

# The Subprime Mortgage Market and the Valuation of Subprime Bonds

*The dynamics that led to the  
current subprime market mess.*

**THE GROWTH OF** the sub-prime mortgage market in the United States began in the mid-1990s when investors became receptive to securitizations backed by subprime mortgage loans. These securitizations took the form of standard residential mortgage-backed securities (RMBS) and credit-tranched structures, such as asset-backed securities (ABS). The industry expanded until 1998, when the Russian debt crisis led to decreased liquidity in the mortgage market as well as in other capital markets. By early 2000, the industry recovered with \$50 billion in securitizations.

This number was still small, however, compared to what was to come in the next

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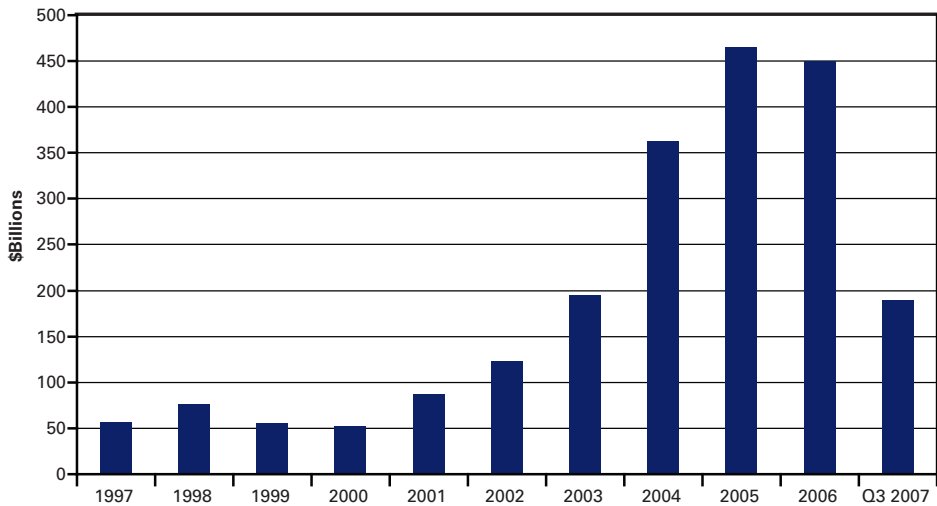
several years. In the peak years of 2005 and 2006, more than \$450 billion of subprime loans were securitized. At this point, subprime loans represented more than 20 percent of all U.S. mortgage originations (Figure 1). This growth was fueled on the supply side by: improved technology for processing mortgage applications and closings; low barriers to entry; easy access to financing for originators; receptive public equity markets; less restrictive underwriting guidelines; low absolute interest rates; and, most important, rising home prices.

On the demand side, growth was driven by investor demand for structured finance products such as RMBS. At the top of the capital structure, the highly rated RMBS were attractive investments because not only were the spreads earned

on these bonds higher than spreads on similarly rated credit instruments, but compared to corporate bonds with the same rating, structured finance securities (with hard assets backing them as collateral) appeared safer. In an era of corporate misgovernance and fraud by companies such as Enron, Tyco, and others, the appeal of investing in securities collateralized by mortgage loans was strong. At the bottom of the capital structure, the ability to restructure subprime mezzanine bonds into CDOs provided a strong underlying bid for these assets that not only drove prices higher but significantly increased demand for subprime assets.

Beginning in late 2005, several factors caused conditions in the subprime mortgage market to change. The Federal

**Figure 1:** Annual securitization volume of HEL ABS



Source: Inside MBS&ABS – October 12, 2007 edition.

Reserve began raising short-term interest rates, and since most subprime loans reset off LIBOR, this caused the borrowing cost to homeowners to increase. Furthermore, the U.S. housing market began to show flat to declining values after five years of substantial price appreciation.

## INNOVATIONS

The subprime originators launched a campaign to prevent lending volumes from slowing. There had always been limited documentation loan programs for certain borrowers such as small business owners, but these borrowers typically had low loan-to-value ratios (LTVs) and good FICO scores. Similarly, there had always been 90 percent to 100 percent LTV loan programs for selected borrowers, but these programs typically required full documentation. To combat declining lending volumes, the originators married these two concepts and the “100 percent LTV no-doc (or low-doc) mortgage” was born. Other structural innovations also were brought to bear to keep origination volume high, such as interest-only periods, piggy-back second lien loans, and 40-year amortization schedules. And it worked: 2006 was the second-largest issuance year on record.

But cracks in the dike were appearing. By late 2005, the first evidence of increasing delinquencies appeared, and, in par-

ticular, an increase in early payment defaults, which typically occur in the first month or two after the loan is closed. In response, the rating agencies began to change their ratings parameters, resulting in an increase in subordination required to achieve each rating.

By late 2006, these factors had resulted in decreased prices for whole loans, which led in turn to operating losses and decreased access to funding for most originators. Interestingly, even as these early signs of trouble appeared, the large securitizers on Wall Street were eager to control an origination source in order to keep their pipelines of securitization business full and also to capture whatever profits were being generated on the origination side of the business. The close integration of loan origination and capital markets execution had become critical to the profitability of an industry highly dependent on the securitization market, and therefore closely linking the two seemingly made economic sense. (The same business model was working well in the commercial mortgage market, where large securitizers were also large loan originators.) On the other hand, the small- to medium-sized originators, who were privately owned and thinly capitalized, were reluctant or unable to inject additional capital. As a result, significant consolidation occurred, including the bankruptcy or liquidation of small- and medium-sized originators, and the acquisi-

tion of larger originators by major banks and Wall Street firms.

The remaining originators were focused on lowering their cost to originate and reducing credit-related losses. In order to minimize credit losses from early payment defaults, which were typically the responsibility of the originator (even if the loans were sold or securitized), originators began refining underwriting guidelines. They eliminated loan products that had higher credit risk or were no longer attractive to the securitization market. These guideline and product changes were an attempt to improve whole loan values and improve profitability. But the changes proved to be too little, too late; the credit problem turned out to be much larger than anyone anticipated.

