A LIBOR-Based Approach to Modeling the Mortgage Basis

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A number of factors have focused mortgage investors more heavily on swap spreads recently. First, the composition of mortgage ownership is changing, shifting more toward LIBOR-based investors. Second, the divergence between swaps and Treasury rates has become much more pronounced, reflecting a scarcity of Treasury issuance.

We examine each of these points. We then introduce our LIBOR-based mortgage-Treasury spread model. Finally, we compare the results of this model to the Treasury-based model we have been using.

Exhibit 1 shows dramatically that the composition of mortgage ownership is changing. The latest data available are as of year-end 1997. Note that over the past few years, there has been a decided shift among mortgage investors away from depository institutions and toward FNMA/FHLMC (and "other," which includes hedge funds).

I. TIMES ARE CHANGING

Since the end of 1992, mortgage-related securities held by depository institutions have shrunk from 36.7% to 28.8% of the total holdings. Meanwhile, "other" institutions expanded their holdings from 4.6% to 8.0%, while FNMA/FHLMC grew from 1.5% to 11.9% of the picture. This represents substantial growth for the FNMA/FHLMC portfolio. A related point is that the investor base is shifting more heavily toward LIBOR-based customers.

Both hedge funds and the FNMA/FHLMC portfolio tend to make mortgage decisions referencing a LIBOR rather than a Treasury curve. The agencies look at where they can issue callable debt (which is driven by the swap and swaption markets). Hedge funds generally try to maintain zero duration on highly leveraged positions (their financings are dictated by LIBOR).

II. SCARCITY OF TREASURY ISSUANCE

Recent experience provides an interesting opportunity to observe what happens upon divergence of swap rates and Treasury rates. This leads into our second point: Over the past six months to a year, swap spreads have become wider and more volatile.

Exhibit 2 shows that, for the period since 1994, swap spreads for the ten-year maturity averaged 40 basis points. Since October 1997, however, they have averaged 48 basis points. Exhibit 2 also shows that the volatility of swap spreads averaged 29% since October 1994, but 35% for the subperiod since October 1997. Thus, if the average level of swap spreads is 40 basis points, 29% volatility implies a standard deviation (on swap spreads) of 11.6 basis points. Over the more recent period, 35% volatility and an average level of 48 basis points imply a swap

EXHIBIT 1

Mortgage-Related Security Holdings by Investor Type (dollars in billions)

	Year-End							
	1992		1994		1996		1997	
Investor Type	Amt	% of Tot	Amt	% of Tot	Amt	% of Tot	Amt	% of Tot
FDIC Commercial Banks	$306.9	22.09%	$327.2	20.13%	$336.0	17.70%	$384.6	18.97%
FDIC Savings Banks	30.6	2.20	39.6	2.44	42.3	2.23	42.2	2.08
OTS Regulated S&Ls	155.6	11.20	172.9	10.64	149.5	7.88	140.2	6.91
Federal Credit Unions	17.0	1.22	20.8	1.28	16.1	0.85	16.1	0.79
Total Depository Institutions	$510.1	36.72%	$560.5	34.48%	$544.0	28.66%	$583.1	28.75%
FHL Banks	22.8	1.64%	36.1	2.22%	45.7	2.41%	49.0	2.42%
Public Pension Funds	115.0	8.28	136.0	8.37	139.6	7.35	152.3	7.51
Private Pension Funds	58.0	4.18	64.0	3.94	62.3	3.28	66.5	3.28
Life Insurance Cos.	244.1	17.57	276.4	17.00	325.5	17.15	320.0	15.78
Mutual Funds	104.6	7.53	92.5	5.69	75.5	3.98	78.5	3.87
Private Individuals	32.0	2.30	29.0	1.78	27.1	1.43	28.3	1.40
REITs	16.9	1.22	10.2	0.63	4.3	0.23	24.1	1.19
Foreign Investors	130.0	9.36	166.0	10.21	182.9	9.64	216.4	10.67
MBS Dealer Inventory	70.7	5.09	94.5	5.81	105.0	5.53	107.0	5.28
FNMA/FHLMC Portfolio	20.6	1.48	76.0	4.68	183.8	9.68	240.9	11.88
Depository and Major Investors	$1,324.8	95.37%	$1,541.2	64.81%	$1,695.7	89.33%	$1,866.1	92.02%
All Other Investors	$64.3	4.63%	$84.4	5.19%	$202.6	10.67%	$161.8	7.98%
Total Outstanding	$1,389.1	100.00%	$1,625.6	100.00%	$1,898.3	100.00%	$2,027.9	100.00%

Source: The Mortgage Market Statistical Annual for 1997.

spread standard deviation of 16.8 basis points.

