Market-Implied Losses and Non-Agency Subordinated MBS

LAURENT GAUTHIER

LAURENT GAUTHIER is a director at UBS Warburg in New York City.
laurent.gauthier@ubsw.com

Non-agency residential mortgage-backed securities are structured bonds collateralized by U.S. residential mortgages that do not meet the underwriting criteria of the agencies (Fannie Mae, Freddie Mac, and GNMA). Non-agency mortgage securities are generally divided into three groups:

- "Jumbos," where borrowers have a very good credit score, and loan sizes are too large for the agencies. There was about $145 billion of jumbo MBS issuance in 2002.
- "Alt-As," where borrowers have prime credit, but some issues about the loan prevent it from qualifying as an agency loan (such as lack of income documentation, or non-owner occupancy). In 2002, about $55 billion of Alt-A MBS were issued.
- "Subprime," for loans made to borrowers with a low credit score that makes them unable to qualify for agency purchase. Subprime MBS have a strong following among international investors, because they are mostly floaters, and are less prone to average life variability than jumbos or Alt-As. Subprime MBS issuance represented about $155 billion in 2002.

Securities not guaranteed by the agencies must find credit enhancement elsewhere. The great majority of non-agency deals use internal credit enhancement and subordination. In 2002, around $25 billion of non-agency subordinated securities were brought to market.

We focus on the relative value of jumbo and Alt-A subordinated tranches. Traditionally, jumbos and Alt-As have been called whole loans. This name did not apply to subprime deals, since that market was not as developed as it is today, and subprime MBS were in fact considered asset-backed securities. We will follow that tradition, and use *whole loan* to designate jumbos and Alt-As together. There are some structural differences between jumbos and Alt-As on the one side, and sub-prime on the other side; these differences make it difficult to extend our relative value method from jumbos and Alt-As into sub-prime at this stage.

The characteristics of new issue whole-loan subordinated bonds have changed over time. In particular, subordination levels and collateral quality have significantly evolved in the past few years. These characteristics also differ across issuers, maturities, and product types.

All in all, looking at new issue spreads is of little use if one is to understand relative value in these credit tranches. Besides, the way market participants analyze new issue jumbos or Alt-As is subject to inconsistencies that make it difficult to compare whole-loan spreads across ratings. We propose an innovative approach that at the same time addresses these inconsistencies and allows relative value analysis across all new issue whole-loan subordinated securities.

We will articulate the discussion in four steps:

- First, we discuss the evolution of the characteristics of whole-loan subordinated bonds. We show that credit enhancement levels have declined across the board, and that this decline can be explained by improvements in collateral quality.
- Next, we tackle finding the fair value of whole-loan subordinated bonds. We show that the usual method has several important shortcomings. We propose a new method, improving on the old one. It is based on market implied losses—that is, the perception of future losses embedded in market prices.
- Then we detail the calculation of these implied losses, and compare them with historical losses. We also discuss the factors that affect implied losses.
- Finally, we focus on the use of the implied loss model in relative value analysis. We first perform rich/cheap analysis across products and across ratings using our model. We take a closer look at the impact of changes in collateral quality or in subordination structure on the fair values of bonds.

I. EVOLUTION IN THE CHARACTERISTICS OF SUBORDINATED MBS

Around 1992–1993, the subordination structure on whole-loan deals (then essentially jumbos) began to converge toward a so-called six-pack. As opposed to the previous structure with two subordinated bonds, one with a AA or A rating and the other a first-loss, the six-pack provided credit enhancement with six tranches, one for each rating below AAA and a non-rated one. This new structure allowed issuers to tap credit investors as a function of the amount of protection these investors desired, and minimized the size of the unrated piece.

Since then, there has been little divergence from this type of credit enhancement. Pure senior/subordination, in lieu of excess spread and overcollateralization-based structures, is appropriate when the assets in the deal do not yield much more than the liabilities. These very conventional six-packs are thus systematically found in jumbos and most Alt-A deals. On deals with lower collateral credit quality, excess spread structures are more common, since there is more available excess spread (riskier loans carry higher rates).

The basic principle of a pure senior/subordination structure is fairly simple, although whole-loan deals always carry some nuances and differ from this pure structure. For example, some issuers make it more difficult than others for principal to be repaid to the first-loss bonds.

In whole-loan deals, the payment of principal to the subordinated tranches is generally structured similarly to a NAS (non-accelerated security). For several years, a NAS does not receive any principal prepayment. After this lockout period ends, the NAS receives a variable proportion of its prorated prepayments, until it is paid down.

This structuring technology is called "shifting interest"; it allows the principal cash flows on NAS bonds to be very stable as a function of collateral prepayments. As a result, the timing of principal cash flows on a NAS is generally more stable than on typical mortgage securities such as pass-throughs or sequentials, everything else equal. Whole-loan deals practically always include a senior NAS bond, in which case the subordinated tranches look very similar to this NAS in terms of average life profile. The main difference is obviously the allocation of collateral losses.

In an ideal structure, a subordinated tranche would not receive principal unless its senior bonds have been entirely repaid. This way, whenever losses take place, the senior tranches would be covered up to the subordinated tranches' original size. Whole-loan structures generally provide for a ten-year lockout, however, after which the subordinated bonds begin to receive principal. If after that point, losses dramatically increase, the senior bonds would not be as protected as their original credit enhancement would indicate.

Still, whole-loan subordinated bonds are intended to protect the seniors—as long as the timing of losses follows a reasonable evolution, the senior bonds are not affected.

One side effect of a six-pack in each deal is that we get pricing information on six credit-linked securities for each new issue deal. It makes a lot of sense to use this wealth of information about the way the market values mortgage credit risk. It is useful in relative value analysis.

Evolution of Credit Enhancement

In the past several years, the level of credit enhancement requirements on jumbo and Alt-A deals has declined significantly. Exhibit 1 illustrates this trend, and shows the size of subordinated tranches relative to the deal's original size on a large selection of deals through time. Exhibit 1-A focuses on RFC's RFMSI deals backed by 30-year jumbo loans. Exhibit 1-B shows RFC's 30-year Alt-A deals issued on the RALI shelf, and Exhibit 1-C shows Countrywide's Alt-A deals on its CWALT shelf.

EXHIBIT 1-A
Evolution of Credit Enhancement Requirements on RFC 30-Year Jumbo

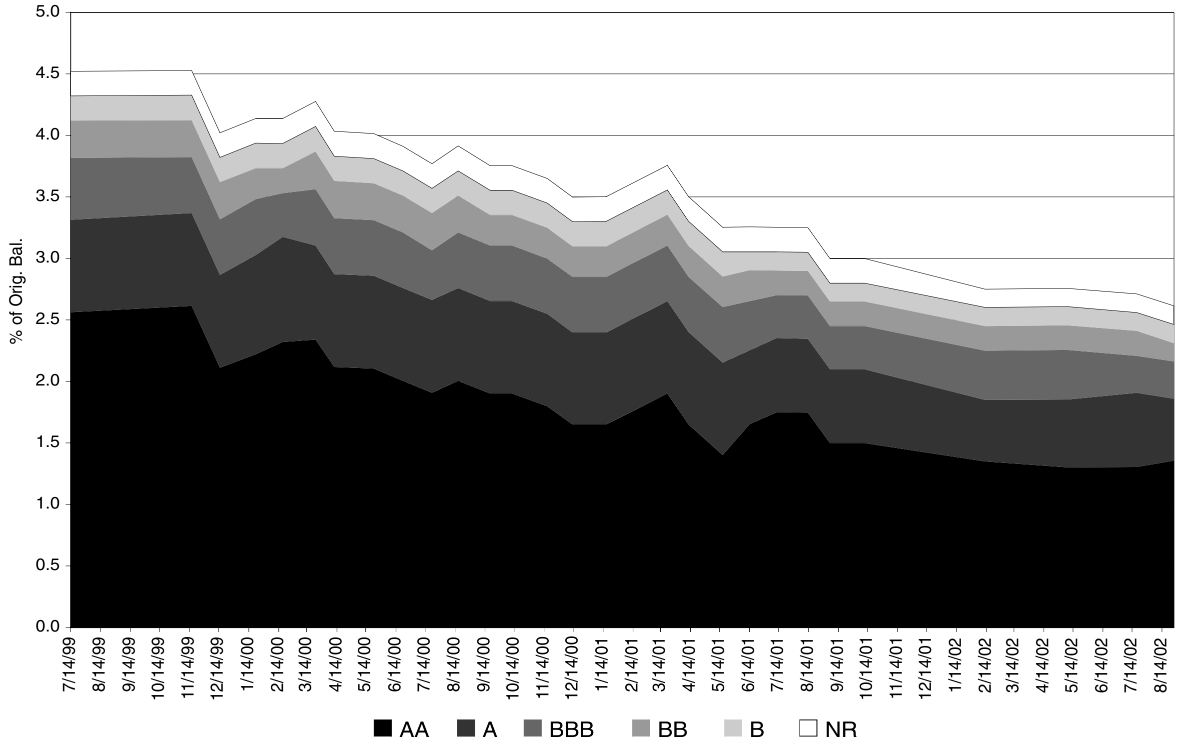


EXHIBIT 1-B
Evolution of Credit Enhancement Requirements on RFC Alt-A

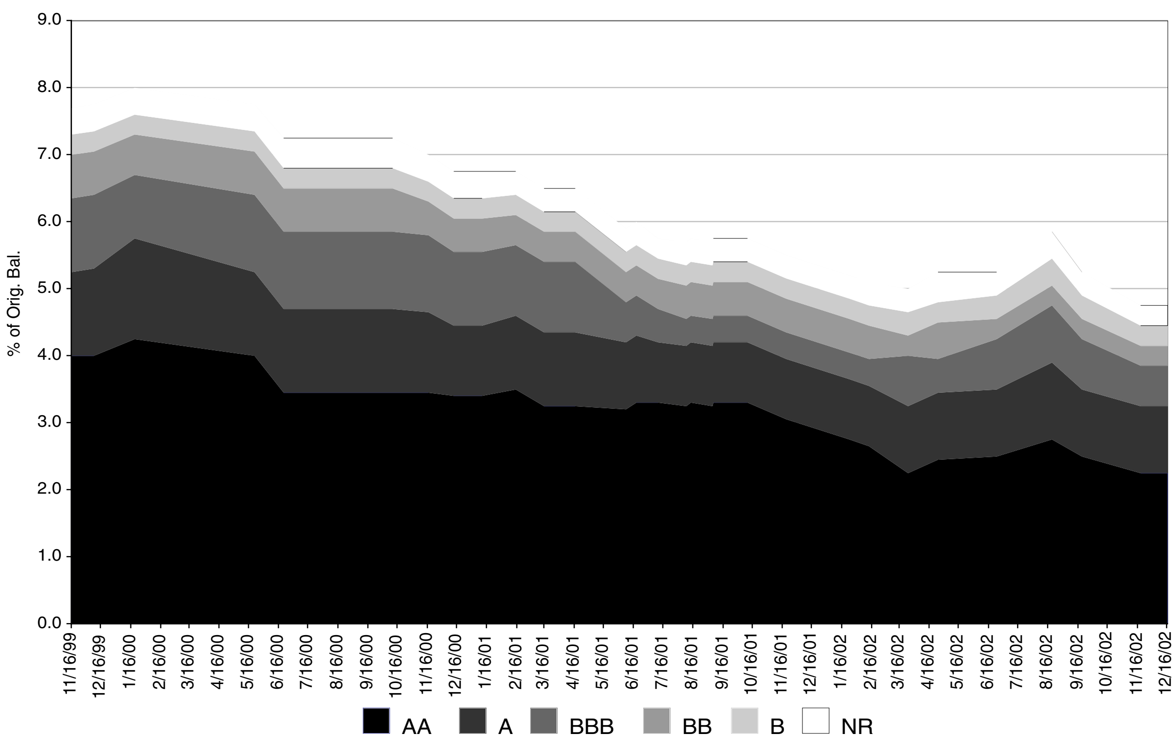
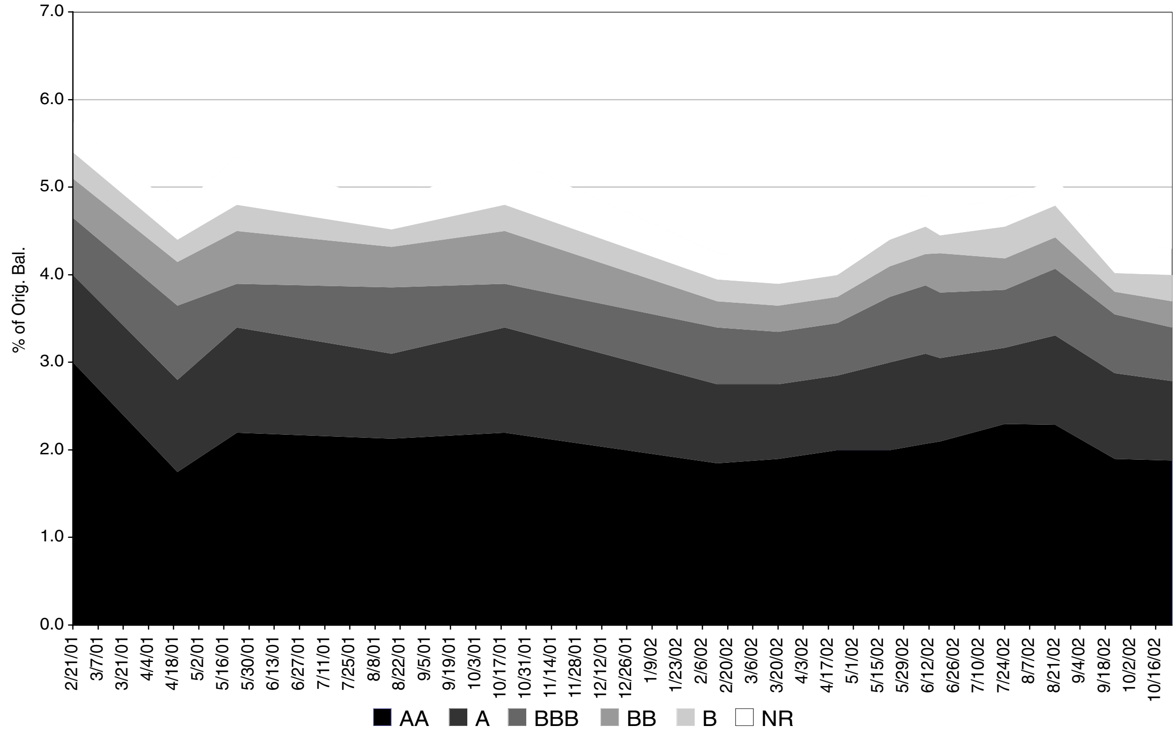


EXHIBIT 1-C

Evolution of Credit Enhancement Requirements on Countrywide Alt-A



In each exhibit, each separate band represents the size of a subordinated tranche. The entire area therefore represents the amount of credit enhancement provided by all the subordinated bonds.

What can we see in Exhibit 1? There are several important patterns:

- On 30-year jumbos, total subordination dropped from about 4.5% to 2.5% between 1999 and 2002. The size of all subordinated tranches was affected by this evolution, and their relative size has not been significantly affected.
- In the case of Alt-A paper, there is a similar evolution. Credit enhancement levels declined on RFC's Alt-A shelf from about 8% in 1999 to 5% in 2002. In relative terms, the decline is less than on jumbos. Comparing Exhibits 1-A and 1-B, it appears that the credit enhancement on Alt-A today looks the same as the credit enhancement we used to see on jumbos in 2000.
- A comparison of Exhibit 1-B and Exhibit 1-C shows there is some variability across issuers. The amount of subordination on CWALT was generally higher than on RALI. Both trended down over the period, however.