While this deteriorating story was playing out on the origination front, significant innovations in the securitization markets were taking place, which, when they came into contact with the combustible origination issues, would cause the subprime explosion whose meltdown dominates today's headlines. In particular, in late 2005, the growth in subprime originations drove a tremendous growth in the ABS CDO market. ABS CDOs consisted of tranches of RMBS repackaged into new securitizations. For example, a pool of BBB- rated RMBS were converted into new securities with tranche ratings from AAA down to unrated. The CDO market

caused increased demand for subprime assets that, in turn, encouraged further origination of subprime loans (with lax standards) in order to meet that new demand, creating even more CDOs.

In the past, because the volume of BBB- RMBS issued was small and the CDO manager had to acquire his assets either from the meager origination pipeline or the even more meager dealer inventories of secondary positions, it would take six to twelve months to accumulate enough assets to execute a small ABS CDO. Furthermore, it was nearly impossible to sell the riskiest portions of these CDO capital structures, and managers typically had to retain large amounts of the first loss pieces. Both of these effects had historically conspired to keep ABS CDO production low. In 2005 and 2006, CDO volumes would probably have increased simply due to the increased volume of subprime mortgages, but Wall Street dealers, sensing an untapped market, aggressively promoted credit default swaps (CDS) on individual tranches of subprime securitizations. Using these "single name" CDSs, investors did not need to know who owned a bond in order to buy it, or own a bond in order to sell it. Suddenly, CDOs backed by CDSs of subprime ABS could be created in a matter of days and weeks instead of months.

As the securitization market grew, so did the demand for hedging instruments

in the subprime market. The dealer community sought to create instruments and a liquid market that would allow them to hedge their growing pipelines of subprime mortgages as well as their growing ABS CDO pipelines. Following on the heels of the growing and successful credit-default swap market for indices that had developed in the corporate sector, the first comparable subprime instrument, the ABX 06-1 index was launched, which referenced twenty ABS securitization deals issued in the second half of 2005. ABX 06-1 consists of AAA, AA, A, BBB and BBB- components, each of which is traded separately. Each rated tranche of the index is made up of those tranches from each of those same twenty deals that have the given rating of the index. The index is not a CDO; the economics of the index are that of an equally weighted portfolio of those twenty securities. Similarly, ABX 06-2 references twenty bonds issued in the first half of 2006, 07-1 references twenty bonds issued in the second half of 2006, and 07-2 references twenty bonds issued in the first half of 2007. Each series has the same rated components, AAA through BBB-.

Over the past year, the ABX indices have become by far the most liquid instruments in the subprime market, even more liquid than the bonds underlying the index. Investors can be long or short and, today, market participants use the ABX to

benchmark all other subprime instruments in the market trade. Monthly remittance reports detailing the credit performance of the loans underlying the indices are followed closely by all market participants. Big price swings often occur when remittance reports show differences from near-term expectations.

In the middle of 2006, some large hedge funds began significant programs to create these ABS CDOs in large size and retain the first loss (equity) pieces, which were typically 5 percent of the structures. As a result, CDO managers did not have to retain much, if any, economic interest in the structure and could merely collect management fees. The CDO creation business became a true capital markets arbitrage activity for the first time. Since the non-rated tranches had found sponsorship, the mezzanine tranches of the CDOs were the most difficult pieces to sell. However, it turned out that further improvements to the CDO arbitrage could be gained if each new CDO had approximately a 10 percent allocation to other subprime ABS CDOs, mostly using BBB-rated tranches. Therefore, each CDO was able to sell its mezzanine tranches to other CDOs. Ironically, CDO underwriters and arrangers did not worry much about the AAA-rated so-called “super senior” of these CDO structures, which accounted for roughly 60 percent of the securitization, and had 40 percent

in credit enhancement below it. In actuality, it would be the retained super-senior tranches of the ABS CDOs that would cause the bulk of the \$200 billion of losses for the large financial institutions announced to date.

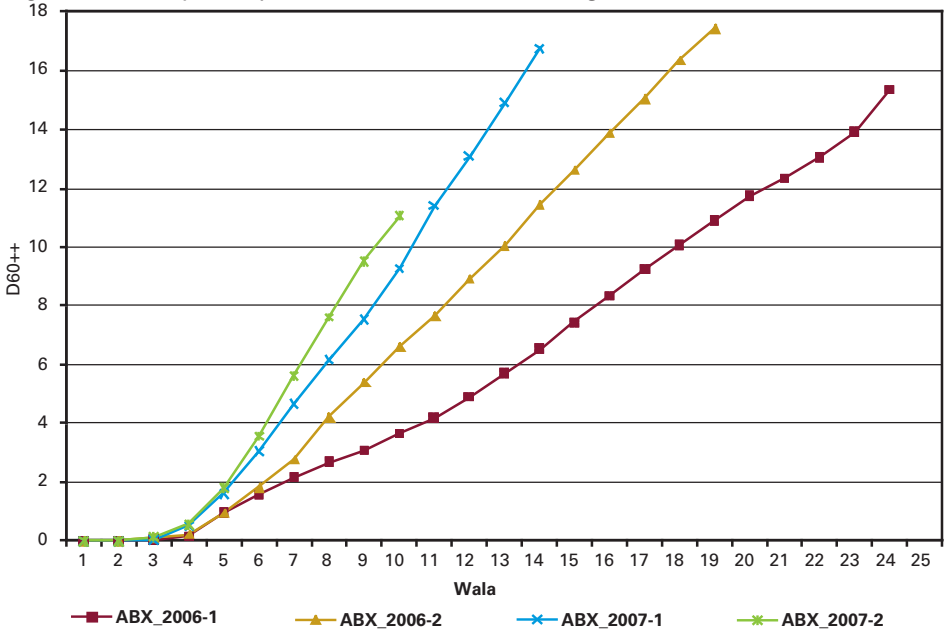
It is important to note that while the existence of the synthetic single-name CDS market spurred the growth of the synthetic ABS CDOs, they did not increase overall risk in the market, nor did they increase the amounts of losses that can be attributed to subprime mortgages. A CDS is a contract between two counterparties, and therefore is a “zero-sum” transaction. The synthetic market redistributed the gains and losses among participants in a way that would have been impossible without these derivatives. For example, without derivatives, if \$100 of losses needed to be accounted for, say half would be on dealer balance sheets and half with investors. With the derivatives, however, one might encounter investors with a \$100 gain and dealers with \$200 of losses.