The increase in both the level and volatility of swap spreads largely reflects the scarcity of Treasury issues, and hence their increased specialness in repo markets. For fiscal 1998, the United States is expected to run its first surplus in three decades. Current Congressional Budget Office estimates call for an $8 billion surplus, but they've hinted of likely upward revisions. Our analysis pegs this year's surplus at $50 billion, but we believe it may go as high as $80 billion, according to growth and inflation forecasts.

In addition, we expect the U.S. Treasury to issue about $32 billion of TIPS (Treasury Inflation Protected Securities) in fiscal 1998, in an attempt to "fill out" a

EXHIBIT 2

Swap Spread Volatilites

	10yr Swap Spread			Spread Volatility			bp 10yr Special		
	High	Low	Avg	High	Low	Avg	High	Low	Avg
Since 10/94	54	30	40	40	17	29	550	–56	141
Since 10/97	54	44	48	40	28	35	478	–8	184
Last		49			33			421	

TIPS yield curve. So outstanding fixed-rate debt will most likely contract by about $80 billion ($50 billion surplus plus $32 billion in TIPs). This has caused (and will continue to cause) much more severe collateral shortages than at any time in recent memory.

Exhibit 2 shows average specialness of the ten-year repo rate. We subtract the ten-year repo rate from the repo rate on general collateral, using repo rates provided by Bankers Trust (available on Bloomberg — the ticker for the ten-year repo is BTRI10Y <Index>; the general collateral repo is BTRIO/N <Index>). Note that since October 1994, the ten-year Treasury has been special by 141 basis points. Since the subperiod starting October 1997, it's been special by 184 basis points.

As this has occurred, we have observed mortgage spreads that behave similarly to swap spreads and longer-dated cap and swaption volatility. For example, Exhibit 3 shows that the current coupon is wide to Treasury rates but tight to LIBOR. We would have expected spreads to be on the tighter side, due to low volatility.

Exhibit 4 shows that this is also the case when we graph spread between a perfect current-coupon mortgage and five-year cap volatility and three-month volatility on OTC options. There is a much stronger relationship between the decline of swapped spreads to LIBOR and declines in volatility when volatility is measured using five-year cap volatility.*