Evolution of Collateral Characteristics

There must be an explanation for such a reduction in credit enhancement levels. Has the market been willing to accept so much more risk over the past few years? Looking at the quality of the collateral that backed these deals, the answer is clear.

Exhibits 2-A and 2-B show the evolution of the average Fair Isaacs Co. (FICO) score and loan-to-value on 30-year jumbo and Alt-A deals. These charts show data only for RFC, so that we do not have to worry about variations across issuers.

In Exhibit 2-A, it is apparent that FICO scores have kept increasing since 1999–2000. We know this has been a general evolution in U.S. mortgage collateral—FICO scores declined in 1999 and 2000 from their previous levels, and then increased again in 2001 and 2002. As production volumes declined in 2000 because of higher interest rates, mortgage lenders had to be more lenient in terms of credit quality to keep origination volumes up.

On 30-year jumbos, FICO scores moved from about 720 in 2000 to almost 750 in recent months. On Alt-A paper, FICO scores went from 710 to 725. Note that RFC's Alt-A shelf is at the high end of Alt-A credit, and is therefore not representative of all Alt-As. Other Alt-A

EXHIBIT 2-A
Evolution of FICO Scores on RFC Deals

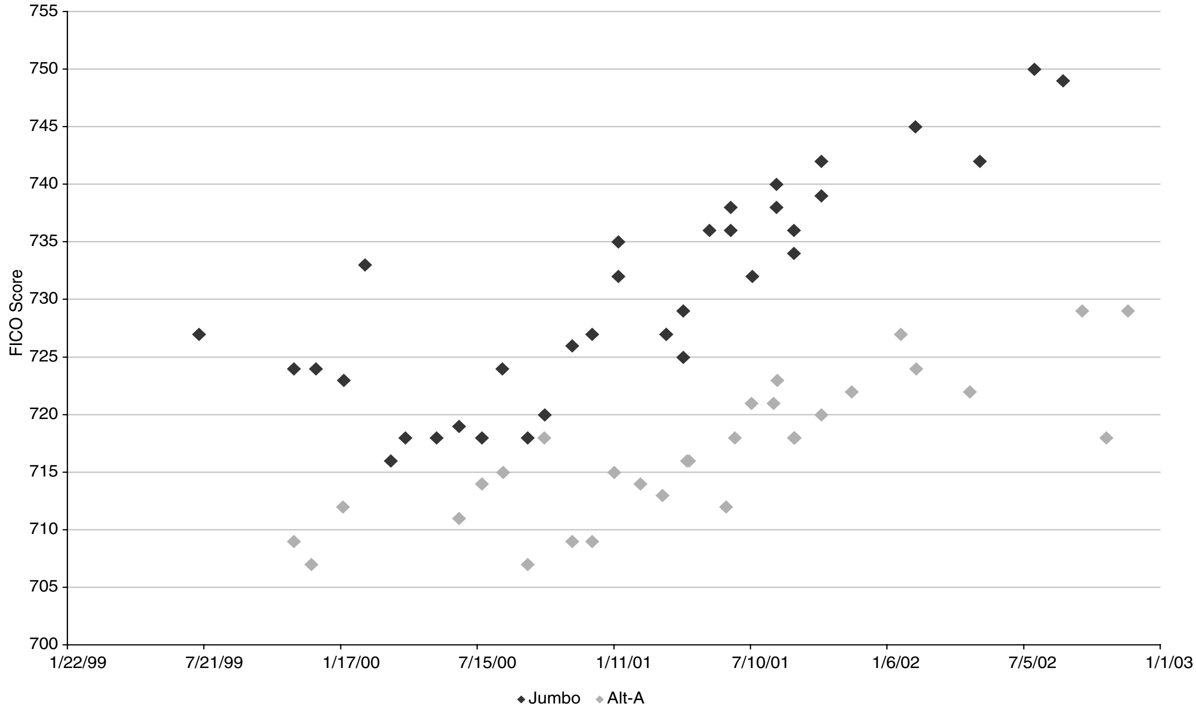
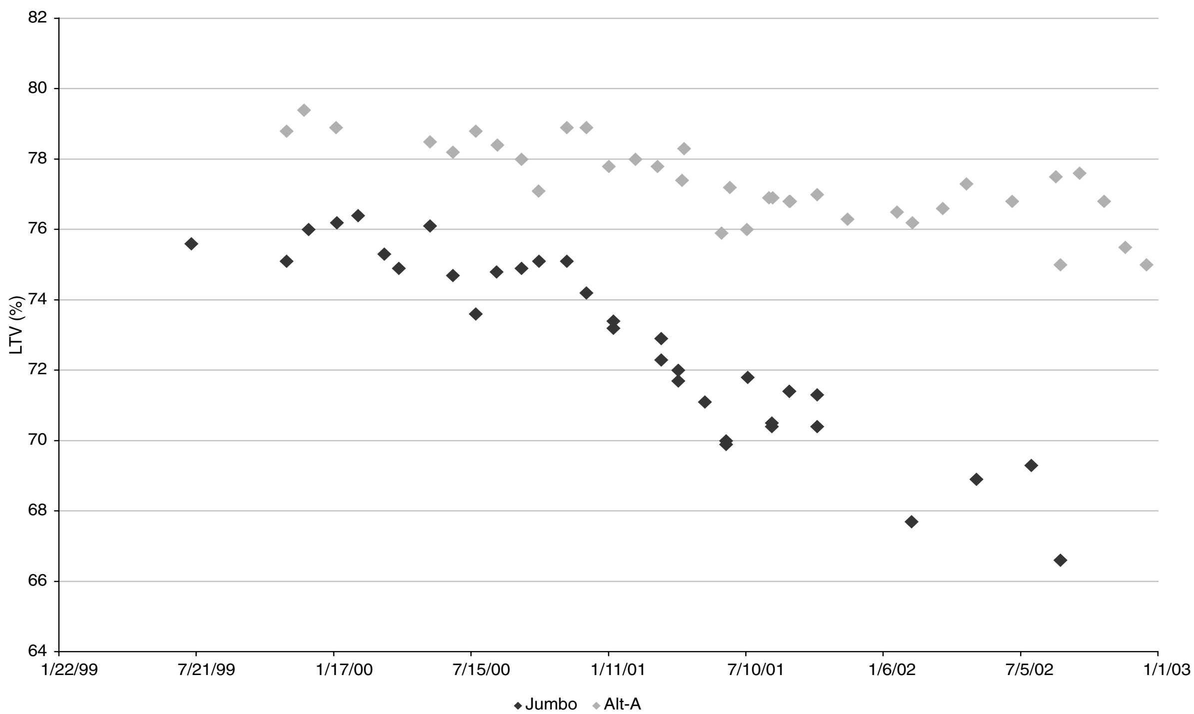


EXHIBIT 2-B
Evolution of LTV on RFC Deals



issuers (PNC, for example) were targeting borrowers with a lower FICO at the time, and therefore had an average around 690.

The average FICO on jumbo paper has increased much more than on Alt-A. Jumbos are the highest range of credit quality; it therefore makes sense that when the overall credit quality of borrowers improved, the average FICO on jumbos also increased. Alt-As, on the other hand, lie between jumbo and subprime in terms of collateral credit. As a result, their characteristics have stayed more constant over time.

The LTVs in Exhibit 2-B show a pattern very similar (in terms of credit improvement) to Exhibit 2-A. LTVs on jumbos improved from about 76% to 67%, and on Alt-As from 79% to 75%. These evolutions, in particular on jumbos, are significant.

The reason we find to explain why FICO scores were more stable on Alt-As than on jumbos also applies to LTVs. Note that in both Exhibits 2-A and 2-B, it appears that today's Alt-A collateral looks similar to jumbo collateral two and a half years ago. This simple fact goes a long way toward explaining why credit enhancement diminished over the period.

Evolution of Spreads

The evolution of credit enhancement levels has reflected changes in collateral characteristics in a reasonable way. Now, what about the market's perception of this risk? Exhibits 3-A and 3-B show the evolution of pricing spreads on the same deals as in Exhibits 1-A, 1-B, 2-A, and 2-B. In the past few years, non-investment-grade spreads have tightened overall. Jumbo Bs moved from a little over 1,200 to 1,100, and jumbo BBs moved from 600 to about 400. In Alt-A non-investment-grade bonds, spreads tightened to a lesser extent: 1,300 to 1,200 on Bs and 700 to 600 on BBs.

To get a more precise picture, we can also look at Exhibit 4. It shows the evolution of generic spreads, marked on a weekly basis using what is considered to be generic jumbo new issue paper. We can see that spreads tightened—particularly BBs after the beginning of 2002. Over the period, spreads on investment-grade paper have also tightened but not by as much as non-investment-grade. For many, this difference is due to the expectation of fast deleveraging embedded in the pricing of new issue subordinated bonds.

Still, how can we draw any conclusion from Exhibit 3 or Exhibit 4? These spreads refer to securities that were very different and whose characteristics have changed dramatically over time. We have seen that credit enhancement was reduced, but collateral quality improved. On top of this, spreads tightened. What is the bottom line? Are the subordinated bonds richer or cheaper today than their 2000 levels?

There is no way we can answer this question by restricting our analysis to historical spreads. To be able to say meaningful things about whole-loan subordinated bonds' relative value, we need to first ask ourselves how we should price these bonds. Once we find a good way to do this, we hope we can figure out what their fair value is.

II. FAIR VALUE OF SUBORDINATED MBS

We first discuss how whole-loan subordinated bonds are generally valued. Then we show the limits of this approach and propose a new and, we argue, better approach.

Usual Method

First, let us take a close look at how new issue subordinated packages are generally priced. The method is fairly straightforward, and very ad hoc. Suppose there is a new deal, and we want to find a price or a spread for each one of the subordinated bonds in the six-pack. Here are the usual steps:

- For each bond (more specifically, each rating), we need a default and loss assumption. In general, we keep the loss severity the same for all bonds and just change the default assumption: for example, 200% of the standard default assumption for the AA, 125% SDA for the A, and so on. We use the pricing speed along with the SDA to calculate the actual amount of losses.
- Then, we assume a certain loss-adjusted yield for each bond. This yield incorporates a risk premium; it is higher for the riskiest tranches.
- Using the default and loss assumption in combination with the loss-adjusted yield, we obtain a price for each bond. This price can easily be converted into a spread if need be (assuming no losses, which is the conventional way to quote a spread on these bonds).

The valuation of each bond in an example deal is illustrated in Exhibit 5. We see how applying the loss assumption, and then the loss-adjusted yield, gives us the quoted spread.

One important issue is how we can make the pricing on a deal consistent with other deals in the market. For