By mid-2006, dealers were selling massive amounts of CDS of ABS to CDOs (“buying credit protection from the CDO,” they called it) and they became worried about getting too short. They began searching for other outlets to which they could sell the protection in excess of what they needed to hedge their pipelines. An effort was begun to draw new investors into the fixed-income cred-

it-sensitive space, touting the ABX as the preferred way to take a negative view on the U.S. housing market. The hedge funds obliged, and many non-traditional mortgage investors such as macro funds, equity long/short funds, and others decided the ABX was a better way to short the housing market than shorting REIT stocks or housing stocks. Certain very large hedge funds were set up with the primary purpose of shorting ABX, single-name subprime CDS and the like. The flows coming from these new market participants overwhelmed the dealers, and prices fell.

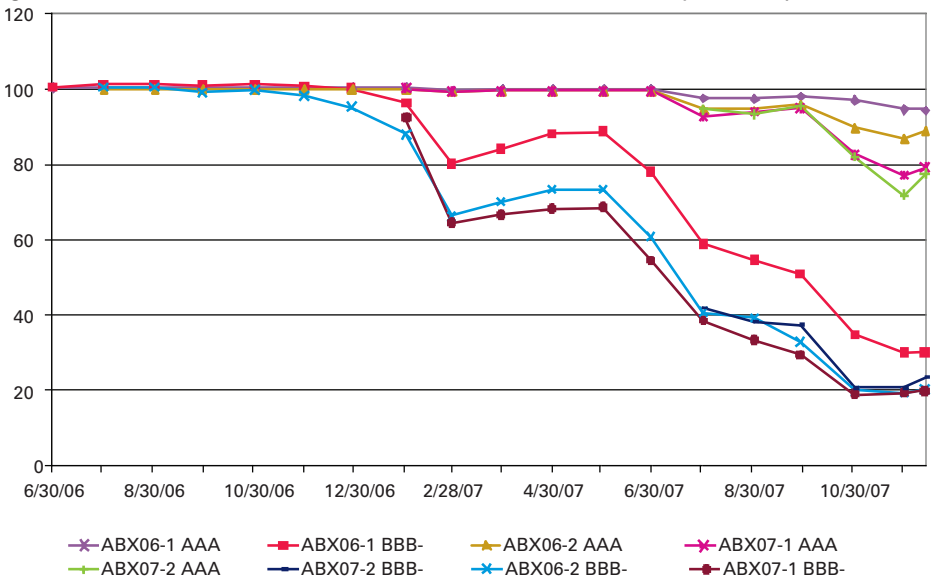
Although most observers became aware of the subprime crisis in the summer of 2007, the first real movement in market prices in the subprime sector appeared in late November 2006. A pattern emerged of delinquencies on the bonds underlying the ABX 06-2 being greater than historical experience and greater at the same age than the 06-1 index (7 percent vs. 4 percent after eleven months). Furthermore, these differences were growing larger each month. The market interpreted this to mean that the loans underlying the 06-2 index were considerably worse than the loans underlying the 06-1 index. Figure 2 shows historically the percentage of the loans that were sixty days or more delinquent (60+) for the loans underlying 06-1, 06-2, 07-1, and 07-2 indices as a function of loan age.

**Figure 2:** 60+ day delinquencies as a function of loan age for each of the 4 ABX indices



Source: Intex.

**Figure 3:** Price of ABX 06-1 and ABX 06-2 AAA and BBB- from July 2006 to present



Source: Markit.

In hindsight, the selloff that occurred from late November 2006 through early February 2007 was modest. Hedge funds were generally selling, but ABS CDOs were still buying. In fact, the wider spreads were seen as an investment opportunity by ABS CDO managers and investors. In particular, the bulk of the selloff in late 2006 took place in the ABX 06-2 BBB- index as opposed to the cash market or even the earlier vintage ABX 06-1 BBB- index (Figure 3). There was virtually no selloff in other sectors such as Commercial Mortgage-backed Securities, for example. Although ABX 06-2 BBB- prices declined slightly starting in November 2006, there was virtually no decline in 06-1 until February 2007. Of course, this tradeoff turned out to be only the beginning. Falling ABX prices, coupled with continuing negative performance of the underlying mortgages, encouraged more selling of the index, and prices kept dropping into the new year. Initially, as delinquencies continued to increase and as evidence of declining home prices mounted, the ABX BBB- and BBB sectors traded off considerably, to the point where they were valued as if all principal associated with these bonds would be lost. As market participants continued to revise their loss expectations upward, both hedgers and speculators focused up the capital structure to the A and AA tranches, and even the AAAs, to

the point today where the 07-2 AAAs are priced below 55 percent of notional amount and the 06-2, 07-1 and 07-2 BBB-s trade around 10 percent.

As of November 2006, there was still uncertainty about whether these high delinquencies represented a short-term blip or a long-term trend. Also, it was unclear what impact the increased delinquencies would have on actual foreclosure and loss rates. Delinquencies alone are not a problem for these bonds, but losses—and in particular, the timing of losses—are the main problem. It is one thing to say that delinquencies are higher and losses are higher, but it is another thing to say that these bonds will take losses. Everybody knows subprime borrowers default with some frequency and the securities are built to withstand those defaults. As already noted, the ratings agencies had already begun to tighten their standards by this time as well. The question became: Would the losses be large enough to overcome the structural enhancements of the securities? This uncertainty remains today. With prices so low, many participants are considering whether now is the time to buy. If today's pricing reflects an over-reaction to the true risk in these loans or if certain bonds or indices are mispriced relative to others, then investing in this sector today may yet prove to be a rare and profitable buying opportunity.



