

The Prepayment Behavior of Credit- Impaired Borrowers

- Our pool-level study of the prepayment behavior of credit-impaired versus normal borrowers in the 30-year fixed rate sector analyzes the prepayment patterns of 1994 and 1995 origination GNMA and FNMA premium pass-throughs during 1995 and 1996.
- We identify as credit impaired pools that are originated at a WAC substantially higher than the prevailing mortgage rate. These pools are termed high spread at origination (high SATO) pools.
- Credit-impaired pools prepaid as much as 17% CPR lower than normal pools in recent refinancing episodes. The lower callability of such pools makes them more valuable from an investor's perspective. We estimate that credit-impaired pools could command fair value pay-ups of 40 ticks over normal pools.

October 1997

Amitabh Arora 212-526-5751
Sanjeev Jain 212-526-6760
Prafulla Nabar 212-526-9251

The authors thank Akiva Dickstein, Ravi Mattu, and Andy Sparks for their many helpful comments.

Publications: M. Parker, D. Marion, V. Gladwin, A. DiTizio, C. Triggiani, B. Davenport, J. Doyle

This document is for information purposes only. No part of this document may be reproduced in any manner without the written permission of Lehman Brothers Inc. Under no circumstances should it be used or considered as an offer to sell or a solicitation of any offer to buy the securities or other instruments mentioned in it. The information in this document has been obtained from sources believed reliable, but we do not represent that it is accurate or complete and it should not be relied upon as such. Opinions expressed herein are subject to change without notice. The products mentioned in this document may not be eligible for sale in some states or countries, nor suitable for all types of investors; their value and the income they produce may fluctuate and/or be adversely affected by exchange rates.

Lehman Brothers Inc. and/or its affiliated companies may make a market or deal as principal in the securities mentioned in this document or in options or other derivative instruments based thereon. In addition, Lehman Brothers Inc., its affiliated companies, shareholders, directors, officers and/or employees, may from time to time have long or short positions in such securities or in options, futures or other derivative instruments based thereon. One or more directors, officers and/or employees of Lehman Brothers Inc. or its affiliated companies may be a director of the issuer of the securities mentioned in this document. Lehman Brothers Inc. or its predecessors and/or its affiliated companies may have managed or co-managed a public offering of or acted as initial purchaser or placement agent for a private placement of any of the securities of any issuer mentioned in this document within the last three years, or may, from time to time perform investment banking or other services for, or solicit investment banking or other business from any company mentioned in this document. ©1997 Lehman Brothers Inc. All rights reserved. Member SIPC.

THE PREPAYMENT BEHAVIOR OF CREDIT-IMPAIRED BORROWERS

Credit-impaired borrowers are widely known to exhibit muted refinancing sensitivity. For example, a seasoned burned out mortgage pool, that relatively better borrowers have refinanced out of, is understood to be less callable and to command a pay-up over otherwise similar unseasoned pools. But what if it were possible to identify, *at issuance*, pools with a higher than average proportion of credit-impaired borrowers? Such pools, from the outset, should be less callable than average and be worth more than normal pools of the same coupon and vintage. We provide a methodology for identifying these pools and computing their fair pay-ups over normal pools. **Our analysis shows that credit-impaired pools have prepaid as much as 17% CPR slower than normal pools in recent refinancing episodes and that the fair pay-up over normal pools could be as much as 40 ticks.** Our methodology can be used to measure the proportion of credit-impaired borrowers within a coupon-issue year aggregate and to develop appropriate prepayment and relative value views for such aggregates.

INTRODUCTION

The Lehman Brothers Mortgage Strategies group has long emphasized that mortgage pools backed by credit-impaired borrowers have less refinancing sensitivity than average pools.¹ Credit-impaired borrowers typically take out high loan-to-value (LTV) mortgages. Unless home prices increase significantly, these borrowers are less attractive as candidates for refinancing from the perspective of mortgage originators. Furthermore, these borrowers are more likely to have an imperfect payment record on their mortgage installments, which also affects their eligibility for refinancing. For instance, for FNMA and FHLMC fixed rate programs, any 30-day delinquency in the prior 12 months disqualifies a borrower for streamlined refinancing under the same program. Such borrowers are often liquidity constrained and may be unable to meet the up-front refinancing costs. In addition, the more stringent due diligence that a lender is likely to carry out on such borrowers may increase their refinancing costs.

