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Ivan Gjaja
(212) 816-8320
ivan.m.gjaja@ssmb.com
New York

New Model of Subprime Mortgage Rates

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- **We describe a new model of the spread between the subprime and conforming mortgage rates. The model depends on changes in the conforming rate and successfully describes the recent widening of the subprime-conforming spread.**
- **Lower elasticity of subprime rates in the new model leads to lower speeds in the unchanged interest rate scenario and lower variation of speeds under interest rate shifts.**
- **OASs and effective durations increase, while option costs decrease and convexities become less negative. The changes in all parameters are significant.**

Introduction

Subprime borrowers respond to changes in the subprime rate, not the conforming rate.

In addition to their dependence on loan characteristics and borrower characteristics, prepayments on subprime mortgages are strongly affected by changes in interest rates.[1] Since a large majority of subprime borrowers carry loan rates that are well above the conforming rate, and few such borrowers refinance their loans into conforming loans, the relevant measure of the refinancing incentive is given by changes in a suitably defined **subprime mortgage rate,** rather than the conforming rate. In this article, we describe the relationship between the subprime rate and the conforming rate and provide a method for projecting the subprime rates from the conforming rates. Such projections are essential for OAS calculations, because the expected future values of subprime rates cannot be efficiently determined from traded instruments.

Historical Data

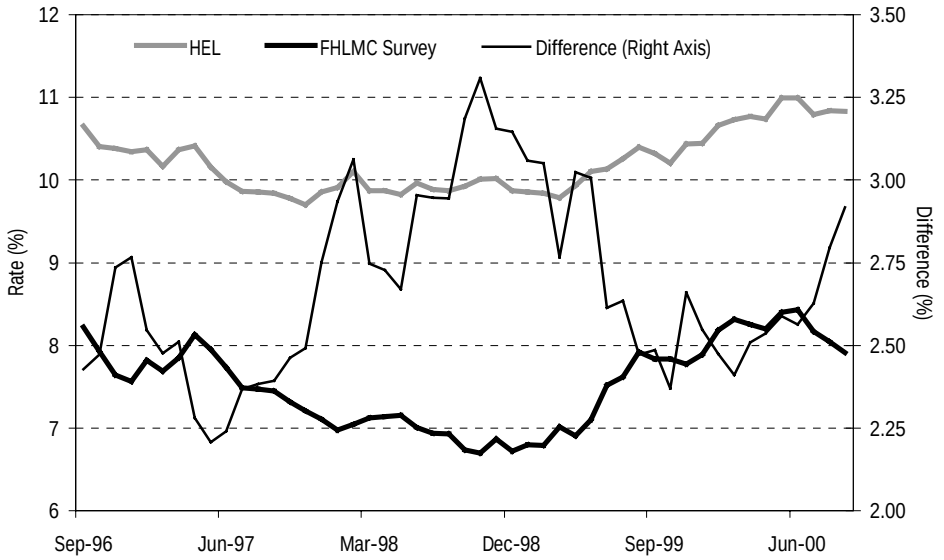
The spread between the subprime and conforming rates has not been constant.

Coupons on subprime mortgages typically depend on several key collateral characteristics, such as the initial loan-to-value ratio (LTV), loan term and payment schedule, the borrower's credit score and prepayment penalties. The simplest relationship that can be assumed between the subprime and conforming rates is that the spread between the subprime rate charged for a loan with precisely defined characteristics and the conforming rate remains constant over time. Historical data indicate, however, that this assumption can often be in error by as much as 50bp over extended periods of time. Figure 1 shows the loan rates charged by a major subprime lender on loans with an LTV between 71% and 83%.[2]

[1] For a detailed estimate of the sensitivity of prepayments on interest rates see *Prepayments on RFC Subprime/Home Equity Loans*, I. Gjaja, Salomon Smith Barney, August 2000.

[2] The borrower credit profile and the average loan term have remained within a narrow band over the period shown. We do not control for these variables to insure that the number of loans originated in each month is sufficiently large to limit random variation.