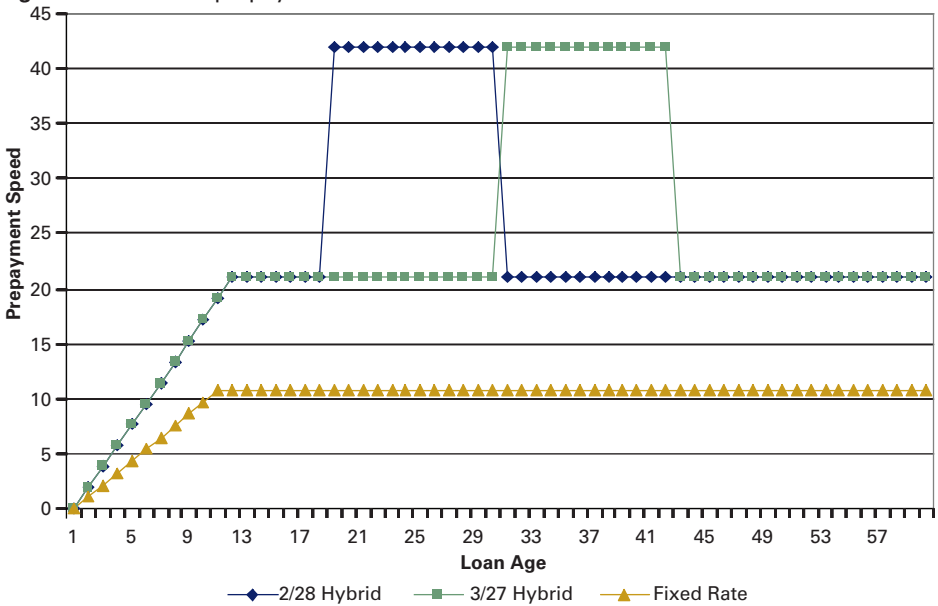
## MODELING THE MARKET

With this market background, we now describe a set of models that we have developed in order to extract information from ABX and ABS market prices. These models were not designed to determine whether a given index or a given security is rich or cheap in an absolute sense. But by examining what assumptions are necessary in order to reproduce the market prices, an investor can then decide whether those assumptions seem reasonable, which leads, in turn, to an opinion about both relative value and absolute value. We focus in this paper on the analysis of the ABX indices, since these are the most common and liq-

uid ABS assets, although we also actively use the same tools to evaluate and trade single-name ABS bonds.

We use our base model cumulative loss, delinquency and prepayment curves to generate scenario cash flows for each security in each ABX index. Our base curves are derived from an analysis of historical delinquencies, losses and prepayments. The fixed-cap nature of the CDS is also explicitly modeled. There are two kinds of interest rate caps in CDS: “variable” and “fixed.” We focus on “fixed” cap in this paper. In a credit default swap, the buyer of protection pays the seller a running coupon. This coupon can be either less than or greater than the reference bond

**Figure 4:** Base case prepayment curves



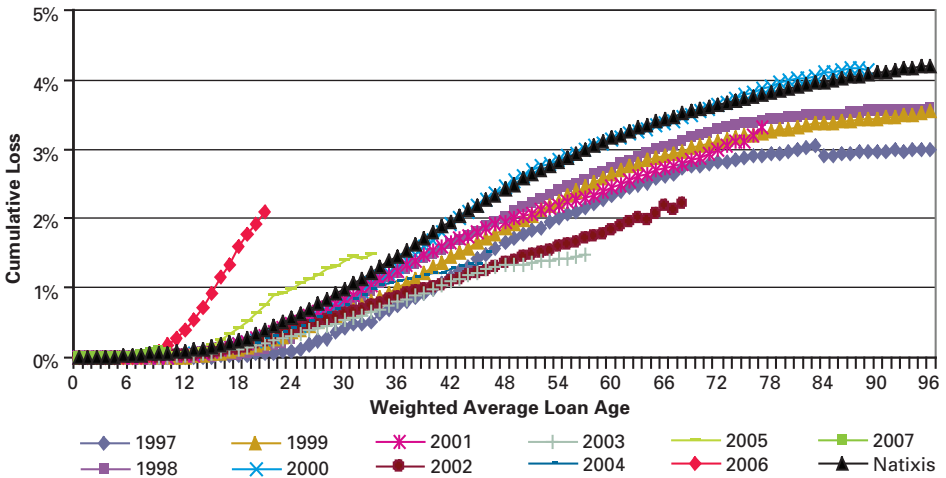
Source: Natixis Capital Markets Inc.

coupon. The CDS is meant to mimic the bond cash flows as closely as possible (with 100 percent financing), so that if the bond experiences an interest shortfall, so should the CDS. The terms of “fixed cap” state that the shortfall on the bond is applied dollar for dollar (as opposed to a percentage basis) on the CDS, up to the maximum amount of the CDS coupon, such that the seller of protection never has to make a payment to the protection buyer due to interest shortfall.

We now describe our “market-implied” model. In order to extract information (such as the implied cumulative loss) from the market prices, we first must specify prepayment and loss curves. These prepayment and loss curves are shown in Figures 4 and 5. Figure 4 shows the base case prepayment curves for both adjustable-rate

