Show me the money

One of the main questions on everyone's lips in the wake of the subprime crisis is whether banks can expect any money back on their subprime loan portfolios and, if so, when? **Anne Ching** says that it is possible to model subprime default rates and the speed with which they are likely to occur

Just a year ago, investors began to focus more intently on the performance of subprime mortgages. Default and delinquency levels were beginning to rise, sending the first early warning of the storm that would follow. Since then, the 25th of the month has become a critical day for subprime and other mortgage investors. The 25th is the date when remittance reports are released and new data on the performance of loans becomes available. Each month investors study the latest performance trends to assess the status of their investments.

Much of this analysis is focused on measures of sixty plus delinquencies (60+). This represents the percentage of borrowers in a given deal who are two or more payments behind. Investors tend to focus on 60+ delinquencies because they provide a good indication of possible future losses. Loss rates are less useful because of the long lag between the time the borrower defaults and when the loss is realised. While 60+ delinquencies are a good measure of performance, a better understanding of collateral performance can be gained by taking a closer look at the changing characteristics of the collateral.

There are two principal approaches to modelling credit risk. The first approach forecasts the likelihood of default based on information available at the time the loan was originated. It is difficult to develop insights about the future behaviour of a loan because the model does not take advantage of updated information about delinquency status, changes in loan-to-value ratios (LTV), loan balances, etc. Therefore, the future performance of the loan is unconditional regardless of changes in loan characteristics or in the interest rate or home price environment.

The second approach is a Roll Rate model, which involves a much more elaborate process of forecasting the likelihood of loans entering and exiting a myriad of delinquency states. A Roll Rate matrix could include as many as nine delinquency states or 81 transitions. The benefit of this approach is that it captures dynamic changes to the loan and the economic environment. The model is able to adjust its forecast to account for updated information. The major drawback of the Roll Rate approach is that it can only make reasonable forecasts a few months forward. It is also very difficult for investors to draw inferences about the behaviour of a loan because of the innumerable delinquency transitions to keep track of.

A third approach, that we developed at Andrew Davidson, a firm specialising in mortgage analytics, combines the best of both worlds. This framework collapses the number of delinquency states to a more manageable number and captures information about how a loan or portfolio of loans has evolved since origination. This simplified approach still uses econometric techniques for estimating a smaller number of transitions. The principal benefit of a condensed transition framework is that it produces results that are more intuitive than the results from a traditional Roll Rate matrix, which can be unwieldy due to the large number of transitions. More importantly, investors can develop greater insights about loan collateral and security performance by dissecting broad performance measures such as 60+ delinquencies, conditional prepayment rates (CPRs) and conditional default rates (CDRs) into their component transitions.
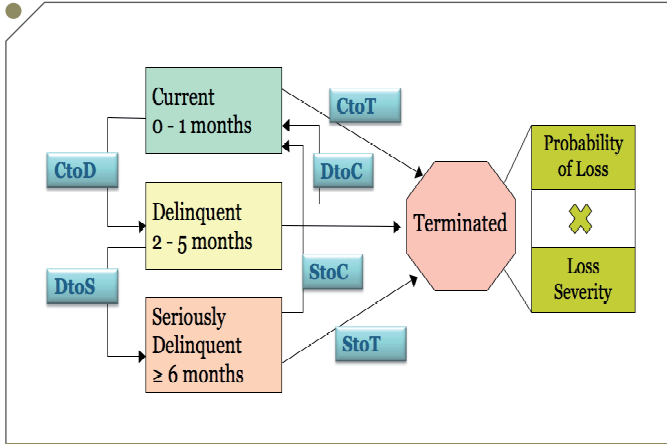
Figure 1. Condensed transition modelling framework

Definitions	
CtoT	Current to Terminations (voluntary prepayment)
DtoC	Delinquent to Current (cure)
DtoT	Delinquent to Termination (delinquent prepayment)
StoC	Seriously Delinquent to Current (recovery)
StoT	Seriously Delinquent to Termination (liquidation)
CtoC	Current to Current
DtoD	Delinquent to Delinquent
StoS	Seriously Delinquent to Seriously Delinquent

Condensed transition framework

The method starts by establishing three states or statuses for active loans. These states are current (C), delinquent (D) and seriously delinquent (S). Current loans include loans that are at most one payment behind schedule. Delinquent loans consist of loans that are two to five payments behind schedule, while seriously delinquent loans are six months or more behind schedule, loans in foreclosure and real estate owned (REO). These categories were chosen partly because they fit with traditional measures of 60+ and 180+ delinquencies, but more importantly, because they reflect significant changes in borrower behaviour as these thresholds are crossed.