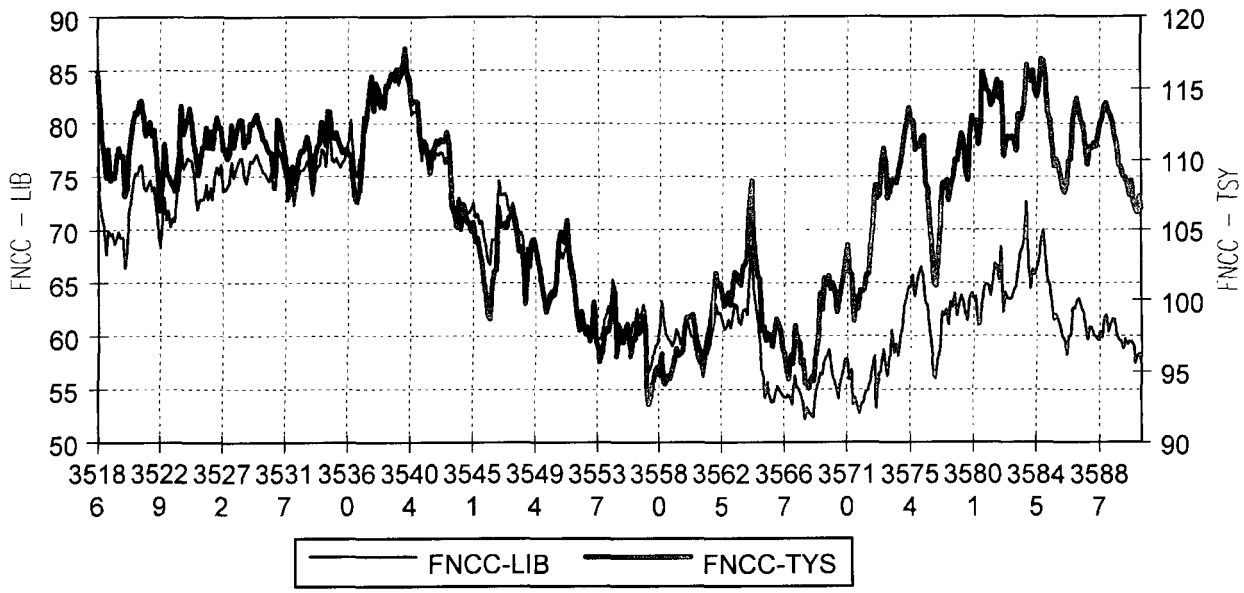
III. MORTGAGE-TREASURY SPREAD MODEL REVISITED

Our mortgage-Treasury spread model has been an extremely valuable tool for assessing basis between mortgages and Treasury securities. This model is discussed in detail in Goodman and Ho [1997]. It measures the richness or cheapness of the perfect current-coupon mortgage (the mortgage selling exactly at par for corporate settle). This is a function of fundamental variables influencing mortgage pricing — the level of rates, shape of the curve, volatility, and the specialness of the roll.

We have estimated this model for principal sectors of the pass-through market: thirty-year GNMAs, thirty-year conventionals, fifteen-year GNMAs, fifteen-year conventionals, and seven- and five-year balloons. We always use the latest rolling two years of historical data; each new day's observation is added, and the two years' prior observations dropped.

The old model has been working quite well lately. The only time it provides less-than-satisfactory results is in switching to a new ten-year note. Since the yield

EXHIBIT 3
Current-Coupon Tight to LIBOR but Wide to Treasuries



on the current ten-year note looks very rich to the off-the-run ten-year, the mortgage-Treasury spread model looks cheaper right after we make the switch, even absent any other changes.

Since increased numbers of our investors are starting to buy mortgages as a function of swap rates, however, we decided to introduce a LIBOR-based model. In this "newer, improved" version, we also incorporate swap rates and cap volatility. This new model does not replace the Treasury-based version of the model — we produce and monitor the results of both.

IV. THE NEW MODEL

Readers familiar with our mortgage-Treasury spread model will recall that the starting point is the perfect current-coupon for corporate settlement (defined as the mortgage selling exactly at par for corporate settlement). We derive the corporate settlement price of all TBA pass-throughs, and then interpolate between coupon classes selling immediately above and below par to determine which coupon would sell exactly at par. This becomes the perfect current-coupon pass-through. We then convert that coupon/yield to a bond-equivalent yield.

For example, as of the close on Friday, May 1, 1998, FNMA 6.5s were selling at 99:01 for regular June settlement and 99:03+ for corporate settlement (5/8/98). FNMA 7.0s were selling at 101:03+ for regular June settlement and 101:07 for corporate settlement. Thus the perfect current-coupon is 6.71%, reflecting 57.7% of the 6.5s plus 42.3% of the 7.0s. The bond-equivalent yield is 6.73% (including mortgage pass-through payment delay plus monthly pay on the mortgage coupon).

In the new model, the dependent variable is the yield on the perfect current-coupon mortgage — exactly the same dependent variable as in the old model. Independent or explanatory variables include the level of rates (measured by the ten-year yield), curve shape (the spread between the two- and ten-year swap yield), and specialness of the roll (ticks per month). We use ten-year swap spreads to capture the "LIBOR" effect. We change the volatility variable from three-month options on the ten-year note to five-year cap volatility. This change was incorporated to reflect the pattern shown in Exhibit 4.