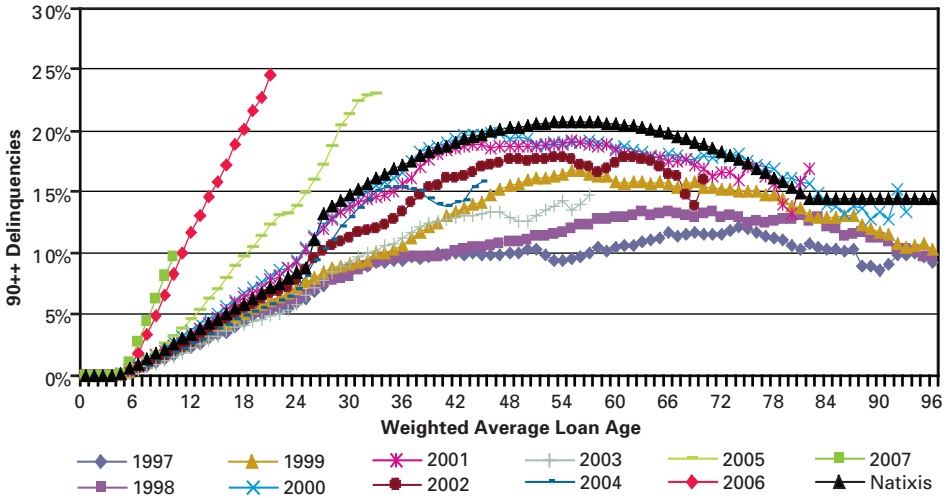
and fixed-rate loans. During the heyday of subprime origination of 2005 to 2007, about 80 percent of subprime loans were adjustable rate and only 20 percent or so were fixed-rate. Of those adjustable rate mortgages, virtually all were of the “hybrid” variety, which means that the mortgage rates were fixed for either two years (“2/28”) or three years (“3/27”), and then adjusted periodically, typically every six months based on LIBOR rates. The initial rates were often in the 7 percent to 8 percent range, and the reset rates were around LIBOR plus 600 bps. The prepayment behavior of hybrid loans is qualitatively well known, ramping up from very slow speeds in the early life, to faster speeds around the reset date, and then slowing back down to some equilibrium rate after the efficient refinancers have left the pool.

**Figure 5:** Base case cumulative loss curves, with experience of recent vintages



Source: Loan Performance, Natixis Capital Markets Inc.

**Figure 6: Base case delinquency curves, with experience of recent vintages**



Source: Loan Performance, Natixis Capital Markets Inc.

During the years of high home price appreciation, prepayment speeds on ARMS would peak in the 60 cpr area, with 80 cpr prints not unknown. Similarly, fixed rate prepayments would be 15 to 20 cpr. With the decline in home prices and the absence of refinancing alternatives for many borrowers, prepayment speeds have declined significantly, so that the ones we use in the paper and shown in Figure 4 are representative of the current environment. In-depth analysis of index pricing and single-name security analysis would typically also involve stressing the prepayment curves, but we ignore this dimension here, focusing on the cumulative loss instead.

Figure 5 shows the base case cumulative loss curve and the experience from previous years. Before 2005, the highest

cumulative loss was in 2000, which saw losses approaching 4 percent of the original pool balance. While it is still early in the lives of the 2005 to 2007 losses, and cumulative losses are still quite low in absolute terms, it is already apparent that losses will be much higher than any historical experience to date. This can more easily be seen by looking at recent delinquencies compared to older vintages (Figure 6), as delinquencies are three or more times greater than historical levels. (It is not uncommon to see securities that are six months old and have 30 percent of the loans sixty or more days delinquent already.)

With such a dramatic deviation from historical values, one can question the value of looking at historical curves. The

approach that we use is to use multiples of our base case cumulative loss curve that are consistent with recent experience. So what we are really taking from the historical experience is the timing of losses. It is also worth mentioning that our fundamental curve is the cumulative loss curve, not the delinquency curve. More sophisticated models would start with current delinquencies and apply a transition matrix in order to simultaneously determine the losses and the timing of those losses, as well as the replenishment rates back into the delinquency pipelines. Additionally, the severity would have to be assumed for every period. Rather than trying to specify all of these variables and given the uncertainties inherent in that approach, we find it more economical to live purely in cumulative loss space. It remains true, of course, that a delinquency model is necessary in order to project the trigger states of these securities in the cash flow simulations, and we use the curves shown in Figure 6.

Many researchers express their base case and stress scenarios in terms of home price appreciation (HPA). While we agree that HPA is perhaps the single most important variable driving delinquencies and losses, we disagree with the attempts to model this behavior. The functional form of the relationship cannot be anything but a guess, introducing more uncertainties than it solves. Any data-based relationship—one that uses historical data

from regions of the country where low HPA has been experienced (say, Detroit)—seems implausible to us to be applicable in regions of high recent HPA (say, New York City). Finally, many of these models have large variability of results for very small changes in HPA. For example, it is doubtful that a 1 percent change in HPA is really observable in the housing market, especially given transaction costs of 5 percent to 10 percent. Thus, we prefer to use cumulative loss.

We begin with the base curves and cash flows and then make adjustments. The first adjustment is to account for the higher than expected delinquencies already in the pipeline for most of the bonds underlying our CDS. We flush out the excess (or deficit) of the current delinquency pipeline over that given by our base model, at 50 percent severity, uniformly over twenty-four months, and regenerate the CDS cash flows. We denote this amount of excess delinquencies that will turn into losses by the parameter  $A$ . Historical analysis suggests that loss severity is typically around 40 percent. In order to reflect the declining housing market we are experiencing today, we assume 50 percent loss severity in this analysis. The assumption of twenty-four months for the losses in the current delinquency pipeline to be realized is based on the fact that foreclosures and sales of property take time. We assume 60 percent of the ninety-day delinquency bucket, 50

percent of the sixty-day delinquency bucket, and 100 percent of the foreclosure and REO buckets turn into realized losses. The basic results are not particularly sensitive to modest changes in these assumptions.

Not surprisingly, these adjusted curves produce prices for all tranches of the indices that are high relative to the market prices. That is, the market is assuming more losses than the loss curves described above that were derived from historical experience and adjusted by current actual delinquency pipelines. This is caused, at least in part, by the fact that our methodology merely flushes the current pipeline and does not forecast continued underperformance for a particular underlying bond if that flush amount is large. Rather than explicitly forecasting the degree of continued underperformance for each bond, we take the approach of deriving “market implied loss curves.” This gives us a basis for evaluating what the market is implying for losses in general as well as a basis for comparing what losses the market is implying for different ratings and different cohorts of loans underlying the various ABX indices.

The simplest construction of the market implied curve is to take a multiple of our base curve, and then add the losses derived from flushing the pipeline of delinquencies. One weakness of this implementation is that it applies the same multiplier to each bond in the index, mak-

ing the cumulative losses on even the best bonds in the index quite high, whereas even the market expects low losses on good bonds. Nevertheless, we believe that useful information can still be extracted.