EXHIBIT 3-A
Evolution of Spreads on 30-Year RFMSI

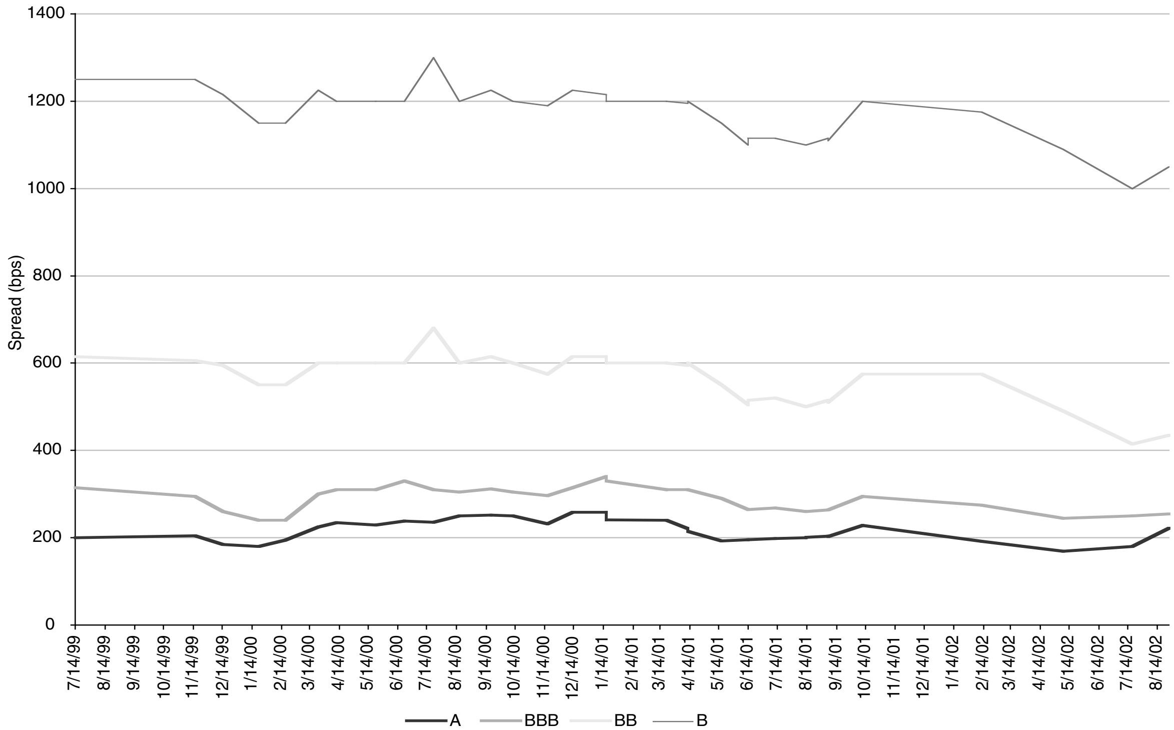


EXHIBIT 3-B
Evolution of Spreads on 30-Year RALI

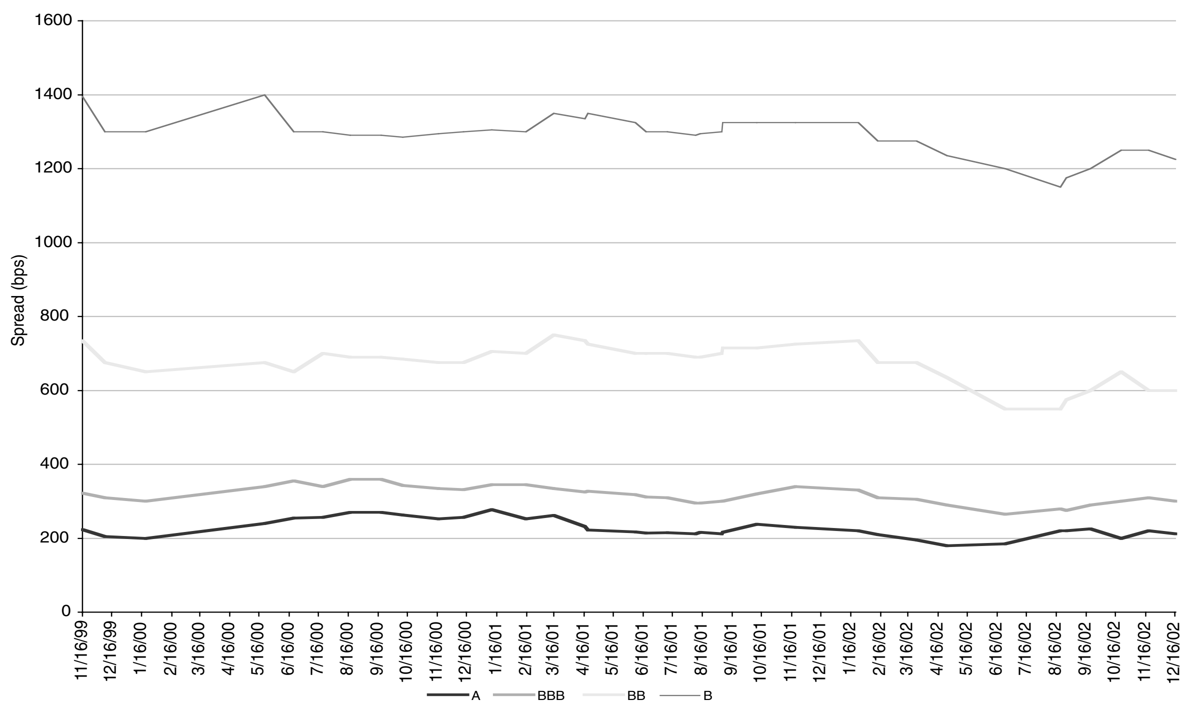


EXHIBIT 4
Evolution of Generic Spreads on 30-Year Jumbo Subs

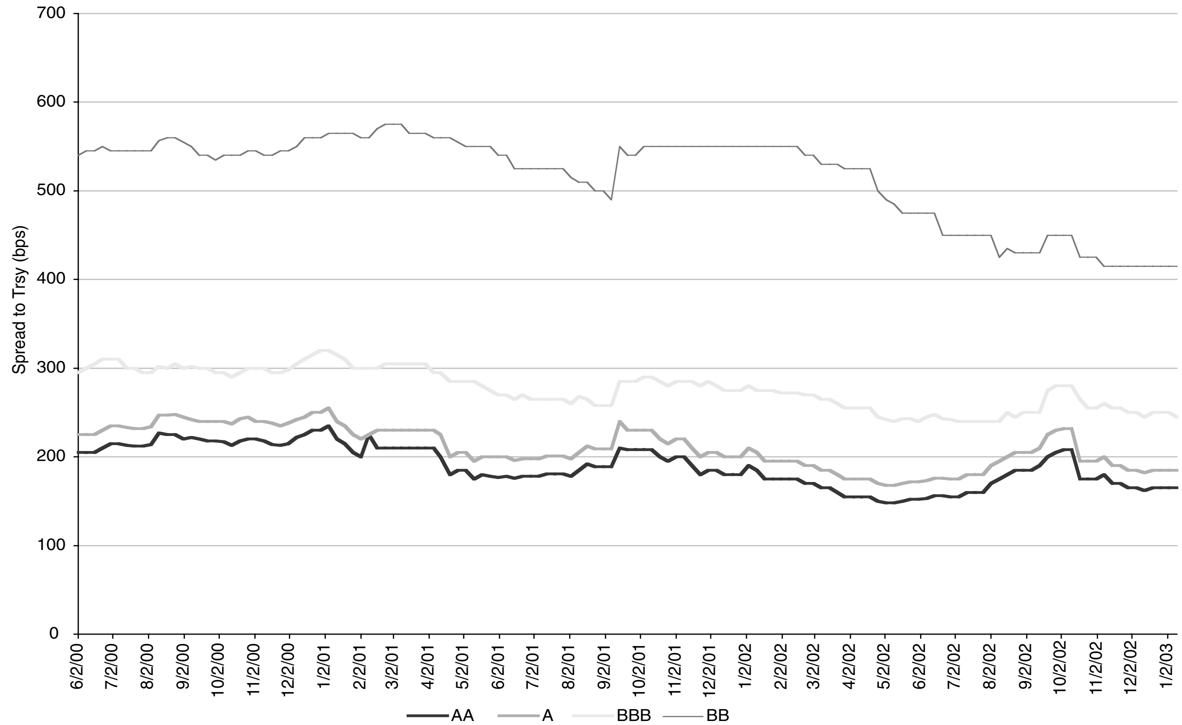


EXHIBIT 5
Usual Way to Price a Mortgage Subordinated Loan

Tranche	Defaults (SDA)	Severity	Cum. Loss	Yield (Loss adj.)	Quoted spread
AA	200	25%	1.00%	5.88%	165bps
A	125	25%	0.64%	6.00%	185bps
BBB	75	25%	0.38%	6.50%	245bps
BB	50	25%	0.26%	7.50%	415bps
B	35	25%	0.18%	10.00%	1025bps
NR	25	25%	0.13%	15.00%	$25

each bond, one has to pick a default and loss assumption, and a loss-adjusted yield. As long as collateral characteristics do not change too much over time and across issuers, we can keep the same loss assumption, and adapt the loss-adjusted yield to reflect movements in interest rates.

If we want to price another A-rated tranche on similar collateral some time after our example deal has been priced, we would proceed as follows:

- We would use the same loss assumption (since we consider the collateral very similar). As the cumulative loss on collateral depends both on the SDA and on prepayments, we would need to tweak the default assumption if the pricing prepayment speed on the new deal is different from our reference deal, keeping cumulative losses at 64 basis points.
- Starting from the loss-adjusted yield of 6.00% on our reference deal, we would have to derive an updated loss-adjusted yield that reflects movements in interest rates.
- Running the new A-rated bond with these default, loss, and loss-adjusted yield assumptions would give us its fair price, consistent with the way the reference deal is priced.

What is Wrong with the Usual Method?

In a nutshell, what's wrong is that there are too many moving parts; it requires too much guessing; and it is subject to some serious inconsistencies.

First of all, the usual method requires us to value the subordinated bonds, which all depend on the same collateral, using different assumptions. Obviously, the collateral is the same for all the bonds—so it does not make much sense to assume a different collateral performance for each bond. Naturally, it is not possible to value all the subordinated bonds in the same deal using a single collateral loss assumption. If we did this, the bonds with credit enhancement greater than this loss assumption would never be affected by losses, while the bonds with less credit enhancement would be wiped out.

An additional issue with the valuation of subordinated bonds is that the thinner the tranche, the more difficult it is to value it. The non-investment-grade tranches in jumbo deals can be very thin (often only 10 bp on 15-year collateral). A thin tranche is very sensitive to the loss assumption used to calculate its value. At the limit, an extremely thin tranche would either be wiped out, or untouched, with no middle ground in between. As a result, the impact of tranche thickness cannot be measured or valued using the usual method.

Finally, finding the loss-adjusted yield, which should reflect a risk premium, requires a lot of guessing. We can certainly look at a similar deal that has priced recently, and back out a loss-adjusted spread that incorporates the right risk premium. The difficulty occurs when the collateral of a deal we use as a reference point is too dissimilar to the new one we are looking at. How can we then adjust the loss-adjusted spread to reflect a lower FICO, for example?

A Better Way to Look at Losses

We do not want to have one scenario per bond (since the collateral is the same for all the bonds in a deal), but the same scenario for all the bonds does not work either. The solution is to consider that future losses are uncertain; the value of each sub is the average of its value in each possible future scenario. This way, all the subordinated bonds in a deal are valued by assuming the same collateral performance in each scenario. We do not consider just one scenario, however, but many, covering all the possible future losses. Instead of specifying precisely what losses will be in the future, we specify a random distribution from which each scenario will be chosen.

Exhibit 6 illustrates how random losses can be used to calculate the value of the subordinated bonds. We consider three subordinated bonds (B1, B2, and B3), the size of each one being 1% of the collateral. We ignore the effect of the timing of losses or prepayments, and assume that a tranche similar to these subordinated bonds with no credit risk would be par-priced.

EXHIBIT 6
Valuing Subordinated Tranches with Random Losses

Total Losses	Probability	B3	B2	B1
0.00%	1%	100.00	100.00	100.00
0.25%	2%	75.00	100.00	100.00
0.50%	5%	50.00	100.00	100.00
0.75%	7%	25.00	100.00	100.00
1.00%	10%	0.00	100.00	100.00
1.25%	15%	0.00	75.00	100.00
1.50%	**20%**	**0.00**	**50.00**	**100.00**
1.75%	15%	0.00	25.00	100.00
2.00%	10%	0.00	0.00	100.00
2.25%	7%	0.00	0.00	75.00
2.50%	5%	0.00	0.00	50.00
2.75%	2%	0.00	0.00	25.00
3.00%	1%	0.00	0.00	0.00
Total/Avg.	**100%**	**6.75**	**50.00**	**93.25**

Exhibit 6 is ordered by the various amounts of cumulative losses that could impact the collateral (shown in the first column). The second column gives the probability that a given amount of cumulative losses will take place. The next columns show us how much each tranche is worth in each scenario. The probability-weighted average of these amounts gives us the value of each tranche according to this method: 6.75 for B3, 50.00 for B2, and 93.25 for B1.

Now, this is obviously not a realistic situation, but one can see the advantages of the model. First, the collateral performance is the same for a given scenario, whatever tranche we are looking at. Second, although each scenario naturally entails all-or-nothing behavior of the tranches (all but one of the tranches are worth zero or their maximum value), averaging over all scenarios results in realistic values for the tranches.

So far, we have not said anything about where we should get these loss distributions. Maybe we could look at historical cumulative losses on a lot of deals, and use this distribution as an input—yet there is no reason why doing so should get us anywhere close to where deals actually get priced. We need a little inspiration, and steal a method from the options and derivatives markets.

Market-Implied Fashion

Instead of trying to guess what the loss distribution looks like by looking at past data, we will calculate a *market-implied* loss distribution. In fact, this is nothing new at all. Participants in options markets have used implied volatilities for a long time. In mortgage derivatives markets, several major players use implied prepayments models;

in credit derivatives, traders value structured products using implied default models from credit default swaps. It is only a natural evolution that we should use an implied loss model for mortgage subordinated bonds.

How does it work? Let us quickly go over the valuation process in options markets:

- First, we draw a list of securities that are liquid enough to be used as benchmarks. These typically are caps (at-the-money, but also out-of-the-money sometimes), swaptions, and/or Treasury options.
- Second, using these benchmarks, we calibrate the valuation model. In other words, we change the model's parameters until this model (more or less exactly) reprices the benchmarks. We thus obtain a model that is consistent with market pricing.
- Third, we can price any derivative with this calibrated model, even very exotic ones, in a way that is inherently consistent with the benchmarks' market prices. We can also evaluate relative value using the implied parameters from the model.

The relationship between mortgage credit and options might sound a bit far-fetched, but in fact it is not. Non-agency MBS subordinated bonds can be viewed as options (puts) on future losses. Future losses are the *underlying* of these puts.

How do we apply option pricing to mortgage subordinated bonds? We follow very much the same process as the one outlined above:

- First, we define our benchmarks. Going forward, we use a large set of new issue jumbo and Alt-A deals. Prices or spreads on the six subordinated tranches are the equivalent of our caps and swaptions.
- Second, we fit a random distribution so that we can exactly reprice the benchmark subordinated bonds.
- Third, we can use the model for relative value to analyze how changes in the subordinated bonds' characteristics (tranche size, support) can affect their (modeled) fair value.

Risk-Neutral Pricing

Risk-neutral valuation is a core concept in financial theory. In our case, it means we do not have to adjust yield or price to reflect the amount of credit risk embedded in a bond. In the usual pricing method, we know the loss-adjusted yield has to be higher on the riskier bonds, to reflect investor aversion to this risk. The issue is that this risk premium might always be a bit arbitrary—how should it differ across issuers, deals, or product type?

When we use the implied loss model, this risk premium is already embedded in the implied loss distribution. That is because the implied loss distribution precisely reprices the bonds used to calibrate it. The value of each benchmark security is exactly what is projected by the model, so there is no need to adjust the model's results by a risk premium. This is called risk-neutral pricing, because we can value the bonds as if we were neutral to credit risk; that is, as if we did not care about credit risk.

III. IMPLIED LOSSES FROM NEW ISSUE SPREADS

First, we describe how to calculate the implied losses derived from whole-loan subordinated spreads. Then we discuss their shape, and whether the shape differs from the distribution of historical losses. Finally, we take a close look at the factors in collateral characteristics, or in the economic environment, that drive the shape of implied loss distributions.

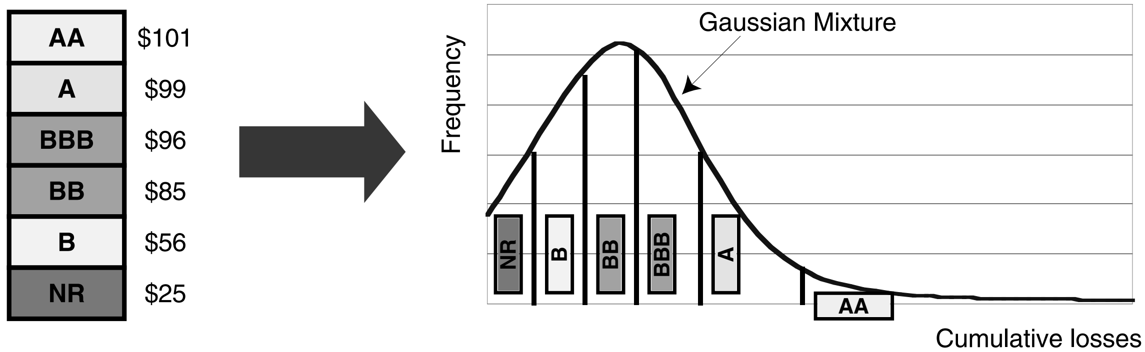
Calculating Implied Losses

We first take a sample of about 250 non-agency deals from major issuers (such as RFC, Wells Fargo, Countrywide) on which we have pricing information on all the subordinated bonds. We obtain information such as tranche size and credit support and some indicative information on the collateral (such as average FICO, LTV) from Bloomberg.

As Exhibit 7 illustrates, for each deal we fit a single loss distribution that reprices each tranche in the deal. In this process, we have to make some simplifying assumptions. We believe these assumptions do not distort our final results in any significant way.

- We assume that the distribution for cumulative losses follows a Gaussian mixture. This is essentially a combination of bell curves, and allows us to represent a wide variety of curves looking like the one in Exhibit 7.
- We assume that the value of the subordinated securities is a proportion of the value of a AAA NAS. If cumulative losses were higher than the tranche's size plus its original credit support, the value of the tranche is zero. If losses were lower than the tranche's credit support, its value is that of the NAS. If losses

E X H I B I T 7
Calculating Implied Losses



were somewhere in between, the subordinated bond's value is set to [(sub support + sub size – losses) / (sub size)] times the value of the NAS. We thus use only the size and support of the subordinated bonds to derive their value; we do not factor in structural nuances or differences in coupons.

- Finally, to be able to convert prices into spreads, we use average spread durations, depending on product type and collateral maturity. Divided by these spread durations, differences in price between a NAS and a subordinated bond give us spread differences.

The density function of a Gaussian mixture is a weighted sum of Gaussian densities. In other words, the density of a Gaussian mixture X can be written as:

$$P(X \in dx) = \sum_{i=1}^{n} \frac{\theta_i}{\sqrt{2\pi\sigma_i^2}} \exp\left(-\frac{(x-\mu_i)^2}{2\sigma_i^2}\right) dx$$

where the weights are all positive and sum to 1. Gaussian mixtures can be seen as random regime switches between Gaussian distributions. The specific Gaussian mixture we use is parameterized by six variables, so that we could exactly solve for the distribution that reprices each of the six subordinated bonds in a deal.