V. REGRESSION RESULTS

Regression results are shown in Exhibit 5 for all six sectors, including regression coefficients, with t-statistics in parentheses. R-square and standard error of

EXHIBIT 4
FNMA Current-Coupon – LIBOR Tracks CAP Volatility Closely

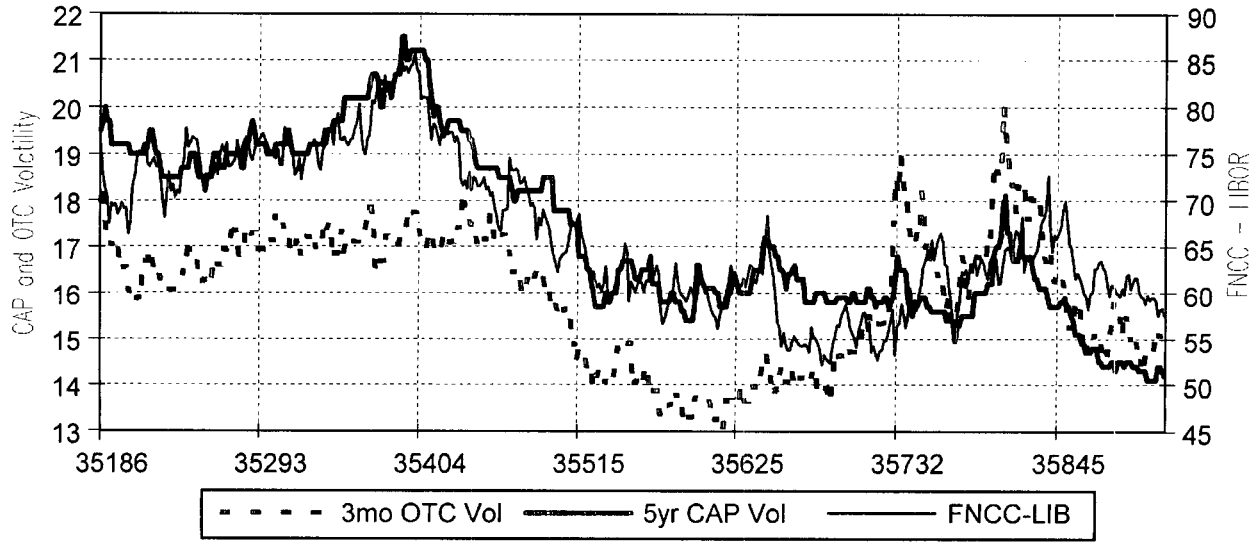


EXHIBIT 5
Coefficients of the Current-Coupon Models

New LIBOR Models

	Intercept	10yr	Swap	10/2 (LIBOR)	5yr Cap	Roll	R-Sqr	S.E.
GNMA 30-yr	0.141 (0.84)	1.034 (66.72)	0.006 (5.84)	−0.002 (6.66)	0.035 (10.18)	−0.03 (5.45)	99.3%	4.7
FNMA 30-yr	0.27 (1.7)	0.997 (68.12)	0.006 (5.36)	−0.003 (8.24)	0.043 (12.92)	−0.011 (2.23)	99.3%	4.4
GNMA 15-yr	−0.176 (0.8)	0.992 (48.85)	0.009 (6.59)	−0.002 (5.72)	0.031 (6.71)	−0.012 (1.95)	98.7%	6.0
FNMA 15-yr	0.093 (0.53)	0.976 (59.66)	0.007 (6.07)	−0.003 (9.9)	0.035 (9.69)	−0.02 (3.51)	99.0%	4.9
FNMA 7-yr	−0.009 (0.05)	0.997 (58.59)	0.005 (4.32)	−0.006 (17.83)	0.032 (8.43)	−0.005 (1.18)	98.7%	6.2
Gold 5-yr	0.228 (1.03)	0.975 (47.01)	0.005 (3.35)	−0.008 (17.7)	0.02 (4.26)	−0.006 (1.12)	97.8%	6.2

Older Models (Treasury-Based)

