When losses occur, the allocation of recovered principal to the senior class can be calculated in one of several ways: (a) as the senior prepayment percentage of recoveries (e.g. NASCOR), (b) as the lesser of (i) the senior prepayment percentage of recoveries and (ii) pro-rata share of liquidated balance (e.g. GE Cap, ABN AMRO Mortgage Corporation and Countrywide), (c) as the lesser of the (i) recoveries and (ii) senior prepayment percentage of liquidated balance (e.g. SASCO), (d) as the pro-rata share of liquidated balance and (e) as the lesser of the (i) senior prepayment percentage of recoveries and (ii) senior prepayment percentage of the lesser of (x) recoveries and (y) liquidated balance (e.g. Bank of America). The subordinate class receives any remaining principal amount. To the extent the principal collected is insufficient to pay the allocated principal, the subordinate class is written down until its principal balance is reduced to zero. Once the subordinate class is reduced to zero, the realized losses are allocated to the senior class (pro-rata to multiple senior tranches). If the balance of the subordinate class is written down completely it is seldom written back up except in certain type of structures as described below.

As mentioned earlier, before any losses are realized, mortgage loans go through periods of delinquency, foreclosure and liquidation. If delinquencies are rising in a pool, it represents a warning for future losses. The loss and delinquency triggers prevent credit support from stepping down in a deteriorating collateral performance environment. After a certain threshold of delinquencies, principal payments due to the subordinates are diverted to the seniors. Some issuers (e.g. NASCOR) are conservative and will require absolutely no principal payments to be distributed to the subordinate class, while others (e.g. SASCO) will allow the pro-rata share of scheduled principal payments and none of the prepayments to be distributed to the subordinate class. Two tests are performed each period when delinquencies and realized losses exist in a mortgage pool. The first test is based on 60+ day delinquency. If the average (rolling or summation) delinquent balance over a given number of months is greater than 50% of the credit support provided by the subordinate class, then the step down or shifting of prepayments in favor of the subordinate class does not take place. The second test is based on the cumulative realized losses. It states that the cumulative realized losses as a percentage of the original pool balance must not be more than a certain percentage (usually, 30%, 35%, 40%, 45% or 50% on each shifting interest
date) of the credit support. Another fact incorporated into deals such as NASCOR 1998-28 structures is that if the senior percentage at any time rises to more than the initial senior percentage, 100% of the prepayments are allocated to the seniors.

Here is some more common sense. The smaller the subordinate class, the more leveraged it is. In other words, it is more likely to get wiped out quickly for the same amount of losses. By the same token, the smaller the size of the senior class the higher the prepayment risk for such class. The same amount of prepayments will be allocated to the smaller senior class thereby creating leverage. Exhibit 11 shows the approximate threshold of cumulative losses before each subordinate class is wiped out in NASCOR 1998-28.

B. Monoline Insured Structure

In the mid to late 1990s, an increasing number of new home equity lenders adopted this structure for a number of reasons, the foremost being the ability to issue “AAA” investments. A slightly higher fee and a viable structure were all that was needed to obtain funding from the capital markets for such issuers. Generally, monoline insurance companies such as Municipal Bond Insurance Corporation (“MBIA”), Financial Security Assurance (“FSA”), Financial Guaranty Insurance Corporation (“FGIC”) and Ambac Assurance Corporation (“AMBAC”) guarantee timely payment of interest and ultimate return of principal for a certain class of bonds. Rating agencies rate these bonds as “AAA” (or the rating of the insuring entity) based on the claims-paying ability of the monolines. Depending on the quality and type of collateral, the fee charged by monolines can vary from approximately 8 basis points (“bps”) to over 50 bps. A typical monoline wrapped structure will have a single class of security credit enhanced first by the excess cash flow in the transaction and then by the insuring entity.

In a monoline-wrapped securitization, the underlying mortgage loans generate higher coupon income, compared to the coupon on the liabilities. The difference between the asset income and liability is called excess spread. This excess spread is “trapped” in the deal by way of paying down more principal on the bonds than is actually received on the collateral, thereby creating overcollateralization (“OC”). To simplify matters, let’s assume the net weighted average coupon (“WAC”) on the collateral is 11% and the WAC on the bonds is 7%. The difference between the two, which is 4%, is called the excess spread or net interest margin (“NIM”). This difference is akin to a WAC IO strip. This excess cash flow can be (a) used to cover any losses on the underlying collateral, (b) used to pay down the bonds faster than the collateral or (c) released to the issuer in the form of residual cash flow. The required OC varies from deal to deal and is dependent on the riskiness of the collateral and the past performance of the issuer. ARMs and GPMs may have higher targeted OC requirements than FRMs to account for the higher risk associated with interest and payment shocks to borrowers. All the excess cash flow is used to pay down the bonds until the step down date. If certain conditions are met, the step-down date occurs at the later of the 30th month (or starting in the 24th month and decreasing in steps up to the 30th month) or when the current OC level is twice the original level. In effect, if the original required OC was 3.0% of the original balance, the current OC must be at least 6.0% of the current outstanding balance for the transaction to step down (which means the deal has paid down to 50% of the original balance).