As a proxy for the proportion of credit-impaired borrowers in a pool, we used the difference between the pool's weighted average coupon (WAC) and the prevailing mortgage rate at origination. This is called the spread at origination (SATO). A large positive SATO indicates that, on average, the loans in the pool have WACs significantly higher than the typical mortgage originated at the same time. We believe that borrowers who contract loans at higher than average rates signal their credit impairment. In a competitive mortgage lending market, pools with a high SATO must contain borrowers who are

¹Also see the Lehman Brothers report, *Borrower Characteristics and Prepayments*, January 1997.

systematically different from the typical borrower. A borrower's WAC might be substantially above the average due to high LTV or a poor credit record. A high WAC might also be due to the fact that lenders meet the borrower's closing costs and amortize the expense by charging a higher rate. Unless such a borrower's economic circumstances change for the better his *effective* borrowing rate will be higher than the average borrower's, and the refinancing incentive lower than for an average borrower with the same WAC at any level of rates. Thus, pools with similar WACs but different SATOs should display different refinancing behavior, with the high SATO pools prepaying slower. This report quantifies this effect and discusses its valuation implications.

BORROWER CREDIT IMPAIRMENT— MEASUREMENT AND POOL CLASSIFICATION

To quantify borrower credit impairment, we measure SATO for each pool. First, we identify the pool's origination month based on information provided by mortgage agencies. We then compute SATO as the difference between the pool's WAC at origination and the average Freddie Mac survey mortgage rate (survey rate) in the appropriately lagged monthly period (measurement period) prior to the origination month. The lag accounts for the time difference between the borrower's purchase/refinance decision and the loan's closing date.

Specifically, a pool is classified as high spread if its SATO is more than 50 bp plus an adjustment for the variability of the survey rate during the measurement period. This adjustment guards against possible misclassification of pools in situations where the weekly survey rate may have varied substantially from the average over the measurement period. Pools with WACs lower than the survey rate less the variability adjustment are classified as low spread. The remaining pools constitute the medium spread group. The 50 bp threshold for the high spread group ensures that borrowers who pay fewer than average discount points, and hence have higher than average WACs, are not misclassified as credit impaired.²

Figure 1 shows the amount of high spread origination as a percentage of total origination by vintage and coupon for FNMA and GNMA. In general, for any origination year the proportion of high SATO origination increases with increasing coupon. One exception to this general trend is the 7 1/2s of 1994 where almost 67% of GNMA and 40% of FNMA originations are classified as high SATO. The corresponding numbers for 8s, the next higher coupon, were 10% and 28%. Upon further investigation, we found that almost 60%

²The survey rate builds in a certain number of discount and origination points. Since 1991, this has varied between 1.7 and 2.1. Mortgage originators indicate that they reduce their lending rate by 25 bp for each of the first 2 points.

Figure 1. Percentage of High Spread Originations for 30-year Fixed Rate Programs

Coupon	1990	1991	1992	1993	1994	1995	1996	1997*
FNMA								
7.0	-	-	-	8	7	-	3	-
7.5	-	-	-	16	40	4	18	2
8.0	-	-	4	23	10	28	30	45
8.5	-	-	8	82	12	19	79	100
9.0	-	-	60	100	61	18	100	100
9.5	-	15	100	100	100	100	100	-
GNMA								
7.0	-	-	-	20	-	-	-	-
7.5	-	-	-	34	67	-	23	-
8.0	-	-	5	54	28	39	15	56
8.5	-	-	21	100	16	25	100	100
9.0	-	2	83	100	76	20	100	100
9.5	-	19	100	100	100	100	100	100

*As of July 1997.

of GNMA pools and 35% of FNMA were originated in the first four months of 1994 when mortgage rates were recovering from the lows of about 7% at the end of 1993. We verified that the trend across coupons did not change when we changed our assumption of lag between origination and measurement months.