Figure 1. Subprime and Conforming Mortgage Rates, Sep 96–Sep 00



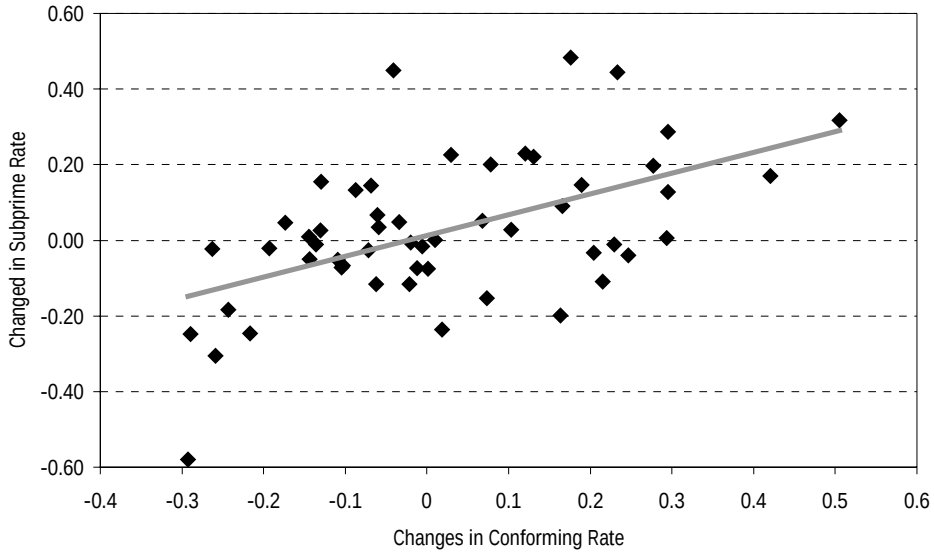
Source: Salomon Smith Barney.

Subprime rates are more stable than conforming rates.

The data imply that the **subprime rates are more stable than conforming rates**. In periods of strong rallies of the conforming rate, the spread between the two widens; in periods of selloffs, it narrows. This view is confirmed by Figure 2, which shows month-to-month changes in the conforming rate versus month-to-month changes in the subprime rate. Changes in the subprime rate are lagged by one month.[3] The correlation between the two data series is significant, at 53%. The slope of the straight line indicates that, on average, each change of the conforming rate of 10bp leads to a 6bp change in the subprime rate one month later.

[3] Since we assign the subprime rate to the month prior to the loan origination date, this implies the lag of two months between conforming rates and the origination time of subprime loans.

Figure 2. Changes in the Subprime Rate Versus Changes in the Conforming Rate, Sep 96–Sep 00



Source: Salomon Smith Barney.

Model

The subprime-conforming spread gradually returns to its mean.

Figure 2, does not reveal the full relationship, however. Since defaults on subprime loans do not show any pronounced dependence on interest rates,[4] we expect that in a scenario where the conforming rates change sharply and then remain constant, the risk premium charged to the subprime borrowers will eventually return to its historical levels. Therefore, if the external competitive conditions in the subprime industry remain steady, the subprime rates may be expected to eventually retrace most of the changes in the conforming rates. This **gradual return to the mean** is also supported by direct fits on the historical data.

The model is a significant improvement over the assumption of constant spread.

We model changes in the subprime-conforming spread as a function of changes in the conforming rate plus a mean reversion.[5] The results are shown in Figure 3. Although the model does not fully reproduce the observed historical spreads, it is a significant improvement over the assumption that the subprime-conforming spread remains constant over time. For example, the model successfully captures the recent widening of this spread.

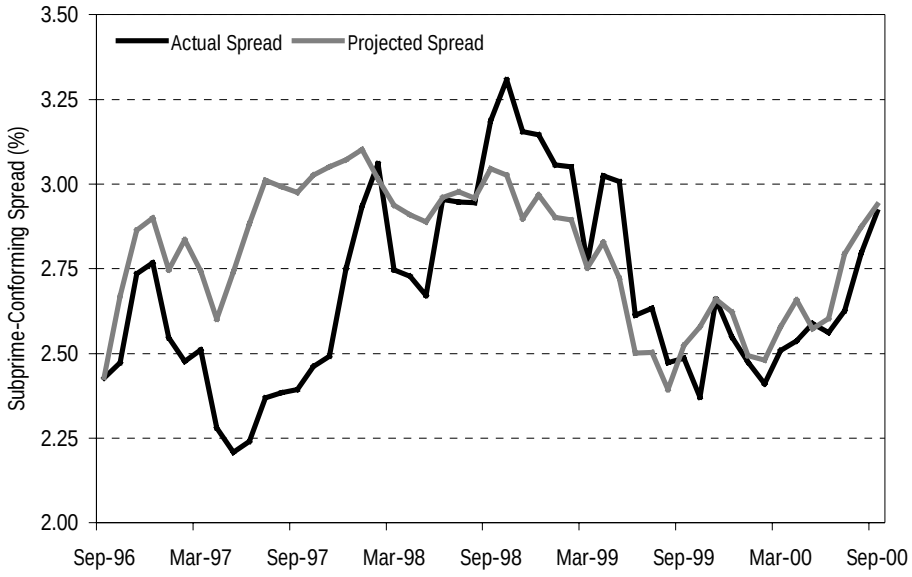
Most of the discrepancies between the model and the observed spreads are likely a result of changing conditions in the subprime industry. For example, the model overpredicts the spread in 1997, which coincides with the period of rapid growth of the industry and relaxing underwriting standards. Similarly, the model underpredicts the spread by about 25bp at the end of 1998, which coincides with the period of the liquidity crisis and the retrenchment in the subprime industry. **It should not be**