Loans can move between these three states, and can also move from active to termination (T). Any loan which ends, whether by prepayment or foreclosure, is considered a termination.

While there are up to 12 possible transitions, the condensed transition framework reduces the number of critical Roll Rate transitions into only six transitions (CtoT, CtoD, DtoC, DtoT, StoC, and StoT) as illustrated in Figure 1.0. (Transitions such as CtoC,

DtoD and StoS are the residuals of transfers out of that state.)

Traditional measures such as CPR and CDR and 60+ delinquencies can be viewed in the context of these transitions. The classic CPR measure includes both voluntary and involuntary prepayments. However, the condensed framework distinguishes between voluntary and involuntary prepayments. Voluntary prepayments are captured by the CtoT transition while involuntary prepayments or defaults are captured primarily by CtoD and StoT transitions.

Sixty plus delinquencies (60+) can be better understood by examining its component transitions. Sixty plus delinquencies reflect loans entering delinquency (CtoD), loans exiting or 'curing' out of delinquency (D toC) and loans paying off from delinquency (DtoT).

We can best see how the interaction of these transitions contribute to 60+ delinquencies by examining the recent performance of the ABX 06-2 index, a synthetic index that tracks the performance of the greater subprime universe and comprises 20 subprime asset-backed security deals issued in the second half of 2006.

Figure 2.0 depicts the actual CtoD transition probabilities for the ABX 06-2 index by Fair Isaac Corporation (FICO) score, a measure that captures a borrower's creditworthiness. (March transitions reflect the change in balance from March to April. They reflect the remittance reports as of April 25.) The graph also reports the outstanding
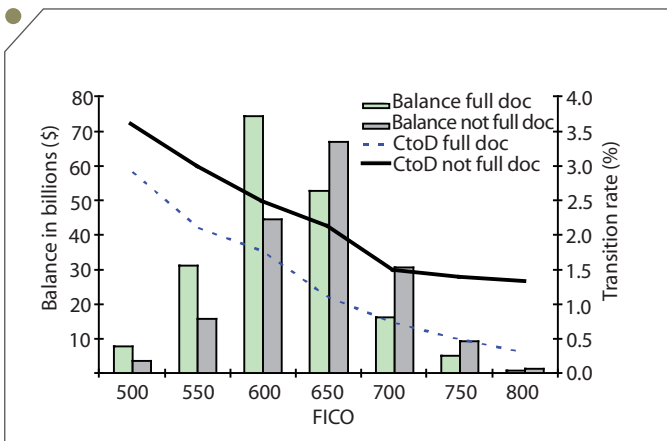

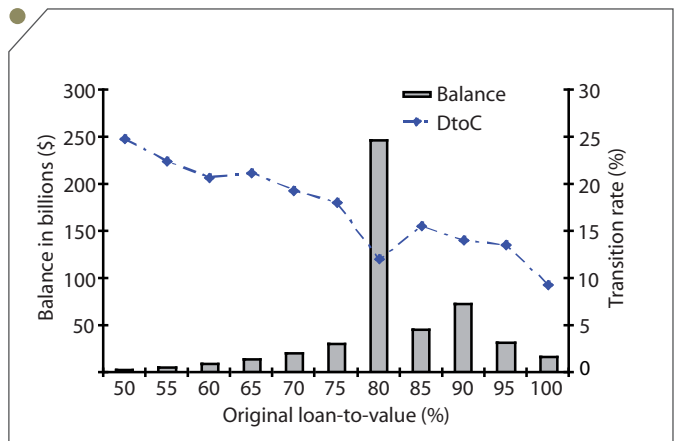Figure 2. ABX 06-2 delinquency transition rates, March 2008