Another discernible trend is greater high SATO issuance for GNMA's compared to FNMA's. This probably reflects the more common high LTV lending in the Federal Housing Administration (FHA) and Veterans Administration (VA) programs that constitute GNMA pools than in the conventional programs. The LTV level is a good predictor of default rates that run higher for FHA/VA loans than conventional loans (see *Secondary Mortgage Market*, Federal Home Loan Mortgage Corporation, July 1997).

Finally, Figure 1 suggests some hypotheses for certain prepayment trends observed over the past few years. For instance, the GNMA 9s of 1995 have consistently prepaid faster than the 9s of 1994 despite having the same WAC and similar factors. This was especially true in the significant refinancing episode in early 1996 when the 1995 originations peaked a full 10% CPR higher than 1994 originations. At least part of the explanation lies in the greater proportion of credit-impaired loans in 1994 originations; the high SATO proportion of the 1994 and 1995 aggregates was 76% and 20%, respectively. It also indicates the pitfalls of basing the callability of lower coupons on the observed prepayment pattern of higher coupons, which may have a substantial proportion of credit-impaired borrowers. For instance, the 1996 origination 8.5s and 9s are substantially more credit impaired than the 7.5s and 8s. We discuss below our contention that it is necessary to adjust

for different levels of credit impairment in these aggregates when extrapolating the prepayment behavior of 8.5s and 9s to that of 7.5s and 8s of 1996.

BORROWER CREDIT IMPAIRMENT— IMPACT ON PREPAYMENTS

We examined 3-month CPRs for the refinancing periods ended September 1995, March 1996, and January 1997. These periods correspond to the refinancing waves of the past two years. During periods of high refinancing levels, the differences in refinancing sensitivity can be more clearly measured. The periods are reasonably current so that the results can be extrapolated to the future. Based on our estimates of refinancing lags, the mortgage rates corresponding to these prepayments were about 7.66%, 7.10%, and 7.77%, respectively. We examined 1994 and 1995 origination FNMA and GNMA 8s, 8.5s, and 9s; there were 12 aggregates in all.³

For each GNMA aggregate, we computed the weighted 3-month CPRs for each spread group; each pool was weighted by its amount outstanding at the beginning of the refinancing period (see Figure 2). Group A is the low spread group with a higher proportion of better than average

³ We do not report the results for 8s in the refinancing periods ended September 1995 and January 1997 because these aggregates did not experience significant refinancing during these periods.

Figure 2. **Effect of Credit Impairment on GNMA Prepayments**
1994-1995 Originations, % CPR by Refinancing Period

Coupon	Year	3-month CPR (%)					
		Grp. A (Low sprd)	Grp. B (Med sprd)	Grp. C (Hi sprd)	Agg.	A-C (Low-Hi)	B-C (Med-Hi)
Period ended September 1995							
8.5	1994	-	17	13	16	-	4
8.5	1995	21	11	5	14	15	6
9.0	1994	-	31	24	26	-	7
9.0	1995	-	35	14	32	-	21
Period ended March 1996							
8.0	1994	24	21	15	19	9	6
8.0	1995	24	18	15	17	9	3
8.5	1994	-	40	28	38	-	12
8.5	1995	52	40	23	40	29	17
9.0	1994	-	47	39	41	-	8
9.0	1995	-	54	33	51	-	21
Period ended January 1997							
8.5	1994	-	15	14	15	-	1
8.5	1995	16	14	16	15	0	-2
9.0	1994	-	20	18	18	-	2
9.0	1995	-	20	20	20	-	0

Notes:

For each coupon-issuance year aggregate, the 30-year fixed rate pools were divided into groups based on spread at origination (SATO): low spread groups A, medium spread groups B, and high spread groups C. Then balance weighted average 3-month CPRs were computed for each group for each aggregate.

credit borrowers. Group B is the medium spread group with average credit borrowers. Group C is the high spread group with relatively more credit-impaired borrowers. In addition to the spread group-specific CPRs, we also report the coupon issue-year aggregate CPR and the prepayment rate differences across groups.