We adopt the following implementation for the market-implied loss curve. For each bond, the cumulative loss curve as a function of time,  $L'(t)$ , is given by,

$$L'(t) = x_{\text{cdr}} L(t) + F(t),$$

where  $L(t)$  is our base case loss curve,  $F(t)$  is the curve, as a function of time, that represents the excess of the current delinquencies over what is expected by our base curve, and  $x_{\text{cdr}}$  was defined above. The multiplier,  $x_{\text{cdr}}$ , is the parameter that is determined in order to obtain the market price using LIBOR flat discounting. Each bond in the index has its own  $L'(t)$  (since they each have their own  $F[t]$  and their own  $A$ ), but we apply a single value of  $x_{\text{cdr}}$  for all bonds in a given index. This parameter  $x_{\text{cdr}}$  is varied until the model price equals the market price.

We look at results for each of the five indices from the AAA, through the BBB-ratings. For the purposes of this paper, we will use the prices as of the close of business on December 7, 2007. The central results are displayed in Table I. Also shown in the table, alongside the market prices, are the multipliers necessary to reprice the index, the cumulative losses that are

implied by that model, and, finally, the percentage write-down of each index under those scenarios. Those indices that have 100 percent write downs will, according to these simulations, receive none of their principal and are essentially interest-only securities (IOs).

The first thing to note is that, in general, the multipliers increase from low levels of around 2x for the BBB- to 6x or 7x for the AAAs. The very newest index, 07-2, is different, and does not exhibit this monotonic behavior by rating, as even the BBB-tranches have to be run at nearly 5x the base model to get the market price. Part of this can be explained by the fact that the 07-2 index is new and that the flush amounts are not large enough to make a meaningful difference in the overall cumu-

lative losses expected from this vintage. However, the amount of cumulative loss that can be attributed to the current pipeline of this vintage is already 3.8 percent. While 3.8 percent is small compared to the expected loss over the life of the bonds in this vintage, it is hardly small compared to historical experience.

The fact that the market seems to be implying different cumulative losses for each rating subindex at first seems troubling. While it may reflect model error due to the simplicity of our model, it is also a common result in the application of theory to practice in finance. For example, in equity options, it is well known that the implied volatility on a given underlying is different for different strike prices, even though the underlying “real” volatility

**Table I:** Multipliers and cumulative losses for market implied model

Rating	ABX Prices				Implied Multipliers			
	06-1	06-2	07-1	07-2	06-1	06-2	07-1	07-2
AAA	93.17	88.09	78.11	72.81	6.29	5.37	5.74	7.15
AA	87.21	68.26	50.33	43.09	4.17	3.84	4.00	5.43
A	67.92	45.83	28.02	31.72	3.00	2.84	3.18	4.78
BBB	37.03	22.65	20.25	22.81	2.43	2.30	2.66	5.16
BBB-	29.75	10.89	19.46	21.49	2.41	2.18	2.68	4.79

Rating	Implied Cum Loss				Percentage Writedown			
	06-1	06-2	07-1	07-2	06-1	06-2	07-1	07-2
AAA	25.1	27.9	31.2	35.5	10%	18%	35%	47%
AA	19.7	22.9	25.2	30.2	21%	47%	73%	93%
A	16.1	19.3	22.0	28.0	55%	82%	98%	100%
BBB	14.1	17.1	19.9	29.3	100%	100%	100%	100%
BBB-	14.0	16.5	20.0	28.9	100%	100%	100%	100%

Source: Natixis Capital Markets Inc.

should not depend on the strike. Another way to understand this result is to think about the structure of these indices. The BBB- bonds generally hold up to about 10 percent cumulative loss. Once the principal on these bonds is wiped out, the index price reflects the present value of the coupon stream, and it does not much matter whether the cumulative loss is 10 percent, 15 percent, or 20 percent. But it matters higher up the capital structure to the AAAs and AAs. To continue the analogy to equity options, where “out of the money” options have significant “skew,” it may be the case that the most accurate estimates of the market’s expectation of cumulative loss is the scenario where the options are “at the money,” indicated by cases where the market price of the index is \$50 to \$70 (remembering that the IO value is around \$15 to \$20), which are the AA and AAA indices, depending on vintage.

It was stated earlier that the indices are not CDOs. Rather, they are formed as equally weighted portfolios of the underlying bonds (at the same coupon), but there is still an element of correlation that is important. Specifically, if the market expects 20 percent cumulative loss on the twenty bonds in the index, it is important for the prices of each of these tranches exactly how losses occurs. If all twenty of the underlying bonds experience 20 percent cumulative loss, then the BBBs are wiped out and worth only their IO value,

but the AAs, for instance, will receive all of their principal back. However, if ten of the bonds experience 40 percent losses and the other ten experience none, then not only will the BBBs get half of their principal back, but the AAs will lose half of their principal. Therefore, the last columns in Table I show the percentage of each index that experiences a loss.

At current market prices, the BBB- and BBB bonds are clearly being priced to IO valuations and, as such, are long options. These options are very deeply out of the money, and in all likelihood these bonds will not receive any principal, but they are long options nonetheless. Furthermore, the original BBB ratings referred to return of principal. The market is saying it believes that these bonds are not getting any principal. So what is the risk of these securities? It is surely better than a BBB risk. At current market prices, it only takes about two years of coupon to return the entire purchase price to the investors. It takes time for servicers to foreclose and work through all these defaulted loans and turn those loans into losses. It is very likely that from a risk perspective, the BBBs, at current prices, are effectively a AAA risk.

Similarly, with the prices on AAAs being what they are, the market is assuming the real possibility of principal losses on those tranches. While by no means a certainty, the probability of that happening is probably more akin to BBB risk than

**Table II:** Implied Index prices under models that price each rating at market for ABX 07-2. The column headings are the multipliers of the base case curve necessary to reprice each index along the diagonal.