	Intercept	10yr	Swap	10/2 (Tsy)	3 month OTC	Roll	R-Sqr	S.E.
GNMA 30-yr	0.752 (6.08)	0.991 (69.82)	na	−0.001 (4.17)	0.03 (7.9)	−0.029 (4.68)	99.2%	5.2
FNMA 30-yr	0.97 (7.35)	0.943 (61.00)	na	−0.001 (3.51)	0.0032 (7.79)	−0.008 (1.34)	98.9%	5.7
GNMA 15-yr	−0.316 (2.30)	0.965 (59.43)	na	−0.002 (6.56)	0.033 (8.03)	na	98.7%	6.0
FNMA 15-yr	0.688 (5.94)	0.938 (67.84)	na	−0.003 (9.21)	0.029 (8.19)	−0.020 (3.39)	99.0%	5.0
FNMA 7-yr	0.167 (1.71)	0.998 (86.89)	na	0.006 (26.50)	0.03 (10.24)	na	99.1%	4.2
Gold 5-yr	0.266 (1.97)	0.993 (62.15)	na	−0.008 (24.45)	0.017 (4.27)	na	98.0%	5.9

Note: T-statistics are in parentheses.

the regression are also noted.

The coefficients look very reasonable. Let's look at them on the thirty-year FNMA regression. The coefficient of the ten-year Treasury is 0.997, indicating that each basis point increase in the ten-year produces very close to a 1 basis point increase in the perfect current coupon. Note that the t-statistic on this variable is a highly significant 68.12 (significance at the 95% level is achieved with a t-statistic of 1.95).

The coefficient on the swap spread is 0.006. This means that each 10-basis point increase in the swap spread translates into a 6-basis point widening in the perfect current-coupon mortgage. That t-statistic is a highly significant 5.36.

The next variable is the 10/2 spread. Each 10-basis point steepening of the yield curve will result in a 3-basis point reduction in yield on the perfect current-coupon mortgage. Again, the t-statistic is a very significant 8.24. Each 1% increase in five-year cap volatility increases spread on the perfect current coupon mortgage by 4.3 basis points. The t-statistic is 12.92. Finally, each tick that the mortgage rolls through carry will tighten the spread on the perfect current-coupon mortgage by 1.1 basis points. The t-statistic is 2.23.

The results are quite reasonable in other regressions as well. All coefficients have the right (expected) sign, and are significant.

The regression's explanatory power is quite strong. The R-square of the regression is 99.3%. This means we are explaining 99.3% of the squared variation through our regression. Even more meaningful is that the standard error of the regression on thirty-year FNMAs is 4.4 basis points.

Exhibit 5's lower panel shows the old model's results as well. These are the sectors in which hedge funds and the Fannie Mae and Freddie Mac portfolios participate the most actively. Note that standard error is much wider on the thirty-year GNMAs (5.2 basis points versus 4.7 basis points on the newer) and on the thirty-year FNMAs (5.7 basis points versus 4.4 basis points). Standard errors on fifteen-year GNMAs and conventionals are roughly equivalent under the old and new models. The standard error on the balloon models is slightly larger on the LIBOR version, reflecting that LIBOR-based investors do not deal in this product.

VI. COMPARISON VERSUS OLD MODEL

To determine richness or cheapness of the current-coupon, we look at actual yield versus that pro-

EXHIBIT 6

LIBOR Current-Coupon Projection Model (Example: 30-yr FNMA)

Term	Coefficient	Value	Value X Coeff
Intercept	0.269751		0.269751
10-Yr Tsy	0.996536	5.66	5.645178
10yr Swap Spread	0.005723	49	0.280426
10/2 Spread (LIBOR)	–0.002571	19	–0.049023
5yr CAP Vol	0.042503	14.20	0.603548
FN30 Ticks over Carry	–0.010568	0.79	–0.008357
Projected Yield from Current-Coupon Model			6.742
Actual Yield			6.730
Difference			1.2 bps rich

jected on the LIBOR model. The latter is determined by multiplying each coefficient by its current value (as shown in Exhibit 6). Thus our current-coupon model has a projected yield of 6.742%, versus an actual yield of 6.730%. The projected yield is higher by 1.2 basis points — suggesting that current-coupon FNMA mortgages are 1.2 basis points rich to model projections.

Note that thirty-year conventional mortgages look slightly less rich in this new model (seen in Exhibit 7). That is, they are 1.2 (rather than 4.6) basis points rich. In the new model, we're squarely within the +/–1 standard deviation error of 4.4 basis points.