Why do we specifically choose a Gaussian mixture?

- First, it is important that the loss distribution curve be smooth (and the Gaussian mixture is smooth). If it were not smooth, and looked rather like a histogram (a piecewise constant curve), the value of subordinated tranches would suddenly jump as we tweak tranche size, and we do not believe this would be realistic behavior.
- The specification of the implied loss curve has to be flexible enough so that we can exactly fit the market values of six subordinated tranches; in other words, there must be at least six parameters.
- Finally, Gaussian distributions are universally used to represent random phenomena. Resorting to a Gaussian mixture instead of a simple Gaussian distribution allows us to model slightly more complex distributions.

Our assumptions let us avoid having to run a cash flow model for each one of the 1,500 securities we use in our calibrations. Naturally, it would be ideal to use all the available information to reprice the subordinated bonds. The loss of precision in the model is, we believe, well compensated by its simplicity. All the data and the calibration fit in a spreadsheet.

The reason we do not include subprime in our discussion is related to the assumptions above. On pure senior/sub structures, with no excess spread, we can generally assume that cumulative losses over the life of the deal translate directly into a principal loss on the subordinated bonds. This is the reason we feel it is not a bad assumption to price the subordinated bonds as a percentage of the value of a NAS—neglecting variations in the timing of losses.

On excess spread-based structures, prepayments have an impact on the amount of loss that is passed to the securities, which prevents us from using our simplifying assumptions. One way to put subprime, Alt-A, and jumbo credit securities on the same level in our analysis would be to use a full-fledged credit option-adjusted spread model, that is, a model combining interest rates and prepayment simulations with loss distributions.

Shape of Implied Losses

Exhibit 8 shows average implied losses depending on product type. Product differences show neatly in these charts. For jumbos in Exhibit 8-A, it turns out that the loss curve on 15-year paper is lower than on 30-year, as we would naturally expect. Relos (that is, loans made out to corporate employees as part of a relocation program) are somewhere between 30-year and 15-year jumbos.

Exhibit 8-B compares Alt-As and jumbos. Losses on 30-year Alt-A paper are higher than on jumbos. It looks like 15-year Alt-As are expected to generate smaller losses than 30-year jumbos, but note that there were few deals in the 15-year Alt-A category, so the data might not be strongly representative. The market-implied average loss was about 55 bp on 30-year jumbos, and 67 bp on Alt-As.

What do these implied losses actually represent? Let's compare them with historical losses. Quite simply, implied losses represent the market's perception of future collateral losses, and are naturally different from actual losses. Yet implied and historical losses are likely to be affected by similar factors. We know that FICO, LTV, and other collateral characteristics are important determinants of actual losses. When a deal is priced, market participants naturally use some of these historical relationships as inputs in their estimations of future losses—this creates a relationship between implied and actual losses.

Still, there is no reason why implied losses should be a good predictor of future actual losses. The market could simply be wrong in its assessment of future losses. In options markets, implied volatilities and historical volatilities evolve often in parallel, but few people use historical volatilities to price options.

That said, let us look at Exhibit 9. We gathered cumulative loss data on many whole-loan deals originated between 1993 and 1998. Earlier deals would have been biased by the underwriting debacle of the late 1980s and early 1990s, and more recent deals would not be seasoned enough for their cumulative losses to be representative. The shapes of the historical loss distributions in Exhibit 9 seem very similar to implied losses. Overall, the average loss on 30-year jumbo deals was 20 bp, versus 35 bp on Alt-As.

Note that these are about half the average implied losses we mentioned above. In fact, it makes sense that market-implied losses should be higher than historical experience. Indeed, this difference corresponds to the risk premium.

As we noted earlier, there is no need to adjust the projection from the implied loss model using a risk premium, because the model exactly reprices the bonds used as benchmarks. If we used historical loss distributions to estimate the value of the bonds, their values would be higher than their market prices. The implied loss is therefore on average higher than historical losses, so that the valuation of the subordinated bonds using the model corresponds to actual prices. Financial theorists would say that historical loss distributions are specified under the real probability, while implied loss distributions are specified under the risk-neutral probability.

Let us summarize our situation here. We have fitted about 250 implied loss curves (one for each deal), each one of these curves consistent with the spreads on the six subordinated bonds in each deal. Within a given deal, we can therefore value the impact of changing a tranche's size or shape. Beyond research purposes, however, this is not that useful. What we need is a way to relate collateral characteristics to the shape of the implied loss curve. Then, given a new issue deal's collateral characteristics and tranche sizes, we will be able to project the spreads on the subordinated bonds in a way that is consistent with our benchmark deal prices.

Factors Driving Implied Losses

By understanding what factors affect implied loss distributions, we can hope to model them, and tackle the analysis of relative value. This is akin to finding the statistical drivers of implied volatility, in an effort to measure relative value in options markets.

First, it is useful to see how average implied losses have evolved over time. Exhibit 10 shows this evolution for various issuers for jumbos and Alt-As. Implied losses have been trending down over time. Implied losses on RFC were in general smoother than those on other issuers, reflecting a more stable evolution of credit enhancement levels and collateral quality.

Why have implied losses trended down? This reflects the decline in enhancement levels, combined with tighter spreads, both on jumbo and Alt-A. We note that implied losses on Alt-A moved from 1.0% to 0.6%, versus 0.5% to 0.2% on jumbos. Relatively speaking, implied losses therefore declined more on jumbos than on Alt-As.

We can actually explain these evolutions, thanks to changes in deal characteristics. As we commented earlier, FICOs and LTVs have improved since 1999–2000. Exhibit 11 shows a scatterplot of average implied losses as a function of the average LTV on each deal's collateral. It turns out that LTV has a strong impact on implied losses. For

EXHIBIT 8-A
Average Implied Loss Curves by Product (Jumbos)

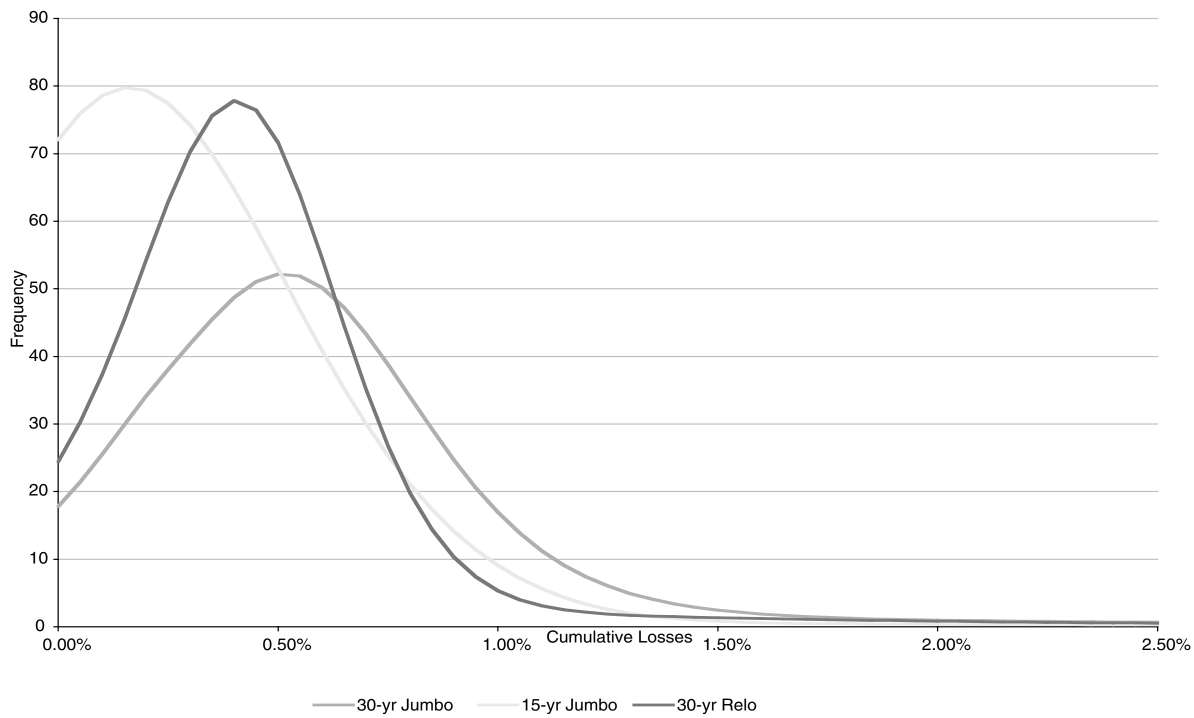


EXHIBIT 8-B
Average Implied Loss Curves by Product (Alt-As)

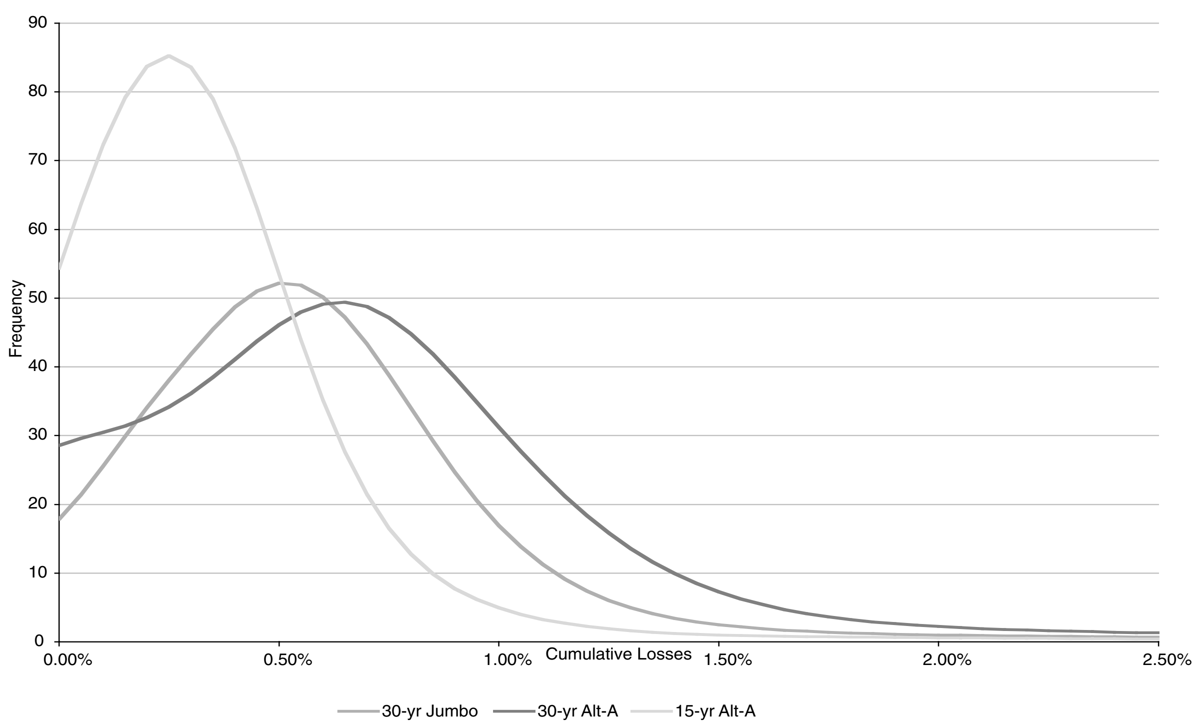
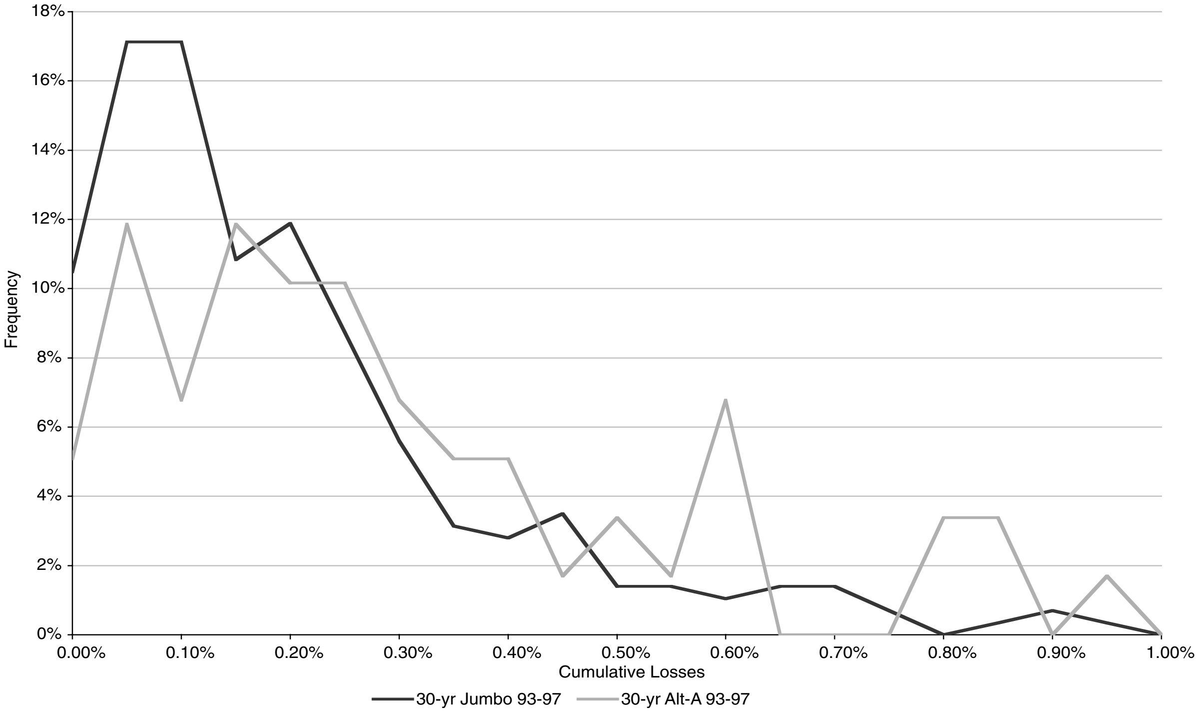


EXHIBIT 9
Distribution of Actual Losses on Jumbo and Alt-A



average LTVs above 75%, the average implied loss rises quickly from 0.6% to more than 1.0%, while the relationship is flatter on lower LTVs. The datapoints for jumbos and Alt-As are fairly well aligned in Exhibit 11, which suggests that the market-implied differences in credit risk between Alt-A and jumbo are due mainly to differences in LTV.

What about FICO scores? As Exhibit 12 illustrates, a higher FICO clearly translates into lower implied losses. For the same FICO score, the implied loss on Alt-A is significantly higher than on jumbos (for a FICO around 720, we have 70 bp on Alt-As versus 50 bp on jumbos). The difference mostly reflects the higher LTV on Alt-A paper.

The evolution of interest rates plays an important role in the valuation of non-agency subordinated bonds. As rates rally, refinancings soar and the deal deleverages quickly. Would it not make sense, then, to observe lower implied losses in lower interest rate environments?

Exhibit 13 shows the relationship between average implied losses and the ten-year Treasury yield. Apart from a few outliers, there is a slight relationship, in that implied losses are higher in higher-rate environments (but we do not believe this relationship is significant):

- New issue paper is at or near the money. The level of rates should therefore not affect new issue paper, but only seasoned subordinated bonds.
- Over the past few years, collateral characteristics have evolved very much in line with interest rates. As rates were rallying, originators could be more picky, and loan characteristics improved, leading to lower implied losses. At the end of the day, running a regression that incorporates loan characteristics and interest rates tells us that rates play no significant role in average implied losses.