	<b>7.15</b>	<b>5.43</b>	<b>4.78</b>	<b>5.16</b>	<b>4.79</b>
AAA	<b>72.8</b>	99.0	102.7	100.8	102.7
AA	23.1	<b>43.1</b>	68.0	52.6	67.6
A	20.8	26.6	<b>31.7</b>	28.4	31.6
BBB	18.6	22.0	24.2	<b>22.1</b>	24.2
BBB-	17.0	19.8	21.5	22.4	<b>21.5</b>

Source: Markit, Natixis Capital Markets Inc.

AAA, a strange role reversal indeed. Another interesting aspect of these results is how similar the multipliers are for all the indices, except for the 07-2, at each rating level. For instance, the single A indices all have multipliers ranging from 2.84 to 3.18, and this encompasses a price range from 28 to 68. These indices are all essentially run using the same model, and 40 points of the price differences can be explained by bond structure and vintage effects only.

We can also derive some relative value information between each of the ratings subindices. The market-implied model described in this section results in different multiplier for the AAA index, the AA index, and so on. For each multiplier, that rating subindex is priced at the market price. One can then ask: What are the prices of the other tranches under that same model? What is the price of the BBB tranches under the model that prices the AAA at the market price? These results are shown in Table II for the 07-2 index.

The first column of Table II shows the prices implied by the model that reprices the AAA index, with a multiplier of 7.15; the second column shows the prices implied by the model that reprices the AA index, and so on. The diagonal elements of the table are the market prices as of December 7, 2007. We can see that under the model that reprices the AAA index, all the other tranches are rich compared to where they should be. At the other end of the ratings spectrum, at a price of 21.5 points, with a multiplier of 4.79, the BBB class is 2 points cheap, the A tranche is fair, and higher up is also cheap.

#### GOOD BONDS AND BAD BONDS

With all the accounts in the news media surrounding the subprime market and related losses, it is tempting to paint the entire market with same broad brush. After all, the problems in the ABS CDO

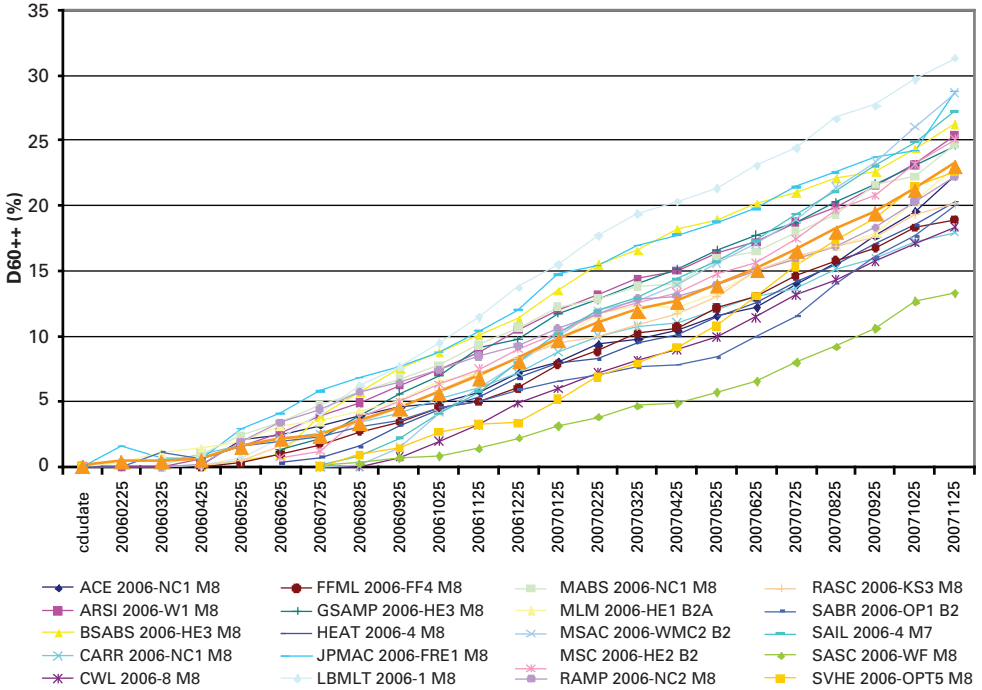


market are largely the result of correlations being much closer to unity than most participants thought. But this is an oversimplification. Figure 7 shows the sixty-plus-day delinquencies for all of the twenty bonds in the ABX 06-2 index, as a function of remittance date. At the underperforming end, there are several bonds with over 25 percent delinquencies and even one (LBMLT 2006-1) that is over 30 percent! On the other side—the good side—many bonds are hovering around 17 percent delinquent and one bond, SABR 2006-OP1, is “just” 13 percent. The rea-

sons for the disparity in collateral performance has to do with documentation types, percentages of second liens in the pool, leverage of the borrowers, and underwriting strength or laxness.

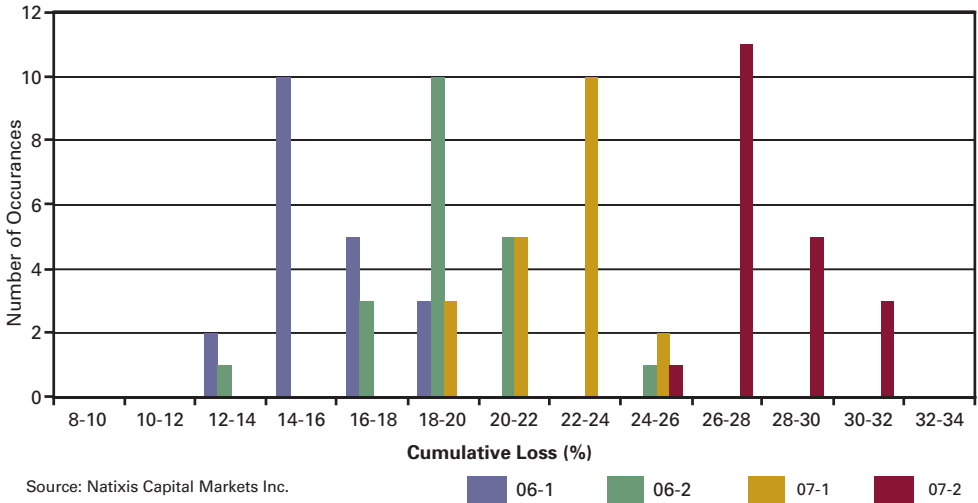
The dispersion in delinquencies also shows up as a variance in projected cumulative losses in the market-implied model described in this paper. For instance, for 06-1, under the scenario that reprices the A index, the index cumulative loss is 16.1 percent. But this belies a dispersion of results of good bonds and bad bonds. Even under this model, where each bond gets

**Figure 7:** Distribution of 60+ delinquencies of the underlying bonds in the ABX 06-2



Source: Intex, Markit.