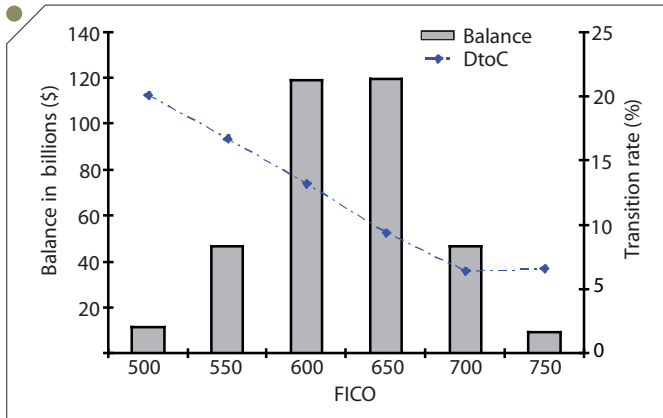Figure 3. ABX 06-2 cure transition rates by loan-to-value ratio March 2008

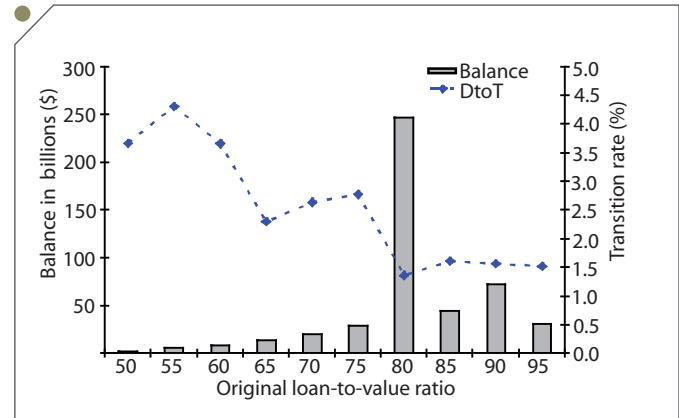Figure 4. ABX 06-2 cure transition rates by FICO, March 2008

Figure 5. ABX 06-2 delinquent prepayment transition rates, March 2008

principal balance for each FICO category for loans with both 'full' and 'not full' documentation of assets and income.

The principal factor that causes a borrower to miss two or more payments is generally a cash flow constraint. The propensity for a borrower to miss consecutive payments and become delinquent is best captured by a borrower's initial credit score. This graph illustrates that borrowers with lower FICO scores have a greater propensity to miss their mortgage payments than borrowers with higher FICO scores, which is consistent with expectations.

The level of income and asset verification also has a strong effect on delinquency rates. Notice how the 'full' documentation loans represented by the dotted line exhibit lower rates delinquency transition rates as FICO scores increase compared to loans that have less than full documentation as shown by the solid line in figure 2.0.

The ability to 'cure' or exit out of the delinquency status also contributes to the 60+ delinquency measure. The cure transition (DtoC) depends greatly on the whether equity exists in the property and whether the borrower is able to access that equity. Typically, a borrower would tap into that equity by either taking out a second lien mortgage or home equity line of credit (HELOC). The condensed transition framework captures the available equity through the original and current loan-to-value ratios (LTV).

The DtoC probability transition rates for the ABX 06-2 are shown in Figure 3.0. The graph shows the strong impact of original LTV ratios on cure rates. The lower the LTV ratio, the more equity is available to help the borrower get out of trouble. Therefore, loans with lower LTV ratios exhibit much higher 'cure' rates than loans with higher LTV ratios as shown by the negatively sloping line.

What is also notable about the cure rates in this graph is how loans with LTV ratios of exactly 80% have significantly underperformed loans with LTV ratios of 85%. The sharp decline is attributable to the strong desire of borrowers to meet the 80% LTV underwriting

guidelines in order to qualify for more favorable interest rates. In some cases, appraisal values were inflated, second lien loans were omitted from loan applications and verification of income and assets were avoided so that borrowers could make the 80 LTV cut-off.

Another important insight about cure rates is the paradoxical relationship between FICO scores and the ability of a borrower to cure out of delinquency.

In fact, Figure 4.0 illustrates the inverse relationship between curing and FICO scores, contrary to popular belief. The graph demonstrates that less creditworthy borrowers cure or become current more frequently than more creditworthy borrowers. The data tells us that the high FICO borrowers who get into trouble do so because of a major life crisis, such as a serious medical condition, a change in marital status, a death in the family, job loss or natural disaster like Hurricane Katrina. Borrowers who experience a major life crisis do not generally recover. Any financial reserves that may have existed are inadequate or are depleted by the life-altering event.