Does size matter? The granularity in a deal's collateral is often considered to be a risk factor. In a $50 million jumbo deal (about 100 loans of $500,000 each), just one default with a 20% severity would wipe out the first-loss piece. In a $1 billion deal, on the other hand, the event risk is more limited.

Exhibit 14 shows a scatterplot relating implied losses and the number of loans in a deal. It does not look as if there is any significant relationship. In fact, in a full multivariate regression the number of loans does not emerge as significant.

What does this mean? Probably that most players in the whole-loan market maintain portfolios that are large enough to be diversified, and therefore to be relatively insensitive to single default risk. The issuer does not seem

EXHIBIT 10-A
Evolution of Average Implied Loss on Alt-A Paper

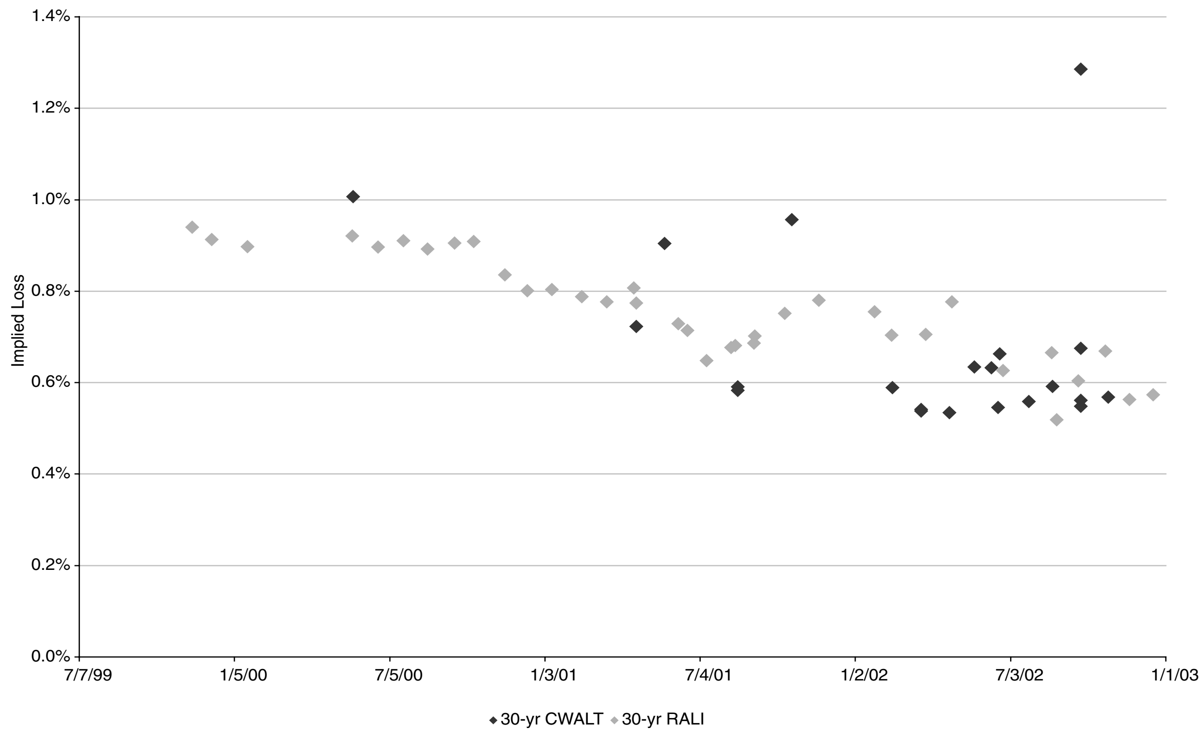


EXHIBIT 10-B
Evolution of Average Implied Loss on Jumbo Paper

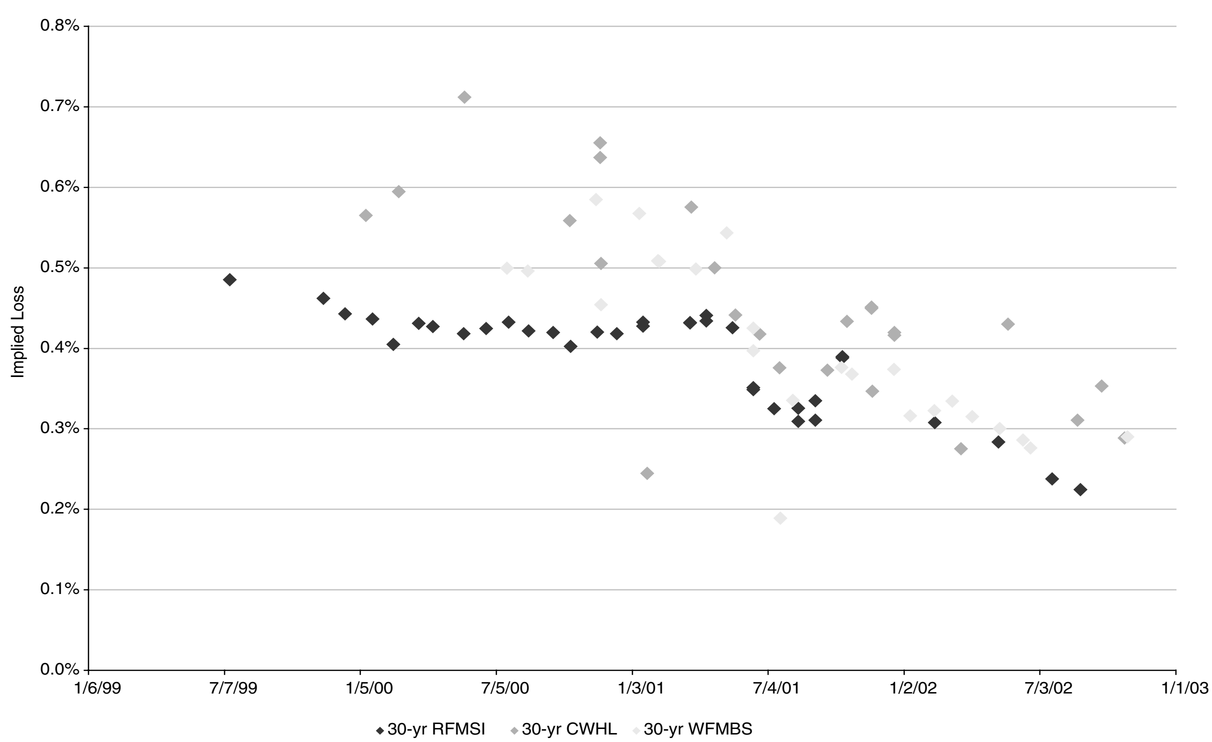


EXHIBIT 11
Average Implied Loss versus LTV on 30-Year Paper

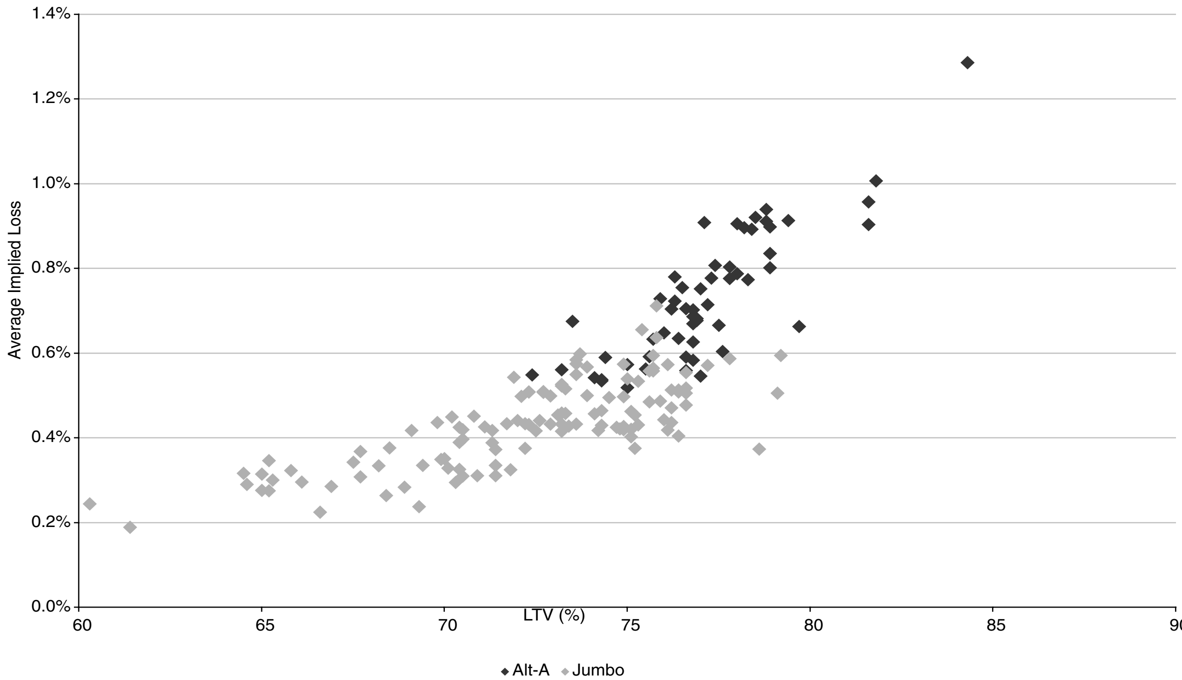


EXHIBIT 12
Average Implied Loss versus FICO on 30-Year Paper

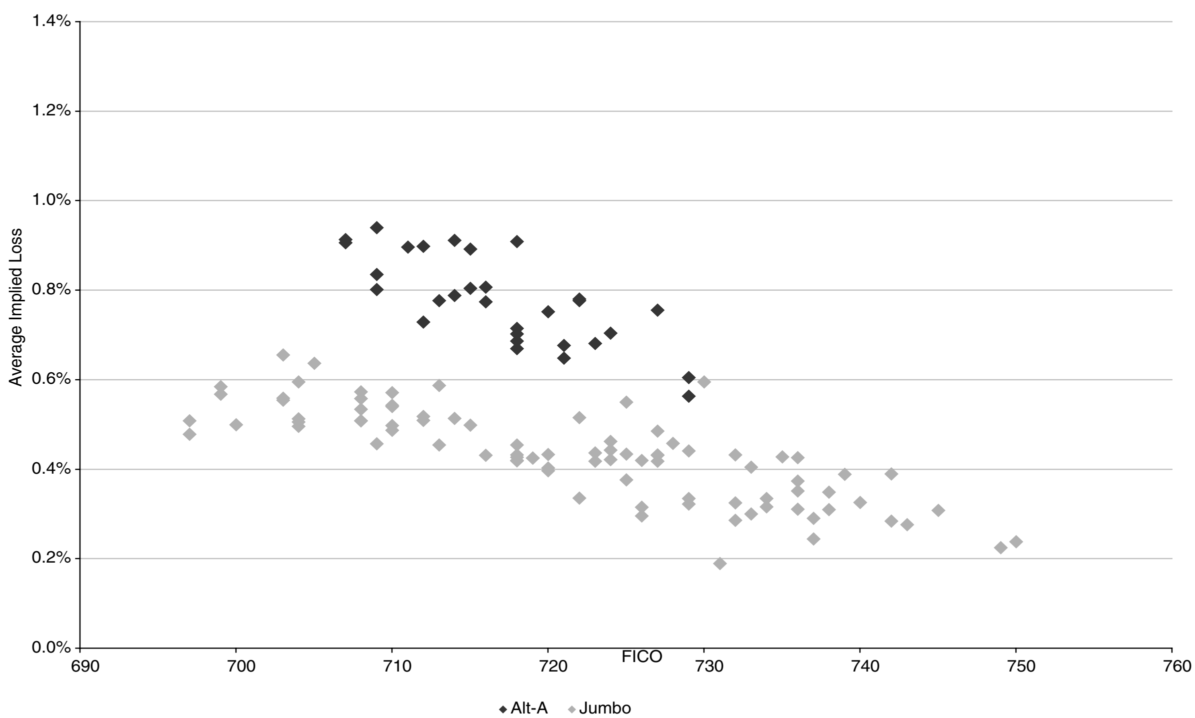


EXHIBIT 13

Average Implied Loss versus 10-Year Treasury Yield on 30-Year Paper

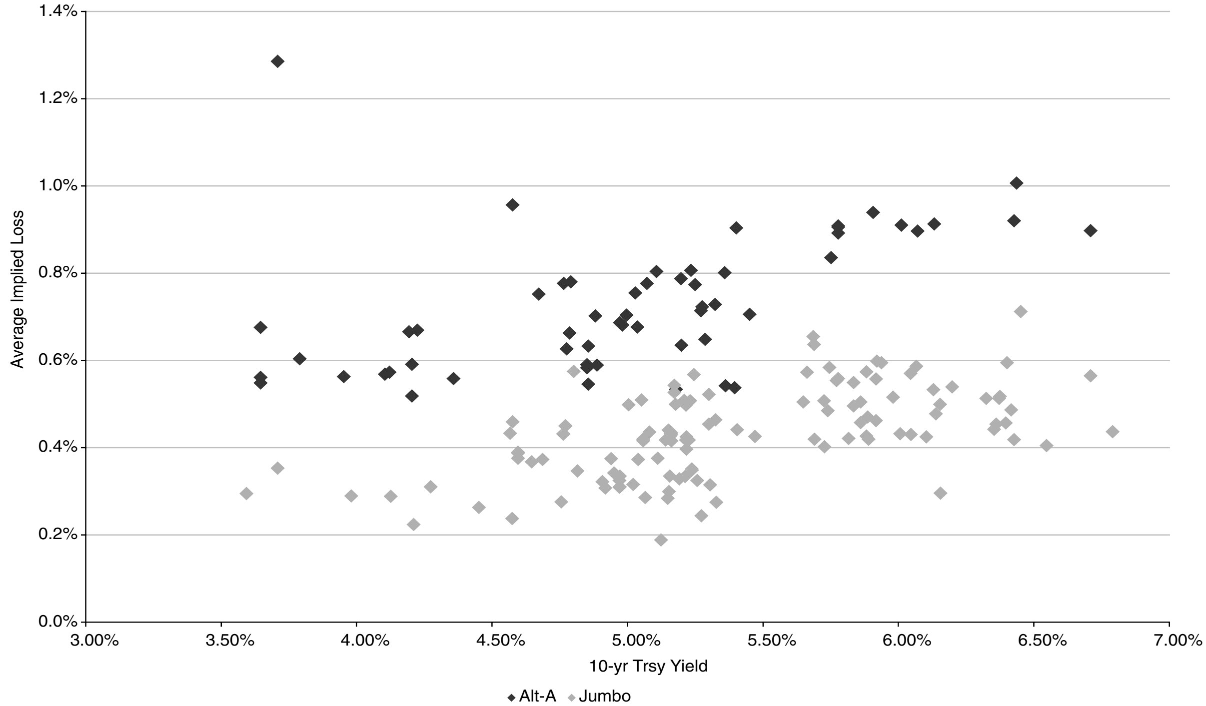


EXHIBIT 14

Average Implied Loss versus Number of Loans on 30-Year Paper

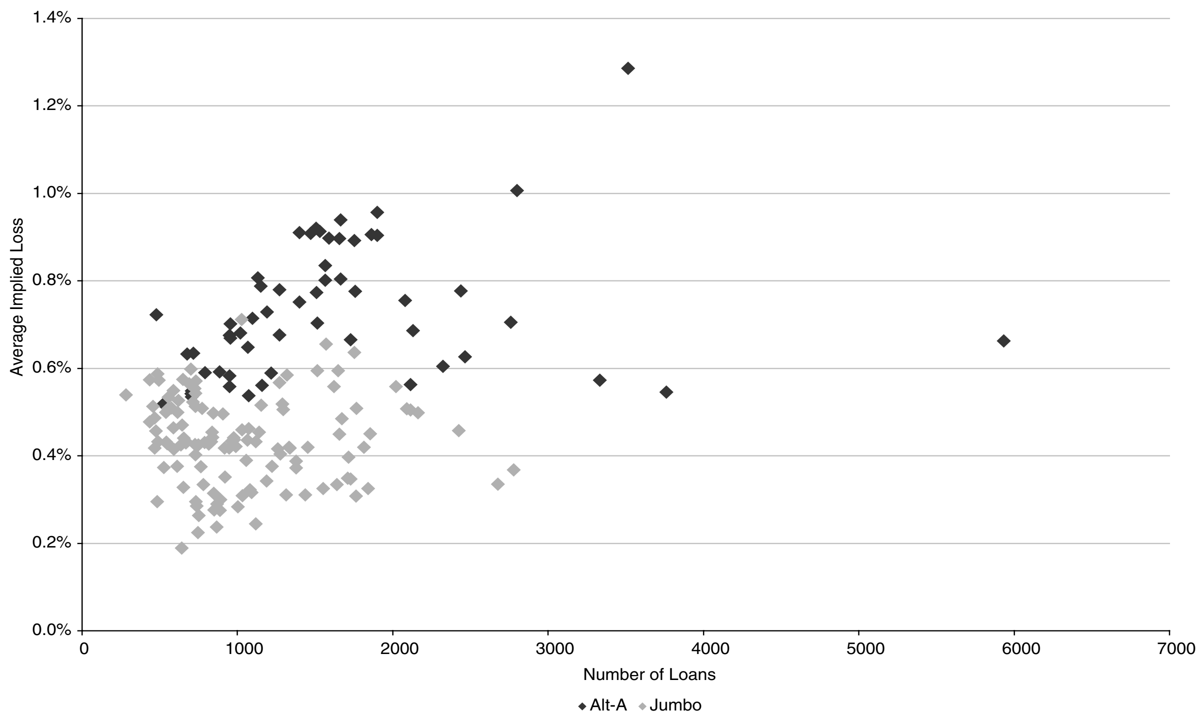


EXHIBIT 15
Projected versus Actual on Average Implied Loss Regression

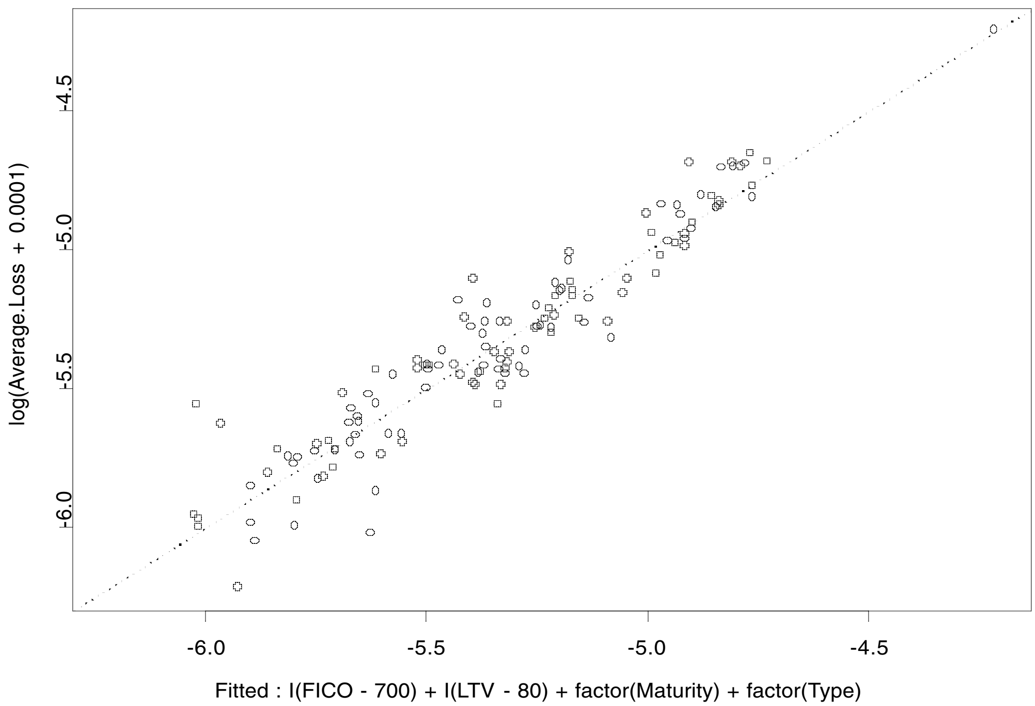


EXHIBIT 16
Parameters of Average Implied Loss Regression

Category	Parameter	Value	Std. Error	t value
Intercept		-4.96	0.054	-92.1
FICO	**(FICO – 700)**	-0.00846	0.00117	-7.2
LTV	**(LTV – 80)**	0.0366	0.004	9.1
Maturity	**15-yr**	0	-	-
	30-yr	0.317	0.049	6.4
	Combo	0.272	0.097	2.8
Type	**Alt-A**	0	-	-
	Alt-A Jumbo	0.237	0.128	1.9
	Jumbo	-0.336	0.03	-11.3
	Relo	-0.635	0.058	-11

to play any role once FICO, LTV, product type, and maturity are included in the analysis, so we do not use the issuer as an explanatory variable.

Using inputs such as average FICO score, average LTV, product type, and maturity in a simple linear regression, we find we could explain more than 90% of the variations in average implied losses. Exhibit 15 shows a plot of this regression (actual versus projected).

Implied loss distributions are defined by more than just an average. We actually use six different parameters to model the shape of the Gaussian mixture distributions. Given our observations on what drives implied losses, we develop a regression model relating collateral characteristics to each one of the six parameters driving implied losses. We do not show the results here for reasons of space, but the main ideas in the regression are captured by analysis of just the average of implied losses.

The model that generates the results shown in Exhibit 15 is a multiplicative model. We apply a linear regression to the logarithm of implied losses, so that the projected average implied loss is the exponential of a sum of linear terms. Exhibit 16 shows the regression parameters. Note that the coefficient for relo mortgages is minus 0.635, versus minus 0.336 for straight jumbos. The difference between both coefficients is about 0.3. Consequently, implied losses on relos are on average 30% lower than on jumbos, everything else equal.

IV. RELATIVE VALUE AND STRUCTURAL INSIGHTS FROM IMPLIED LOSSES

With implied losses for past deals and a statistical model to explain what affected these implied losses, we can perform a wealth of interesting analyses. We first discuss pure relative value insights. Then, we concentrate on the effect of collateral quality on spreads. Finally, we focus on the importance of the structure, more specifically tranche size.

Relative Value Analysis

How can we now perform relative value analysis? And what do we mean by relative value?

For each deal or each tranche, the residual of the implied loss regression will give us a relative value signal. For example, if the residual is positive, implied losses on this deal are higher than the regression would project according to collateral characteristics. As a result, this deal's pricing is pessimistic, in other words a *cheap* signal. Now, this relative value conclusion is valid within whole loans; it does not mean anything for other asset classes. Since the average of the residuals is zero, this means that the 250 deals we track, as a whole, are exactly fairly priced.