There are delinquency and cumulative loss triggers that affect the step down date in such securitizations. Monolines have certain controls that dictate whether the step down should occur if performance of the collateral deteriorates. If the step down does not occur, amounts that would have otherwise been distributed to the residual holder are paid as principal to the senior class holders. The next section describes the actual application and thresholds in a structure somewhat similar in concept to the monoline wrapped structure.

C. Senior Subordinate OC Structure

In the early part of 1997, the Senior-Subordinate structure with OC (“Sr-Sub OC”) was introduced in the mortgage market. Since then, this structure has rapidly rivaled the monoline-wrapped structure. Like monoline-wrapped structures, (most) Sr-Sub OC structures also provide for an overcollateralization to be built over time by using excess cash flow. The excess cash flow is used in the form of principal to pay down the bonds in a pre-determined order of priority thereby building the OC. The Sr-Sub OC structure differs from monoline-
wrapped structure in that it is a multi-tranche self-enhanced structure. The credit support to the higher rated classes is provided by (a) the OC and (b) the lower rated classes.

Exhibit 12 shows the structure of SASCO 1998-3. The initial requirement for OC was 1.75% of the initial balance of the mortgage loans and the initial total subordination for the senior class was 22.85%.

The step down date in this structure is the later of the 36th month or until a specified senior enhancement percentage (49.20% for SASCO 1998-3) is met. Until this date all principal including excess cash flow is directed to the most senior classes in order of rating. If the senior class pays down fully prior to the step down date, the other classes receive principal sequentially until the 36th month and thereafter pay down to maintain the targeted subordination levels. These targeted subordination levels are generally twice the initial subordination levels (including any initial required OC). In SASCO 1998-3, the initial subordination for class A was 22.85%. The initial required OC was 1.75%, so the targeted subordination for class A is equal to 2*(22.85+1.75)% or 49.20%. Similarly, for class M1, the targeted subordination is equal to 24.5%, and so on. In a no-loss scenario, once the targeted subordination levels are met for each class of securities, the excess cash flow is released to the residual holder.

Exhibit 13 shows how the senior class is paid down at different prepayment levels both with and without losses. Note that at 35% CPR, the senior class pays down from approximately 77.15% to 8.75% of the outstanding balance of the mortgage loans at the end of period 36, after which period it is locked out for some time until the target subordination levels for each class are met.

A small variation from the above structure is a Sr-Sub OC structure with 0% required OC. Here, all the excess cash flow is used to either mitigate the losses or is released to the residual class. Realized losses that are not covered by the excess cash flow are allocated to write down the lowest rated subordinate class. However, in subsequent periods if there is any excess cash left after covering current losses, that excess cash is not released to the residual holder but is instead used to pay down the senior class and write up the subordinate class to the extent of previous write downs. Saxon 1998-2 and Saxon 1998-3 were structured without any OC requirement. However,
the subordination levels were targeted to reach twice the original levels for each class of security.

As mentioned in the earlier section, there are delinquency and cumulative loss triggers that are used to determine whether there will be a step down of OC. Most securitizations with such structures have delinquency triggers based on six-month rolling 60+ day delinquencies. There are some differences in delinquency trigger thresholds and actual application for different grades of collateral and different structures. However, in all cases, the triggers are periodically checked for step down of disproportionate allocation of principal to the outstanding senior class. The trigger is tested every month by determining the six month rolling average of collateral that is 60+ days delinquent (including foreclosures, bankruptcies or REOs). This rolling average delinquent amount is then multiplied by a fixed number called a “multiplier” which varies from 1.4 – 2.5. From this delinquency amount, the excess cash flow for the prior three months is subtracted. The resulting amount is called the “net delinquency calculation amount.” If that amount is less than the target, a step down is permitted. Generally, this target is the same as the senior OC target.

IV. CONCLUSION

The viability of securitizations depends on the ratings assigned to MBS. The spreads to the treasury yield curve and prices of MBS rely on such ratings. The higher the ratings the lower the spreads, which in turn maximizes the proceeds or any retained excess spread in a securitization. Ratings are assigned taking into consideration a number of factors such as the quality of collateral and priority of cash flow, among many others. In this article, some concepts and techniques were described that build a foundation for cash flow analysis for MBS. Specifically, we looked at the types of mortgage loans, amortization schedules and prepayment and default models for mortgage loans. These concepts and techniques are all considered in determining the most appropriate structure for the MBS. Three popular structures were discussed herein. The actual structure used depends on the costs associated with such structures (e.g. monoline insurer fee, rating agency fee, accountant’s fee, etc.), the current interest rate environment and investor liquidity and duration concerns. Ultimately, investing in an MBS should be undertaken only after performing scenario analysis taking into account the concepts discussed herein and views of the economic environment.

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