[4] See "*Prepayments on RFC Subprime/Home Equity Loans.*"

[5] Models of the subprime rate, the subprime-conforming spread, or of changes in the subprime rate are less effective than the one described in the text. The fit of changes rather than levels also insures that the auto-correlation of errors is small.

expected that the patterns of the subprime rates driven by factors independent of the conforming market could accurately be reproduced by the behavior of the conforming rate alone. To account for explicit expectations of future competitive conditions in the subprime industry, our implementation of the model in OAS calculations specifies an explicit time dependence of the future **mean** of the subprime-conforming spread.

Figure 3. Actual and Projected Spread Between the Subprime and Conforming Rate, Sep 96–Sep 00

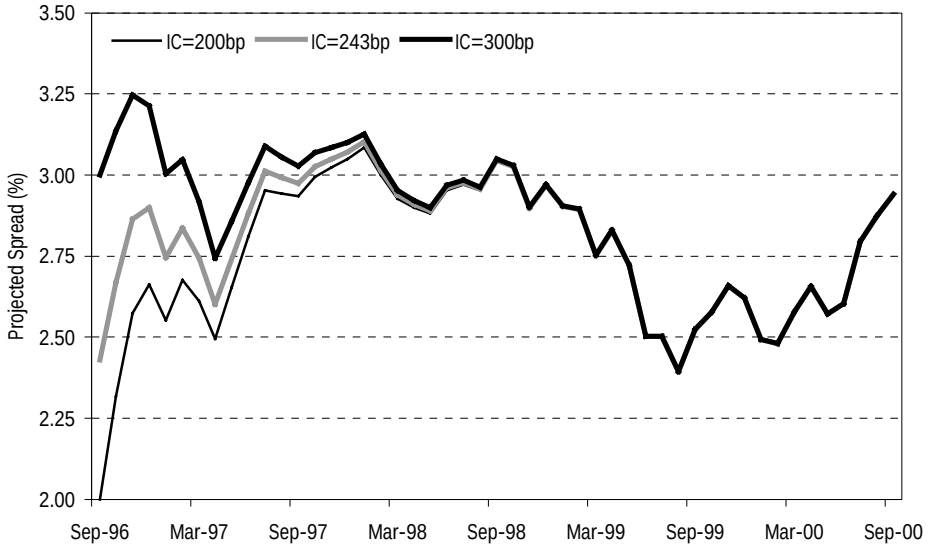


Source: Salomon Smith Barney.

Long-term projections are independent of initial conditions.

Since our model of the subprime-conforming spread is given in the form of a recursion relation, rather than as a level of the spread or of the subprime rate, the projected rates depend on the starting point of the iteration. Normally, the starting point would be the current level of the spread (which is known). However, the mean-reverting feature of the model insures that the precise starting point of iteration becomes unimportant after about 18 months. Figure 4 shows three runs of projected spreads that start in September 1996, but use different starting points. Whether the initial spread is the actual spread in September 1996 (243bp) or is significantly higher (300bp) or lower (200bp) than that, the projections converge.

Figure 4. Dependence of Model Spread on Initial Conditions, Sep 96–Sep 00



IC Initial Condition.
Source: Salomon Smith Barney.

Projections

The fitted model parameters imply that an instantaneous drop in the conforming rate of 100bp increases the subprime-conforming spread by 55bp in the first month. If the conforming rates remain constant after the drop, the spread will be 43bp higher than the initial level in the next month, consistent with Figure 2. Six months after the change in the conforming rate, the spread will return to within 17bp of its initial level.