So our value conclusions are to be understood relative to where whole loans have traded over the past few years.

Exhibits 17-A and 17-B show a relative value analysis of 30-year Alt-As and jumbos, based on average implied losses. Jumbos have been oscillating between rich and cheap over time. They are now about fair, and have richened since the beginning of 2002. Alt-A valuations appeared rich at the end of summer 2001, then cheapened after September 11, and have since richened. Overall, Alt-As are slightly rich.

Note that the average residual on jumbos is slightly negative, and it is slightly positive on Alt-As. In other words, Alt-As have been historically intrinsically slightly cheap, but richened recently.

We can actually drill further down with the model, and look at relative value at the tranche level. Using our regressions for the six parameters of implied losses, we compare the actual spread on past deals to projected spreads, based on the regression and implied loss calculations. The results are shown in Exhibits 18-A–18-C (for investment-grade subordinated bonds) and 19-A–19-C (for non-investment-grade subordinated bonds).

Focusing first on Exhibit 18, we find that Alt-As have recently become richer, but were historically cheaper than jumbos. In summer 2001, both jumbos and Alt-As became richer, and then cheapened after September 11.

As we move into the more leveraged tranches (shown in Exhibit 19), we note that relative cheapness/richness is much more volatile, which makes it difficult to measure relative value just by looking at a plot. We then calculate the Z-scores of recent pricing levels (early January 2003) based on the data in Exhibits 18 and 19. The results are in Exhibit 20.

It turns out that Alt-A paper is on the rich side, in particular, the AAs, As, and BBBs. Non-investment-grade subordinated bonds appear fair-to-rich. 30-year jumbos are about fair across ratings, while 15-year jumbos are slightly cheap; 15-year first loss pieces stand out as cheap. The enhancement levels on 15-year paper are so low (10 basis points first-loss) that there is very little volume out there—so while they might look very cheap, you will have a tough time finding them in size.

What explains the relative richness of Alt-As? Credit enhancement levels have strongly declined on this paper, while spreads have tightened. While collateral quality on Alt-A has improved, it is not by as much as on jumbos.

Impact of Collateral Quality

With our market-implied loss model, we can actually do a lot more than relative value analysis. We can analyze what happens when we tweak some of the many moving parts in a deal: collateral characteristics (FICO, LTV) or structure (tranche size, amount of support).

Let's start with credit scores. Exhibit 21 shows projected spreads on 30-year jumbo new issue B- and BB-rated bonds as a function of FICO score. Note that the rating here applies to the normal range. If average FICO were much lower, these bonds would probably not be rated B or BB any longer. Keeping everything else equal, it turns out that FICO plays a fairly strong role in the fair value of these subordinated bonds. A 10-point difference in FICO, keeping the size of the subordinated bonds the same, is worth over 100 bp on the BBs, according to the model.

We can perform a similar analysis with LTVs. Exhibit 22 shows the impact of LTV on 30-year jumbo spreads, keeping everything else the same (and here again the ratings refer to the normal situation, not the tweaked one). Unsurprisingly, we see that the most junior tranches are the most exposed. Investment-grade bonds, on the other hand, are fairly insensitive to changes in LTV below 70%.

The relationship between fair spreads and LTV actually allows us to proxy for the effect of a drop in the market's perception of future home price performance. Indeed, market-implied losses reflect some perception of future home prices. We cannot quantify this market-implied home price performance, but nothing prevents us from making a few assumptions.

Let us say that today's 30-year spread levels reflect a market perception that home prices will keep on growing