Looking first at the refinancing period ended March 1996, the results are striking. The low and middle spread pools prepaid faster than the high spread pools for each aggregate; the differences were economically and statistically significant.⁴ For the 8.5s of 1995, for instance, the high spread pools prepaid 29% CPR and 17% CPR slower than the low and medium spread groups, respectively. To put the difference in perspective, the entire aggregate prepaid at 40% CPR during this period. For the 8.5s of 1994, the medium versus high spread difference was 12% CPR and the aggregate speed was 38% CPR.⁵ In general, the differences are larger for the less seasoned 1995 originations compared to 1994 originations. Also, the differences are larger for higher aggregate prepayments. The low spread groups, where they existed, prepaid even faster than the medium spread groups.

A similar pattern is observed during the refinancing period ended September 1995. The refinancing incentive on the 9s during this period was similar to that on the 8.5s during the refinancing period ended March 1996. The high versus medium spread group prepayment rate differences were 7% CPR and 21% CPR for 1994 and 1995 origination 9s. The corresponding numbers were 4% CPR and 6% CPR for 8.5s.

The differences disappear by refinancing period ended January 1997 (Figure 3). In fact, the high spread pools prepaid marginally faster than the medium and low spread pools though the differences are neither economically nor statistically significant. The groups appear to start becoming similar after exposure to a particular refinancing incentive. However, the second refinancing episode (ended March 1996) suggests that higher refinancing incentives would again cause prepayment differentials across spread groups. In other words, if rates drop below the levels of the first quarter of 1996, it is likely that prepayment differentials across groups will reappear.

The analytical procedure used for FNMA is similar except for the additional step of controlling for WAC differences within coupon-issue year aggregates. The refinancing incentives associated with Group A, B, and C prepayments, reported in Figure 3, are identical. The results mirror the GNMA patterns.⁶

⁴ Standard errors and percentages are available from the authors upon request.

⁵ This aggregate had no low spread originations.

⁶ The one exception is the muted results for 1994 origination FNMA 8.5s in the refinancing period ended September 1995.

Figure 3. Effect of Credit Impairment on FNMA Prepayments, 1994-1995 Originations, % CPR by Refinancing Period

Coupon	Year	3-month CPR (%)			Agg.	Weighted Diff.	
		Grp. A (Low sprd)	Grp. B (Med sprd)	Grp. C (Hi sprd)		A-C (Low-Hi)	B-C (Med-Hi)
Period ended September 1995							
8.5	1994	-	18	16	18	-	2
8.5	1995	27	28	-	28	-	-
9.0	1994	-	31	23	26	-	9
9.0	1995	-	33	22	33	-	5
Period ended March 1996							
8.0	1994	31	25	20	25	11	4
8.0	1995	29	23	19	24	10	4
8.5	1994	-	34	27	33	-	7
8.5	1995	46	37	21	35	25	16
9.0	1994	-	43	32	36	-	11
9.0	1995	-	43	28	40	-	15
Period ended January 1997							
8.5	1994	-	15	15	15	-	1
8.5	1995	19	19	19	19	0	-1
9.0	1994	-	20	18	19	-	2
9.0	1995	-	20	17	20	-	3

Notes:

This analysis was similar to the one for GNMA pools, as reported in Figure 2, with the additional step of controlling for WAC dispersion within coupon-issue year aggregates. The details are available upon request from the authors.

BORROWER CREDIT IMPAIRMENT— RELATIVE VALUE IMPLICATIONS

The power of our methodology lies in predicting the *relative* prepayment behavior of credit-impaired and normal pools. To the extent that the market does not account for these prepayment differences, we can quantify and possibly exploit relative mispricing among pools *within* an aggregate. This is particularly useful in finding relative value within recently originated aggregates that have not yet generated sufficient prepayment history to exhibit tiering across pools. Our analysis also incorporates differences in the proportion of credit-impaired pools *across* aggregates to develop more realistic prepayment views and identify relative value at the aggregate level.