Our model projects that the subprime-conforming spread increased by 36bp between September 2000 and February 2001.

Given the recent history of conforming rates, our model projects that the subprime-conforming spread increased by 36bp between September 2000 and February 2001.[6] In terms of the benchmark loans used for Figure 1, this places the current subprime-conforming spread at 330bp, rivaling the peaks of the liquidity crisis of 1998. If the conforming rates do not change from this point on (the average February level is 7.05%), we expect that the subprime-conforming spread will return to its September 2000 level by August of this year. If the conforming rates start increasing, the spread will compress more quickly.

Valuation Implications

The new model of the subprime-conforming spread replaces our current calculation in which the spread is projected to be a specified function of time, independent of movements of the conforming rate.[7] The implications of this change for the valuation of securities backed by subprime collateral are significant.

[6] We currently have reliable data on subprime loans originated through October 2000.

[7] The spread is assumed to revert to its historical mean over one year, regardless of changes in the conforming rate.

The new model projects lower and more stable prepayments.

Given the recent history of conforming rates, the current subprime-conforming spread in the new model is wider than its last recorded value, which is the starting point for projections in the old model. In addition, because of the recent runup in the spread, the long-term mean to which the spread reverts is slightly higher in the new model than the mean of the past several years. Therefore, in the unchanged interest rate scenario, the new model leads to **lower projected speeds**. Under parallel shifts of the Yield Curve, the lower elasticity of subprime rates in the new model implies **more stable speeds**. A comparison of prepayment projections under the new and old models of subprime rates is shown in Figure 5.

Figure 5. Comparison of Prepayment Projections for the New and Old Models

		Historical Speeds				Projected Speed (% CPR) for an Interest Rate Change of																				
	Issue	(% CPR)				-300 bp			-200 bp			-100 bp			0 bp			100 bp			200 bp			300 bp		
Deal	Date	1-Mo	3-Mo	1-Yr		New	Old	Diff.	New	Old	Diff.	New	Old	Diff.	New	Old	Diff.	New	Old	Diff.	New	Old	Diff.	New	Old	Diff.
RASC	9/98	17.9	17.4	20.2	LT	47.7	54.3	-6.6	42.1	48.7	-6.6	33.8	38.3	-4.5	24.6	26.4	-1.8	20.0	20.9	-0.9	17.5	18.1	-0.6	14.8	14.7	0.1
1998-KS3					1-Yr	50.4	58.8	-8.4	44.3	52.2	-7.9	34.3	40.6	-6.3	27.4	28.8	-1.4	24.5	23.9	0.6	22.6	21.3	1.3	20.6	18.3	2.3
RASC	9/99	17.5	18.3	17.2	LT	45.1	53.2	-8.1	39.0	46.0	-7.0	29.9	35.6	-5.7	23.4	25.6	-2.2	19.5	20.5	-1.0	16.4	17.6	-1.2	14.3	14.4	-0.1
1999-KS3					1-Yr	43.3	55.8	-13	36.9	46.7	-9.8	27.2	33.6	-6.4	22.7	23.7	-1.0	20.2	19.9	0.3	18.7	17.5	1.2	16.9	15.2	1.7
RASC	6/00	17.9	15.2		LT	45.3	50.9	-5.6	40.8	49.0	-8.2	34.5	38.8	-4.3	26.5	31.2	-4.7	22.0	23.9	-1.9	18.7	19.6	-0.9	15.6	17.1	-1.5
2000-KS3					1-Yr	45.7	54.1	-8.4	39.5	52.0	-13	30.6	38.1	-7.5	23.8	27.5	-3.7	21.1	21.5	-0.4	18.7	18.0	0.7	17.2	16.0	1.2
ADVN	6/98	13.6	16.1	19.2	LT	39.2	47.8	-8.6	33.3	39.3	-6.0	25.9	29.2	-3.3	22.3	24.0	-1.7	17.8	19.6	-1.8	15.1	15.7	-0.6	13.9	13.8	0.1
1998-2 g1					1-Yr	38.8	52.1	-13	31.0	42.3	-11	25.9	29.5	-3.6	23.6	24.9	-1.3	20.7	20.9	-0.2	18.7	17.8	0.9	17.5	16.3	1.2
ADVN	8/99	13.1	13.7	14.4	LT	40.2	46.1	-5.9	35.3	39.4	-4.1	29.1	30.9	-1.8	21.8	22.3	-0.5	18.6	18.9	-0.3	15.1	15.0	0.1	13.1	12.9	0.2
1999-3					1-Yr	43.0	51.9	-8.9	36.4	43.4	-7.0	27.5	31.7	-4.2	22.3	22.0	0.3	20.5	19.1	1.4	18.1	15.8	2.3	16.4	14.0	2.4
Centex	2/99	18.1	23.6	22.3	LT	40.3	46.4	-6.1	35.9	40.7	-4.8	29.3	32.1	-2.8	24.0	26.1	-2.1	21.3	22.8	-1.5	18.5	19.4	-0.9	15.6	16.0	-0.4
1999-1					1-Yr	42.5	49.7	-7.2	38.3	43.6	-5.3	28.5	32.4	-3.9	26.0	27.4	-1.4	24.6	24.9	-0.3	23.0	22.1	0.9	21.3	19.4	1.9