EXHIBIT 17-A
Evolution of Regression Residual on 30-Year Jumbos

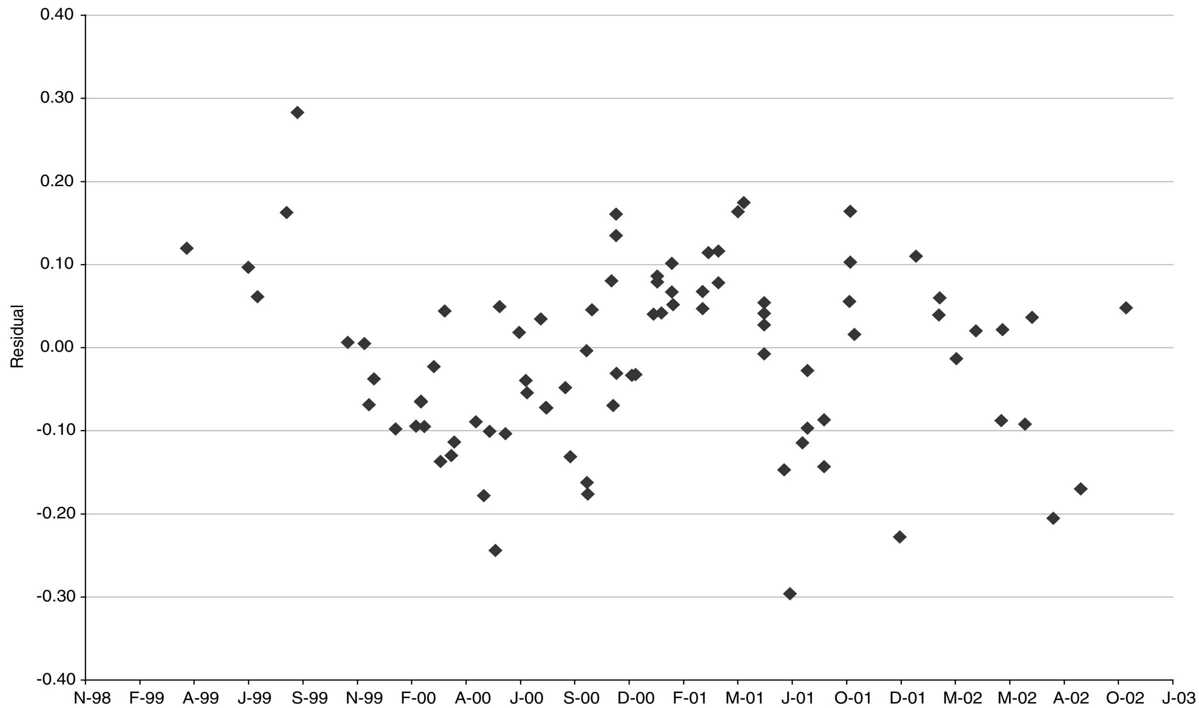


EXHIBIT 17-B
Evolution of Regression Residual on 30-Year Alt-As

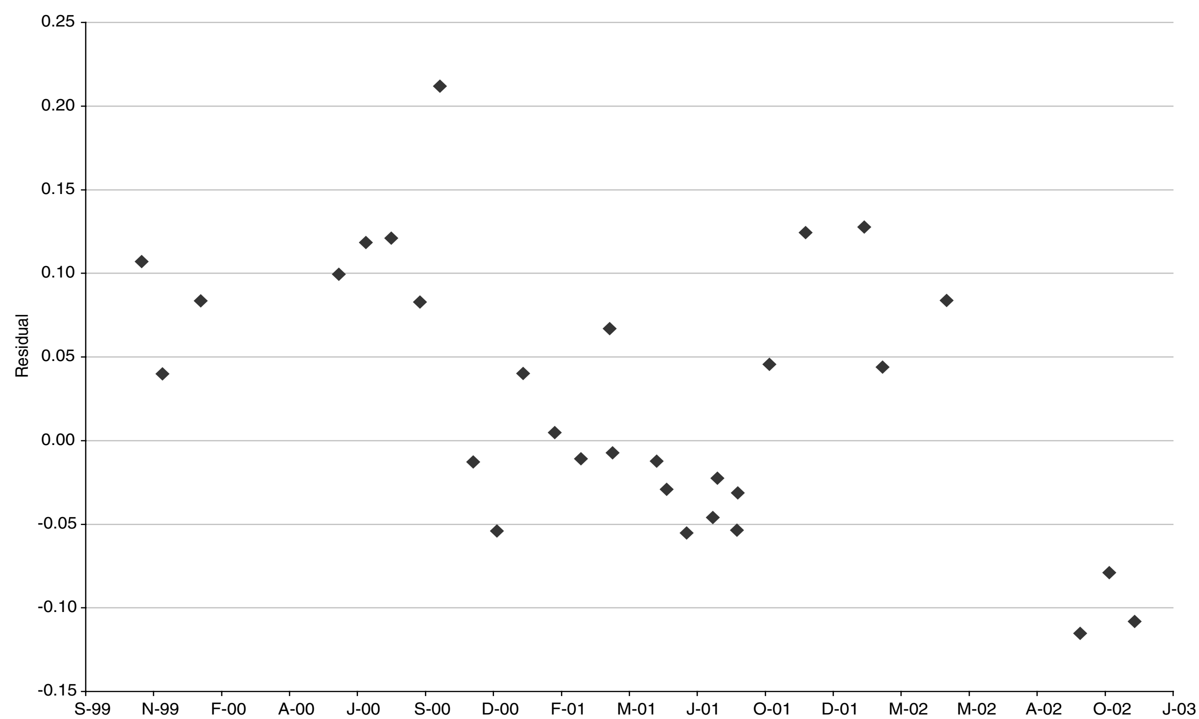


EXHIBIT 18-A
Rich/Cheap Analysis of AAs

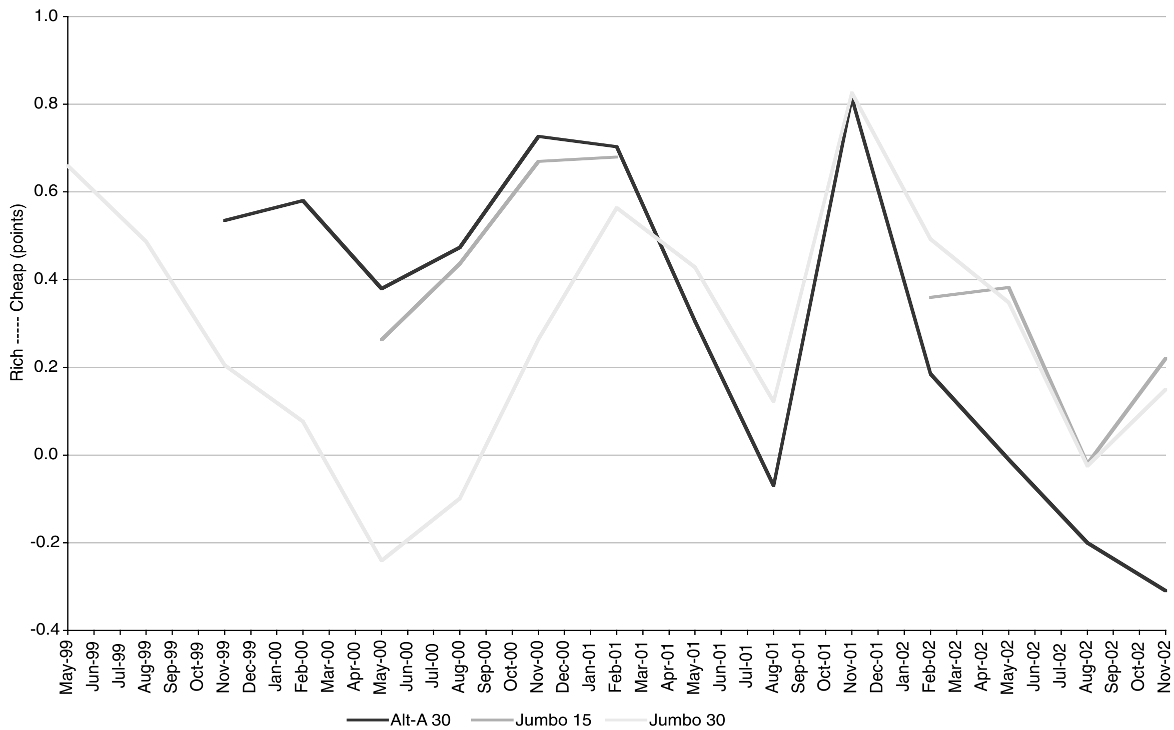


EXHIBIT 18-B
Rich/Cheap Analysis of As

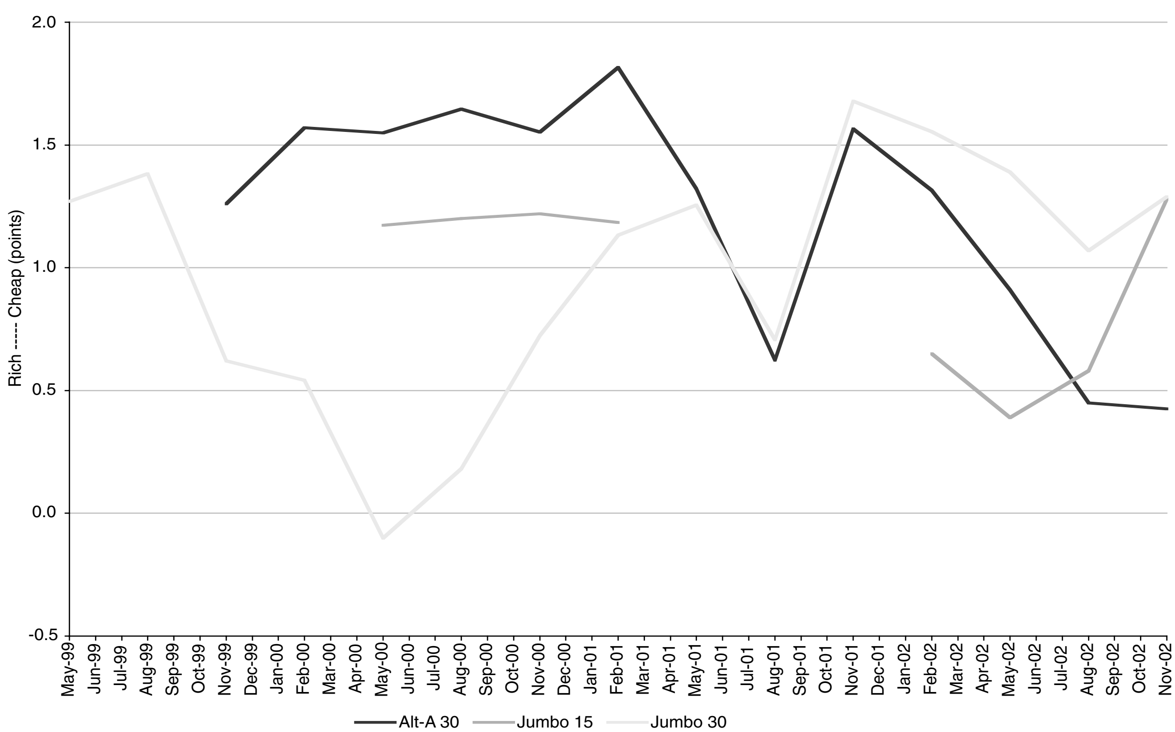


EXHIBIT 18-C
Rich/Cheap Analysis of BBBs

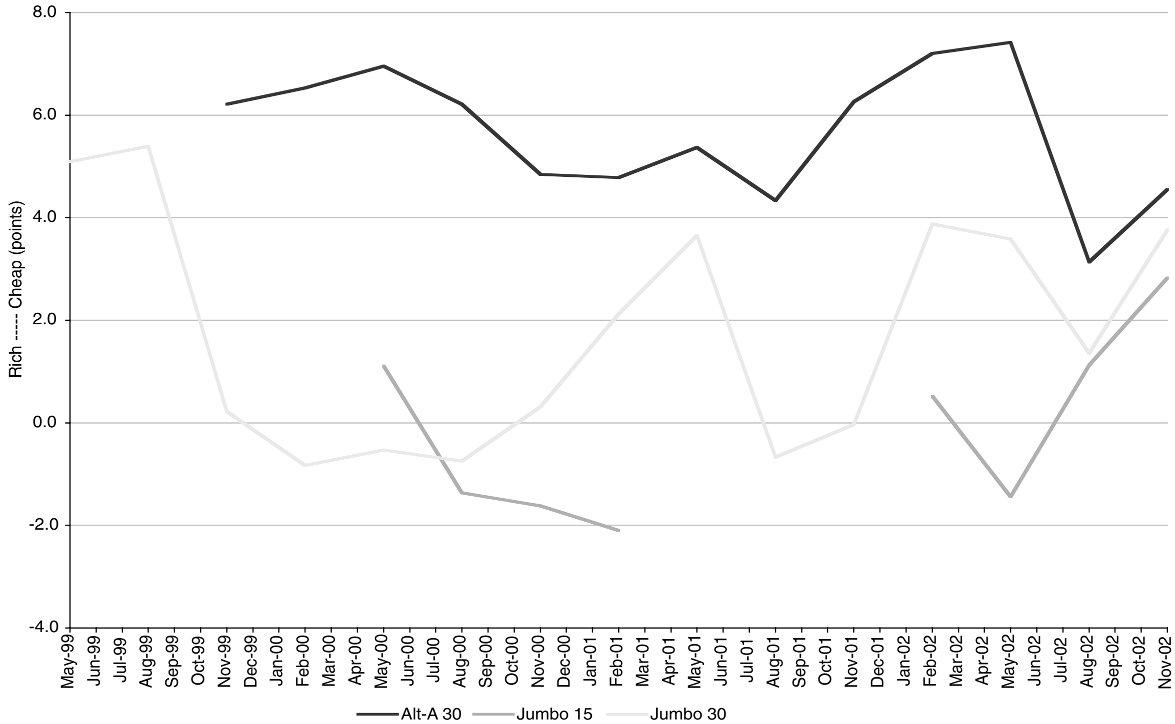


EXHIBIT 19-A
Rich/Cheap Analysis of BBs

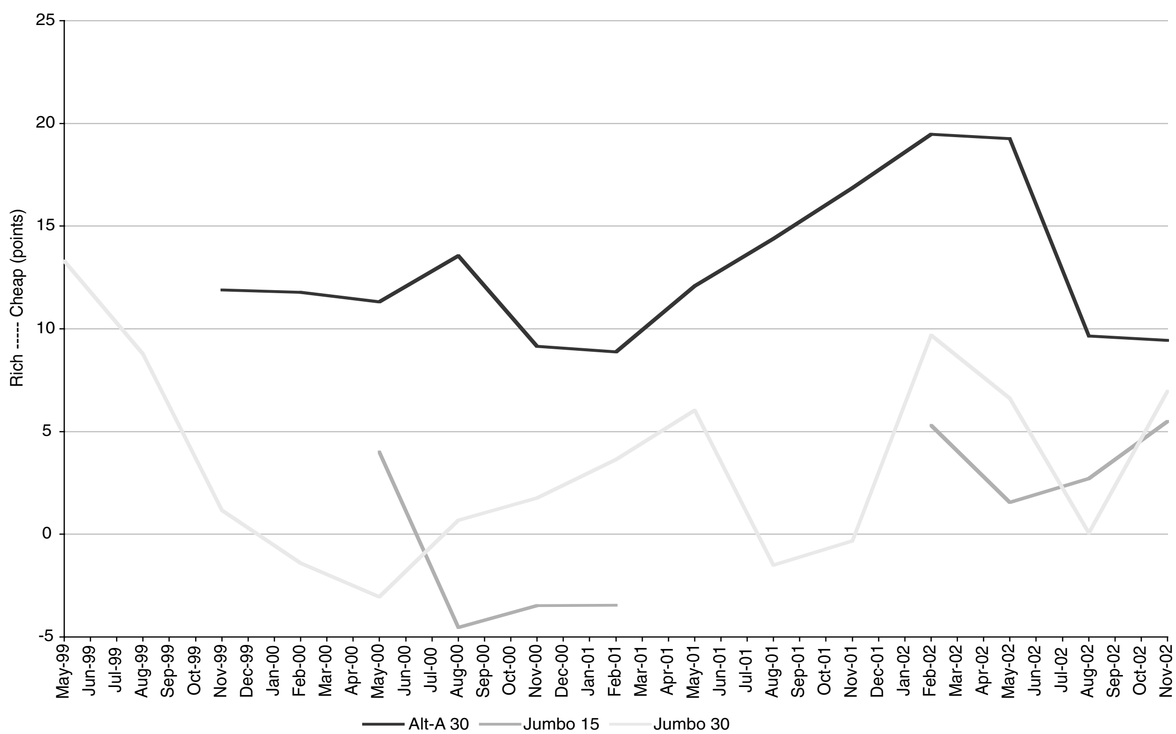


EXHIBIT 19-B
Rich/Cheap Analysis of Bs

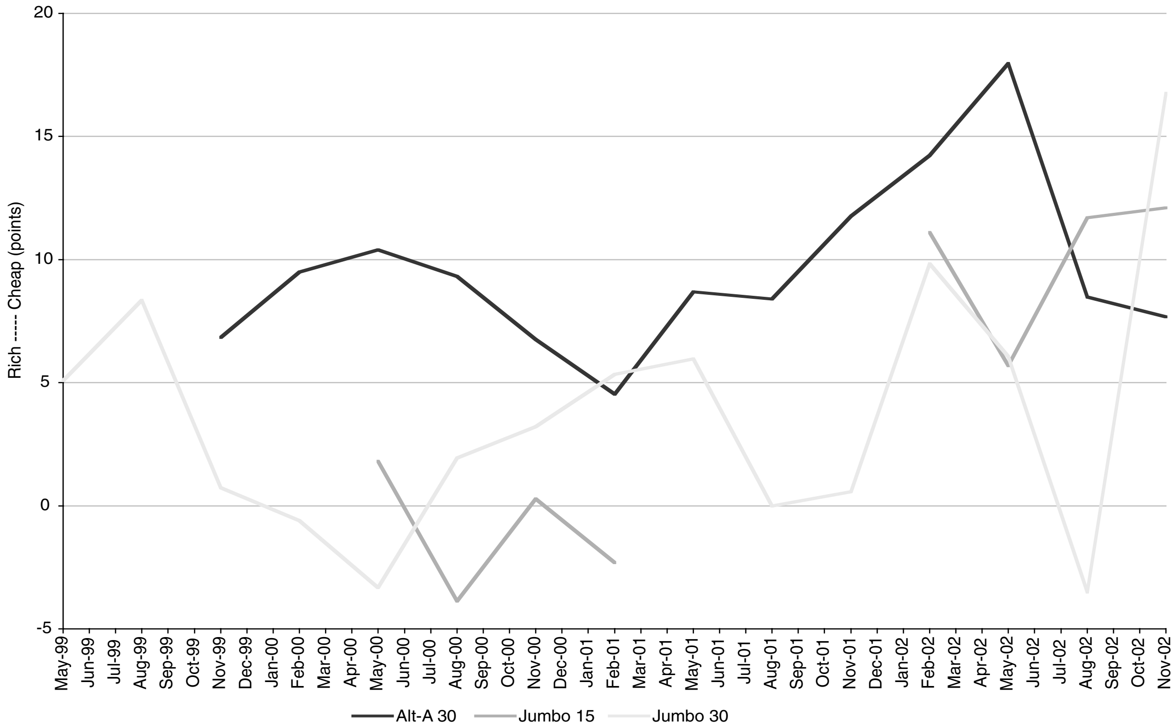


EXHIBIT 19-C
Rich/Cheap Analysis of Non-Rated Tranche

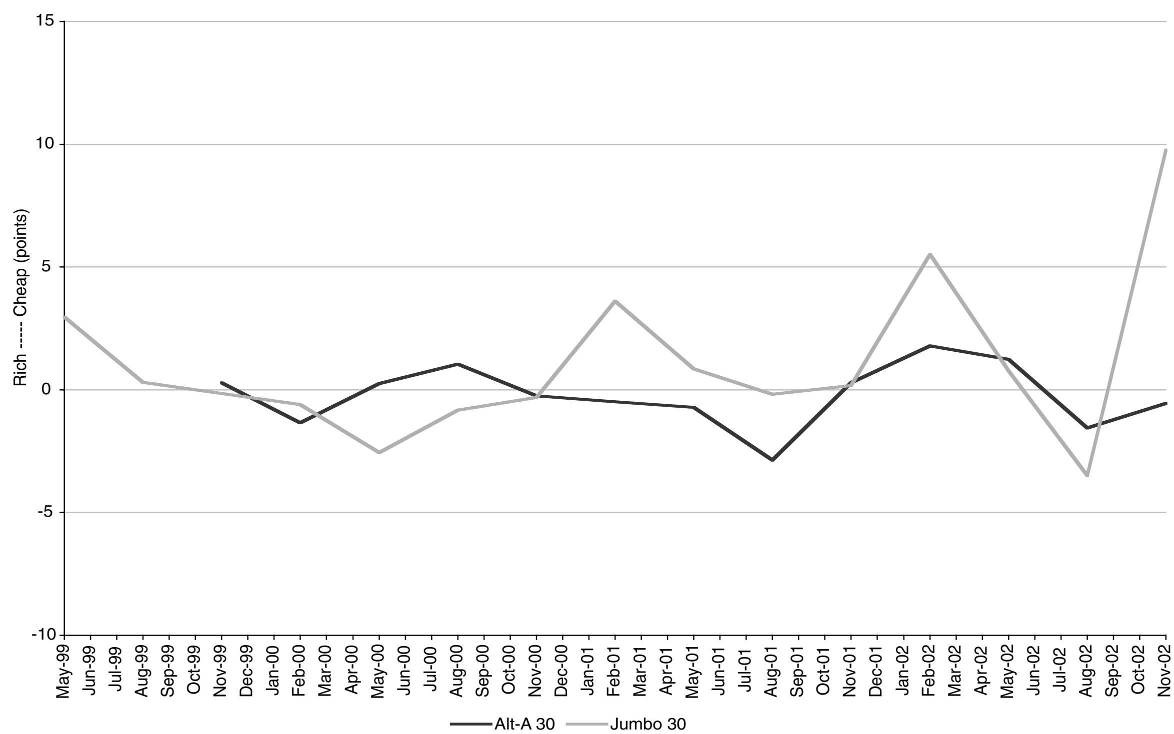


EXHIBIT 20
Z-Scores of Implied Loss-Based Relative Cheapness

	Alt-A	15-Yr Jumbo	30-Yr Jumbo
AA	-1.5	-1.1	-0.7
A	-1.7	0.1	0.4
BBB	-1.4	0.6	0.3
BB	-0.9	0.3	0.0
B	-0.4	0.9	0.5
NR	-0.7	1.4	0.6
Package	-1.4	1.1	0.3

EXHIBIT 21
Impact of FICO on Model Spreads

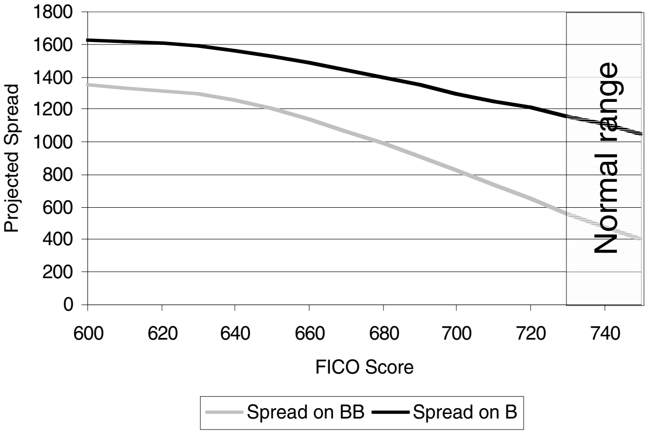


EXHIBIT 22
Impact of LTV on Model Spreads

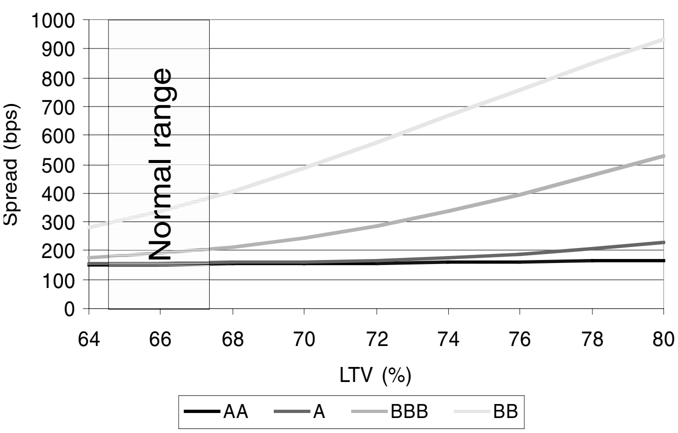


EXHIBIT 23
Impact of Home Price Growth Drop on Jumbo Spreads

	AA	A	BBB	BB	B	NR ($)
Market up	154	160	215	406	1000	25
Market flat	170	257	568	985	1615	12

EXHIBIT 24
Widening Ratio of Market Flat to Market Up

	AA	A	BBB	BB	B	NR ($)
Jumbo	1.1	1.6	2.6	2.4	1.6	2.2
Alt-A	1.2	1.3	2.0	1.9	1.4	2.1

over the next few years—by a total of 20% over the next five years, a slight slowdown compared to what we've seen since the mid-1990s. If there were new elements that led the market to believe that the 20% does not apply any more, and that it should instead be 0%, what would happen? This is a fairly strong stress scenario, but it is useful to try to proxy its impact.

Now, if a new deal comes with a 66% LTV, shifting the home value appreciation expectation from 20% to 0% means raising the LTV to 80% (a 20% relative increase), keeping everything else the same. Using the relationship we illustrate in Exhibit 22, we can project what could theoretically happen to jumbo spreads if the market suddenly priced in a 20% lower home price growth. The result can be seen in Exhibit 23.

In this stress scenario, the spreads on all tranches below AA are significantly affected. First-loss pieces are halved, dropping to a little over 10 cents on the dollar. Overall, the effect is as if all these tranches were downgraded by a couple of notches.

What is the meaning of this? Given the way the market has historically priced differences in LTV across jumbos, but also across Alt-As, the relative increase in LTV due to a negative home price outlook would have a very strong impact.

It can be argued that lower collateral credit quality should in fact provide more protection against a negative evolution in home prices. In a nutshell, loss severities are so high on subprime that even if they increase 20% in absolute terms (to reflect a drop of 20% in the home value appreciation at the time of default), this represents only 50% in relative terms. Yet loss severities on jumbos could go from 15% to 35%—more than double. Alt-A is somewhere between subprime and jumbo, and should therefore offer more protection than jumbo paper. How does this fit with our market-implied model?