**Figure 8:** Histogram of cumulative losses for all 4 indices under the scenarios that reprice the A index in the market implied model



Source: Natixis Capital Markets Inc.

applied to it the same multiple, a bond like JPMAC 2005-OPT1 has a cumulative loss of 11.9 percent, whereas ACE 2005-HE7 has 18.7 percent. The situation in 06-2 is not that different. The index loss under the “A” scenario is 19.1 percent, but the low cumulative loss is 13.7 percent (SABR 2006-OP1) while the maximum is 23.8 percent (MSAC 2006-WMC2). Figure 8 shows histograms of cumulative losses for each of the four indices, in the scenarios that reprice the “A” index in each case. Each of the four indices has progressively higher average cumulative losses, reflecting the market’s expectations of worsening underwriting standards as time progressed. While there are differences in projected cumulative losses in each of the indices,

even the “good” ones are still high enough to completely wipe out the BBBs and below. The interesting question is to what extent some of the AAAs will take losses.

#### WHAT DOES IT ALL MEAN?

There are three major shortcomings to our Market-Implied Model. First, although each bond in the model is run using its own delinquency pipeline flush adjustment, a common curve multiplier is imputed and used for all bonds in the index, regardless of whether the bond is good or bad. Second, because each index has to be priced independently, the model produces different multipliers and differ-

ent cumulative losses for different tranches of the same index, complicating interpretation. Third, the multipliers and losses depend on the exact makeup of bonds in the index. If the index composition were different and the price the same, the multipliers and cumulative losses would be different from what we compute today. If we consider a bond not included in any index, which multiplier should be used? To take a rare example, if one bond happened to be contained in two indices, which multiplier would be appropriate?

In versions of the model not presented here, we have solved some of these problems. All these models can be applied to bonds not in any index, and we have made proprietary investments in the sector using the methods described in this paper. Furthermore, the same methodology can be applied to structured tranches such as TABX and CDOs. The models really just describe how to generate cash flows of securities, taking into account market information. In the CDO sector, the “event of default” language in the legal documents forces outcomes that divert cash flows away from certain tranches and have nothing to do with underlying mortgage loan behavior. While RMBS and ABS securities can trade at “IO” valuations, CDOs typically do not, due to these issues. The TABX does not have these documentary issues and so is a more pure application of correlation structure in this space.

In this paper we demonstrate how to extract the market’s expectation of cumulative losses from the individual ABX tranche market prices, using a very simple approach. This model does not tell the user whether a particular index or a particular security is rich or cheap. However, with market-implied cumulative losses reaching as high as 30 percent, an investor can express a view on whether this outcome is likely or unlikely by buying or selling certain ABX tranches. With cumulative losses this high, the AAA-rated portions of the indices (or AAA RMBS) are expected to take losses, but at 50 percent severity, 30 percent losses implies that 60 percent of the pool will go through foreclosure, and some investors may find that implausible. If those cumulative losses do not materialize, and the AAA-rated securities end up getting their principal returned, the yield at current prices is around 8 percent on an unlevered basis. It was not that long ago when most market participants expected cumulative losses to reach no higher than 5 percent or 6 percent, and yields on AAA-rated securities were only marginally above the risk-free rate.

A particularly interesting sector in the market today is the so-called credit IO sector. These are securities that were originally rated BBB, or sometimes higher, but which are projected not to return any principal to the investor. As such, the val-

uations are independent of how high cumulative losses on the underlying pools actually reach because no principal is expected anyway.

The model also shows that, despite the overwhelmingly negative picture presented by the ABX indices and the subprime market in general, there still exist pockets of reasonable performance. It is true that for originations in 2007 these well performing securities are relatively rare, but they are more common for bonds backed by loans originated in 2005 and 2006. Although correlations among securities are high, leading to almost uniformly poor CDO performance in the junior and mezzanine classes, this variance between good bonds and bad bonds does have importance for super-senior valuations. To the extent that the bulk of the Wall Street losses can be traced to these super-seniors, this dispersion in performance is important.

Finally, it is important to note that in extreme stress environments like the current one, it is unnecessary to invoke a model at all. Consider the ABX 06-1 AAAs. As of March 2008, this index has 52 percent current credit enhancement and 35 percent in loans that are 60 days or more delinquent; the pool factor is 42 percent of original balance. In addition, the AAA tranche has the benefit of 450 bps per annum of excess spread that can be used to fund losses. Assuming 50 percent loss severity, which is the current rate, the

existing 60+ pipeline will generate 7 percent of original balance in cumulative loss. There already is a total of 1.8 percent in realized losses, which brings the total to 9 percent. The remaining 27 percent of original balance in currently performing loans would generate, if each loan defaults with 50 percent severity, another 14 percent of losses, bringing the total to 23 percent.

This is a remarkable result that is worth stressing. If every single remaining loan defaults and is converted to realized losses over a six-month time frame, the ABX 06-1 AAA will not lose any money. If we assume 60 percent severity instead, then the ABX 06-1 AAA can withstand 80 percent of the remaining current loans defaulting.

For a pool of loans to be able to withstand this kind of draconian stress—a 32-month-old post-reset pool that has a payment history and has some home price appreciation—points very clearly to a market that has pushed prices far too low relative to the downside risks and measurable fundamental value. This sector should be a profitable buying opportunity for those investors with idle cash and an insensitivity to further mark to market volatility.

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