> Borrowers who experience a major life crisis do not generally recover

In contrast, the low FICO borrowers who end up a few months behind in their mortgage payments do so because of temporary cash flow impairments and also tend to have a history of missing payments. The cash flow impairments tend to be temporary in nature and not necessarily a sign of a serious problem. High FICO borrowers are generally immune to temporary cash flow shortfalls because they tend to have more financial reserves on hand. Because the circumstances that cause low FICO borrowers to become delinquent are materially different than high FICO borrowers, low FICO borrowers recover more frequently.

The delinquent prepayment transition (DtoT) is also an important contribution to 60+ delinquency measures. A delinquent prepayment is driven primarily by LTV ratios if there is capital available in the property. The borrower will take advantage of that capital by either refinancing the loan or by selling the property and retaining any remaining equity. We see that DtoT transition rates decrease sharply as LTV ratios rise from
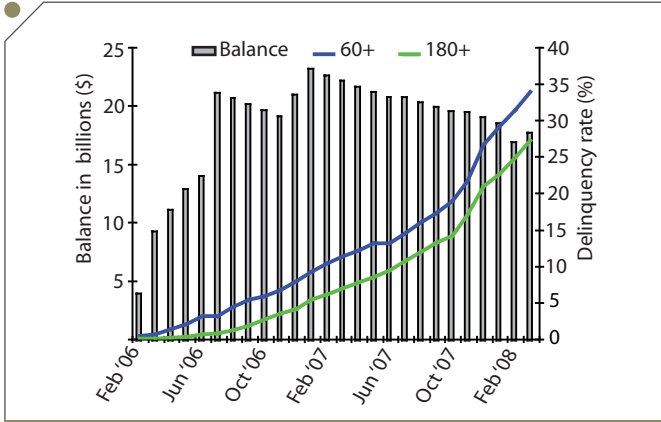
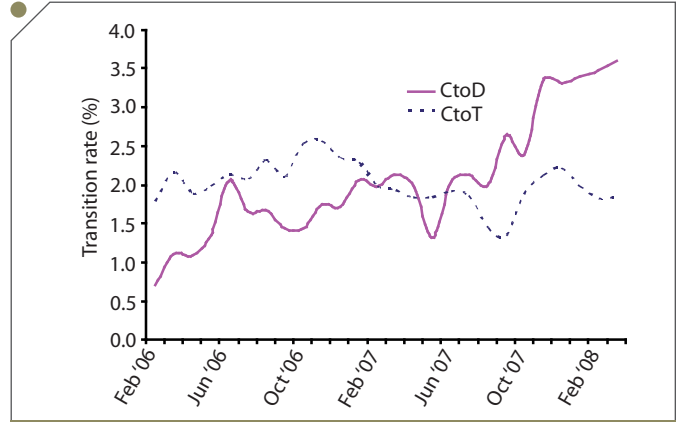Figure 6. ABX 06-2 delinquency rates, February 2006–March 2008

Figure 7. Transition rates from current status, February 2006–March 2008

50% to 80% in Figure 5.0. However, for LTV ratios greater than 80%, DtoT transition rates flatten out because refinancing options have disappeared for borrowers with less than 20% equity in their property. This is even more prevalent with the recent tightening of underwriting guidelines that occurred in early to mid-2007.

One hundred eighty plus delinquencies (180+), another traditional performance measure, can also be explained by its constituent components. Borrowers migrate from delinquent to seriously delinquent (DtoS) if there is insufficient equity available or if they do not have access to that equity. The recovery transition (StoC) only occurs when a borrower makes a last-ditch effort to resume payments. The borrower's ability to recover is also a function of positive equity in the property, although underwriting standards and occupancy type are also important factors. The liquidation transition (StoT) – when the underlying property is liquidated through a sale – is mainly driven by the loan servicer and the legal procedure of foreclosure. If the loan was made in a judicial foreclosure state, the foreclosure process must proceed through the courts for a judgment, resulting in a protracted liquidation process.