To find out, we run the same analysis as in Exhibit 23 for Alt-A paper, and compare it to our results for jumbos. Exhibit 24 shows what we call the widening ratio; that is, by how much projected spreads are wider in the stress scenario than the current levels. It turns out that Alt-As widen a lot less than jumbos, therefore pro-

EXHIBIT 25
Effect of Subordination on Spreads

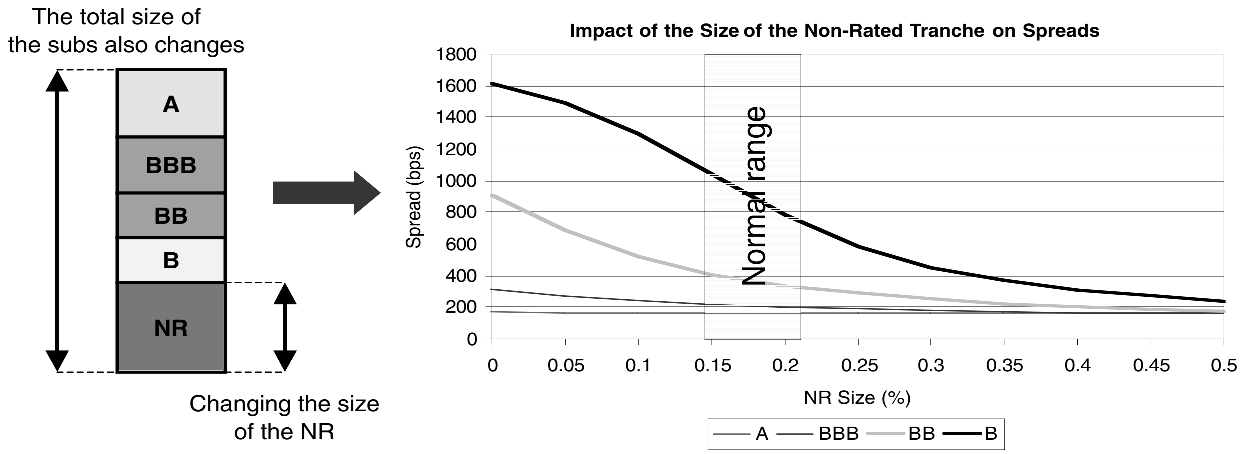
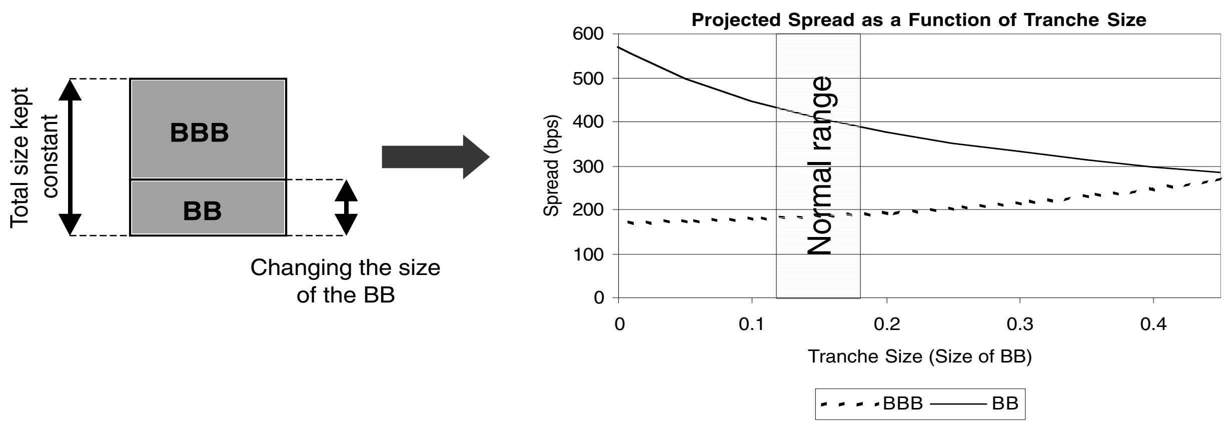


EXHIBIT 26
Effect of Tranche Size



viding this additional protection that we were expecting based on loss severity.

Now, our market-implied loss model does not say anything about loss severities or even the housing market, so how do we find this result in the end? In fact, it just reflects that in the way Alt-A deals are priced as a function of LTV (all else equal), a higher LTV is not punished as much as in jumbos.

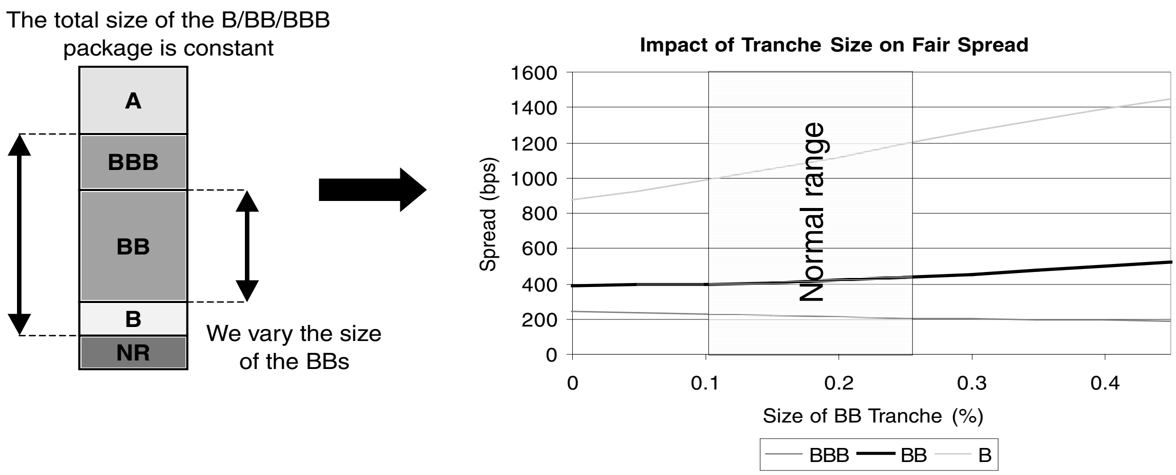
Impact of Structure

How do tranche size and support affect the fair value of spreads on whole-loan subordinated bonds? Exhibit 25 shows the effect of changing the size of the first-loss piece in a jumbo deal, all else equal. Small variations in the size of the non-rated piece can significantly affect the value of the Bs and BBs. The bonds higher up in the waterfall are not strongly affected.

One of the most difficult aspects of valuing a mortgage subordinated bond is to put a price on the thickness of the tranche. In Exhibit 26, we look at how changing the size of BB and BBB bonds (keeping the total size of BBs and BBBs constant) would affect fair spreads. In this case, it appears that thickness has a strong impact on valuations. The BBs would widen from about 400 bp to about 600 bp if thickness shrinks from 15 bp to zero. Expanding thickness from 15 bp to 25 bp tightens the spread from 400 bp to 350 bp.

When we change the size in this example, note that the average support of the tranche (its middle, basically) moves up or down. As the BB gets bigger, the effect of losses is diluted, and therefore its spread tightens. BBB

E X H I B I T 2 7
Effect of Tranche Thickness



size gets smaller as the size of the BB increases, but its probability of being hit by a loss also declines. All in all, its fair value increases.

Another way to look at the effect of tranche size is to change the size of a tranche, but keep it centered at the same place. In a last example, we change the size of the BB, but we also change the B and the BBB so that the average support of the BB remains the same. Exhibit 27 presents the results.

We see that the spread on BB widens; as its size increases, it becomes more likely to be hit by a loss (a negative), and at the same time its greater size dilutes the effect of losses (a positive). All in all, the negative effect dominates. An interesting result is also that if the size of the BB becomes very small, its fair value does not change significantly compared to the normal situation.

V. CONCLUSION

We have presented a new way to look at relative value in whole-loan subordinated bonds. This innovative method overcomes several of the recurring issues in mortgage credit—such as how to compare subordinated bonds across credit, collateral type, and tranche sizes. We can develop a simple method based on implied losses, because the jumbo and the Alt-A subordinated bond markets have benefited from a high degree of structural standardization in the past several years.

To order reprints of this article, please contact Ajani Malik at amalik@iijournals.com or 212-224-3205.