We focused first on estimating the fair value differences between credit-impaired and normal pools within the more liquid premium TBA coupons, e.g., 8s, 8.5s, and 9s. The more recently originated pools (in particular 1996 and 1997 originations), which are usually delivered in TBA settlements, have not generated sufficient prepayment history and are good candidates for exploiting the results of our analysis. We started with the hypothesis that market participants base their expectations about TBA premium prepayments on the observed prepayment patterns of 1994 and 1995 originations during the 1995 and 1996 refinancing episodes. Next, we adjusted our

prepayment model to reflect the prepayment patterns, since origination, of these aggregates. The adjusted prepayment model was used to compute the option-adjusted spread (OAS) for each TBA coupon using observed prices.

Next, we successively adjusted our model to reflect the prepayment patterns for credit-impaired and normal pools for each coupon. Finally, fair values were computed for the credit-impaired and normal pools at the OAS corresponding to the particular coupon. To be conservative and reflect the narrowing prepayment differences across groups after a refinancing episode, the two adjusted prepayment models converged to the TBA (aggregate) model after 36 months. Figure 4 shows pay-ups for FNMA aggregates. The normal pool values and TBA prices do not differ for 8s and 8.5s because there was relatively little issuance of high SATO pools for 8s and 8.5s in 1994 and 1995. Therefore, the prepayment adjustments to compute TBA OAS largely reflect the prepayment pattern of normal pools. On the other hand, given the larger proportion of credit-impaired pools in the 9s of 1994 and 1995, TBA prices are close to those of the credit-impaired pools and differ substantially from normal pool values. A similar pattern is shown in Figure 4 for GNMA.

The last column summarizes the fair value differences between credit-impaired and normal pools. These price differences are computed under the assumption that the prepayment differences, documented earlier, persist for the first 36 months. If a pay-up does emerge for such pools, it will enhance, from an originator's perspective, the relative profitability of refinancing credit-impaired versus normal borrowers. The prepayment differences will narrow until the marginal profitability of refinancing is

Figure 4. Pay-ups for Recently Originated Credit-impaired Pools, 9/22/97

Coupon	TBA Price (\$)	Fair Value (\$)		Credit-impaired Pay-up over Normal
		Credit-impaired	Normal	
FNMA				
8.0	103-5/32	103-18/32	103-5/32	13/32
8.5	104-16/32	105-5/32	104-16/32	21/32
9.0	106-8/32	106-19/32	105-10/32	1 9/32
GNMA				
8.0	103-5/32	103-18/32	103-5/32	13/32
8.5	104-21/32	105-9/32	104-21/32	20/32
9.0	106-10/32	106-16/32	105-14/32	1 2/32

Notes:

The Lehman Brothers 30-year fixed rate prepayment model was calibrated to the prepayment patterns of 1994 and 1995 originations. TBA prices were then used to compute OAS for each coupon using the adjusted model. The model was further adjusted to reflect the prepayment patterns of credit-impaired and normal pools. Finally, the group-specific values were computed using the coupon-appropriate OAS and model adjustment.

equalized across borrower types. However, they will not disappear and a premium should remain for credit-impaired pools.⁷

The above analysis has implications for the pricing of aggregates when combined with the high spread issuance percentages shown in Figure 1. For instance, for FNMA 8.5s and 9s, practically all the 1996 and 1997 issuance was high SATO compared to substantially lower proportions for 1994 and 1995 originations. Investors who extrapolate from the prepayment experience of 1994 and 1995 originations would be overstating the callability of more recent vintages. On the other hand, comparing 1996 origination 7.5s and 8s with 8.5s and 9s shows that the lower coupons have a much lower proportion of high spread pools. Investors who extrapolate from the benign prepayment behavior of higher coupons would significantly underestimate the refinancing sensitivity of lower coupons.

⁷The fair value differences will not disappear if, on average, the refinancing incentive for a credit-impaired borrower is lower than for a normal borrower in any rate environment. If the pay-ups *did* disappear, then an originator would have no special incentive to originate such loans and would not spend extra resources on such borrowers. Then, the credit-impaired borrowers would show lower refinancing sensitivity due to their objective circumstances. But then such pools would be less callable and a rational investor would agree to pay more for them and pay-ups would re-emerge. An equilibrium will emerge where prepayment differences are such that the marginal profitability of refinancing is equalized across borrower types.



LEHMAN BROTHERS