Recent ABX performance trends

Since February 2006, the overall delinquency rates for the subprime collateral underlying the ABX 06-2 have risen to unprecedented levels. 60+ delinquency rates are approaching 35% as shown in Figure 6.0. These rates far exceed the historical performance of similarly aged subprime collateral originated prior to 2005 by a factor of two. The graph also presents the monthly principal balances of delinquent loans. As of March 2008, approximately $18 billion of loans were either two months or more behind on their mortgage payments.

If we examine the delinquency performance of the ABX 06-2 beyond the broad measures of 60+ and 180+ delinquency rates, we can see that the trends are driven by both increasing CtoD and falling CtoT transition rates, represented by the respective rising solid line and relatively flat dotted line in Figure 7.0. Note the particularly sharp increase in CtoD transition rates between July 2007 and November 2007, which partly reflects a significant portion of adjustable-rate mortgages (ARM) approaching their interest rate reset period. Similar increases in CtoD transitions rates were also observed for loans which were not facing reset, thus a large portion of the
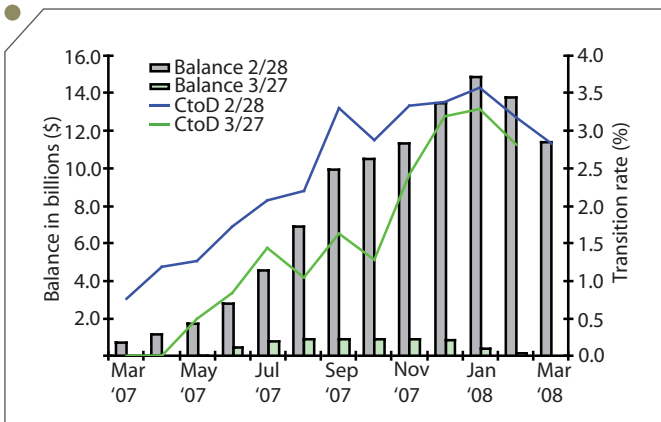

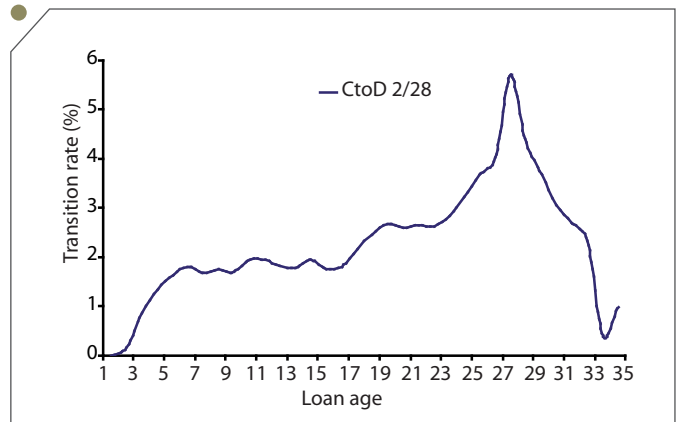Figure 8. ABX 06-2 delinquency transition rates for 2/28 and 3/27 loan types, March 2007-08

Figure 9. ABX 06-2 delinquency transition rates for 2/28 and 3/27 adjustable rate loans by loan age

increases represent the rapid deterioration in the availability of alternatives for troubled borrowers.

The impact of interest reset periods on CtoD transition rates are highlighted in Figure 8.0. The graph shows the CtoD transition rates for both 2/28 and 3/27 adjustable-rate loans whose ages are between 20 and 26 months old. The loans with the shorter interest rate reset periods of two years (ie, 2/28 adjustable rate mortgages) exhibit higher CtoD transition rates than those loans with three-year reset periods (ie, 3/27 adjustable rate mortgages), because they are closer to their reset periods. Borrowers could no longer afford the higher monthly payments once the coupons on their loans converted from fixed to variable interest rates.