Yield curve and swap curve from March 6, 2001.
Source: Salomon Smith Barney.

One-year speeds in strong rate rallies are affected the most.

The differences between the two calculations can be as large as 13% CPR. They are most pronounced for one-year speeds in strong rate rallies. Long-term speeds are affected less by the model upgrade, because of the gradual compression of the subprime-conforming spread following a rate rally. In strong rate selloffs, the subprime-conforming spread initially tightens in the new model, leading to higher prepayment projections. Over the long term, however, the moving mean to which the spread reverts in the new model may be lower than the static mean used in the old model, leading to slightly *lower* speeds in several cases.

The slowdown of projected prepayments in the unchanged interest rate scenario, together with the reduced variation of speeds under parallel shifts of the yield curve, have direct implications for the valuation of securities. Figure 6 compares the valuation parameters obtained from the new and old models of the subprime rates, for several securities from the RASC deals 2000-KS5 and 1999-KS3.

Figure 6. Comparison of WALs, OASs, Option Costs, Durations and Convexities for the New and Old Models

RASC Deal and Class	Price ($)	WAL (Yrs.)			OAS (bp)			Option Cost (bp)			Eff. Duration (Yrs.)			Eff. Convexity (Yrs. Sq.)		
		New	Old	Diff.	New	Old	Diff.	New	Old	Diff.	New	Old	Diff.	New	Old	Diff.
2000-KS5 AI2	102.01	1.63	1.47	0.16	24	11	13	18	18	0	1.20	1.02	0.18	-0.78	-0.97	0.19
2000-KS5 AI3	102.63	2.33	2.10	0.23	22	11	11	33	35	-2	2.00	1.79	0.21	-1.13	-1.31	0.18
2000-KS5 AI4	103.16	3.57	3.17	0.40	26	20	6	58	60	-2	3.60	3.37	0.23	-1.69	-1.92	0.23
2000-KS5 AI5	103.83	5.73	5.06	0.67	51	43	8	69	74	-5	4.99	4.77	0.22	-1.26	-1.28	0.02
1999-KS3 AI7 (NAS)	104.88	5.03	4.77	0.26	45	35	10	31	38	-7	3.67	3.40	0.27	-0.71	-0.85	0.14

Pricing date: March 6, 2001. All securities priced to call.
Source: Salomon Smith Barney.

Under the new model the WALs, OASs, durations and convexities increase, while option costs decrease.

Under the new model all four sequential bonds and the NAS bond have **longer WALs and effective durations, higher OASs, less negative convexities and lower or unchanged option costs**. The increase in OASs ranges from 6bp to 13bp, while the decrease in option costs ranges from 0bp to 7bp. Since all the bonds are premiums, the slower prepayment projections (longer WALs) naturally lead to higher OASs. The decrease in option costs is less straightforward.

As we discussed previously[8], for most securities backed by subprime collateral, an extension of the security, resulting for example from a selloff in interest rates, leads to *higher* option costs. Therefore, a decrease in option costs that goes together with an extension of securities, as is the case for the new model, is an indication of a **significant reduction of prepayment sensitivity to yield curve shifts**. This observation is in agreement with the results in Figure 6 and with the improvement in the convexity profile of all the bonds.

The new model is now available on Yield Book.

The new model of subprime rates is now available on Yield Book under the New Prepay Model option. The model will become the default option on Yield Book in a few weeks.[9]

[8] See *Bond Market Roundup: Strategy*, January 12, 2001.

[9] We expect that the model will become the default option at the same time as the updates to the agency prepayment models.

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