Figure 9.0 also shows the relationship between ARM reset periods and CtoD transition rates, but from a different vantage point. CtoD
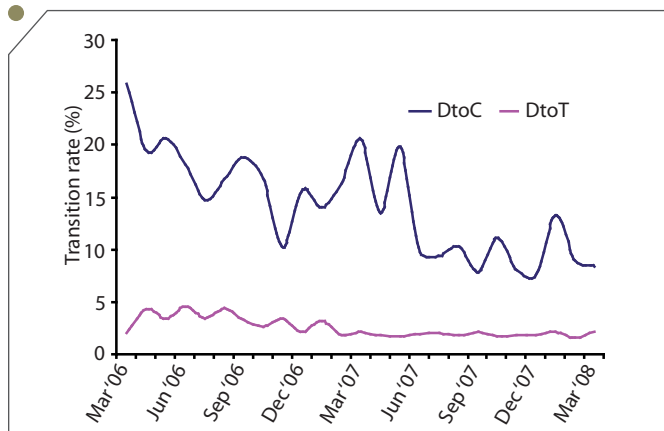
We do, however, see some tentative signs of improvement as evidenced by the recent stabilisation in both the delinquency and cure transition rates. The delinquency transition rates for both 2/28 and 3/27 mortgages in Figure 7.0 above show that CtoD transition rates have started to come down from peak rates in January of 2008. Figure 10.0 also shows that cure rates from December 2007 to March 2008 have started to level off somewhat. Cure rates seem to have improved modestly for loans with full documentation of income and assets as depicted in Figure 11.0 by the upward sloping solid line from January 2008 onwards.

Conclusion

The condensed transition approach described in this paper is a valuable framework for understanding and analyzing credit risk of mortgage
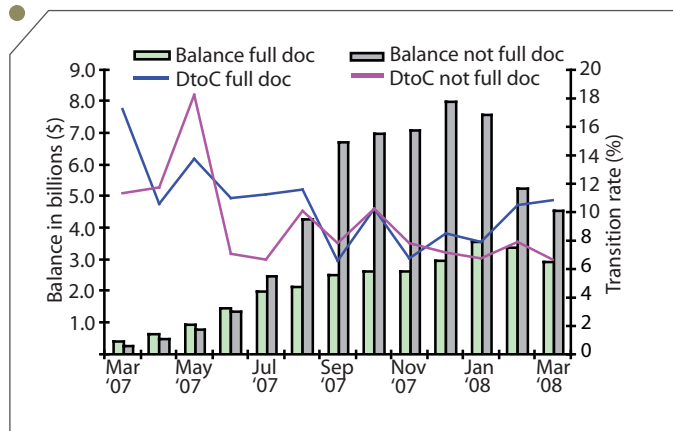

Figure 10. ABX 06-2 transitions from delinquent status, March 2008

Figure 11. ABX 06-2 cure transition rates by documentation type, March 2007–March 2008

transition rates are shown as function of loan age. The graph shows that delinquency transition rates for 2/28 loans continue to rise after the reset period at month 24 and peaks in month 28.

While both the CtoD and CtoT transitions contribute to the 60+ delinquency performance of the underlying loan collateral of the ABX 06-2, an equally important factor is the significant drop in cure rates (DtoC). Figure 10.0 below shows both the DtoT and DtoC transition rates. DtoC transition rates fell from 25% in February 2006 to 8% in March of 2008, while DtoT transition rates remained basically flat during the period. The drop in cure rates is consistent with both falling home prices across the country and stricter lending standards. Since January 2006, the National Association of Realtors reported a decline of 11.5% for national home prices of single family homes, which has essentially eliminated most of the equity that was once available to homeowners in a financial emergency.

Coupled with diminishing homeowner equity, lending guidelines have tightened considerably in the past six months, making it virtually impossible for homeowners to refinance their way out of trouble.

loan portfolios. This approach allows investors to develop insights about why loans migrate in and out of key delinquency states. The condensed transition approach is an attractive alternative to the full-blown Roll Rate matrix because it is easier for investors to understand traditional performance measures like 60+ delinquencies, conditional prepayment rates and conditional default rates, in the context of underlying transitions.

For example, the paper illustrates how 60+ delinquencies arise from the combination of four transitions: prepayment (CtoT), delinquency (CtoD), cure (DtoC) and delinquent pay-off (DtoT). For each transition, we can delve deeper by analysing the impact of key variables in order gain a better understanding of developing trends.

By developing a deeper and more intuitive understanding of what transitions are likely to drive future losses on mortgages, investors will be better equipped to weather the storm of the ongoing subprime mortgage crisis. ●

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