Contrasting the two models in Exhibit 7, rich/cheap swings on the old model have been much larger than on the newer version. Sizable differences do arise now (as the new model shows mortgages to be a bit cheaper) and did during late 1995 (when the new model showed mortgages to be much richer).

That thirty-year conventional mortgages are squarely within "fair value" range shows quite clearly in Exhibit 8. Over the fifty-two weeks, mortgages have ranged from 7.4 basis points rich to 5.5 basis points cheap. They are now in the 52nd percentile within the range. Rich/cheap swings on the new model have been much less dramatic than on the Treasury-based model (results not shown — but they ranged from 11.4 basis points rich to 4.3 basis points cheap).

The greater stability of rich/cheap swings is apparent on the thirty-year GNMAs. These ranged from 8.6 basis points rich to 8.5 basis points cheap, currently weighing in at 1.4 basis points rich. In the Treasury-based model, we have ranged from 10.3 basis points rich to 4.8 basis points cheap. Fifteen-year conventional product looks to be very fairly priced in both models.

EXHIBIT 7

Rich (Cheap) Model ■ Treasury versus LIBOR Current-Coupon Model

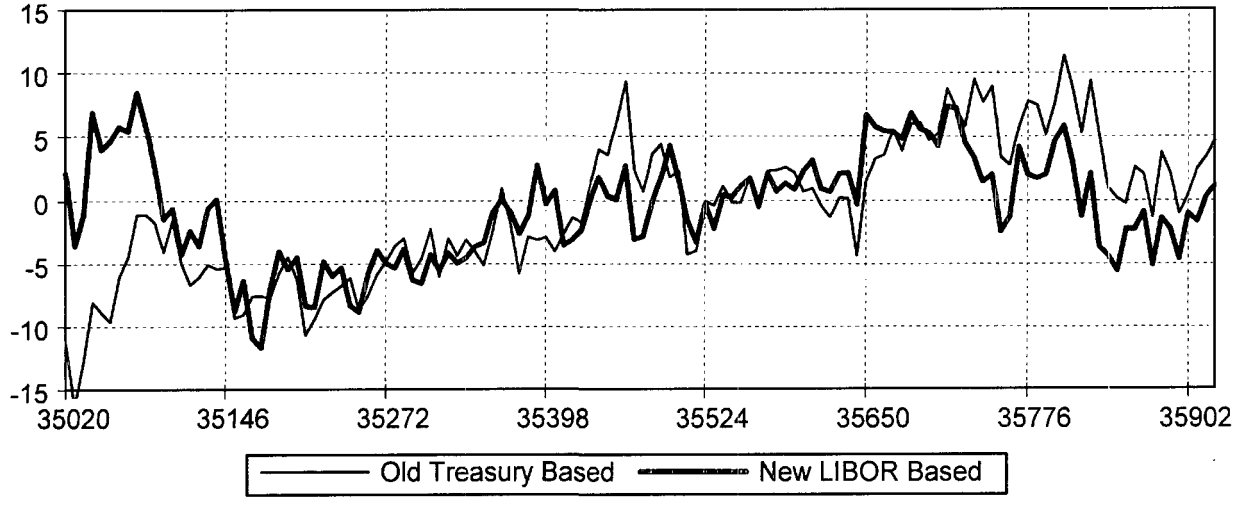


EXHIBIT 8

Current-Coupon Basis Points Rich (Cheap)

	12-Wk Period					20-Wk Period				52-Wk Period			
	Last	Avg	Max	Min	%R	Avg	Max	Min	%R	Avg	Max	Min	%R
GNMA 30-Yr	1.4	–2.8	1.4	–8.5	100	–1.3	5.5	–8.5	71	1.5	8.6	–8.5	58
FNMA 30-Yr	1.2	–2.3	1.2	–5.5	100	–0.4	5.8	–5.5	59	1.5	7.4	–5.5	52
GNMA 15-Yr	–1.9	–5.1	–1.9	–8.3	100	–3.2	9.0	–8.3	37	1.5	14.1	–8.3	29
FNMA 15-Yr	0.0	–2.7	0.1	–5.5	98	–1.1	12.3	–5.5	31	1.3	12.3	–5.5	31
FNMA 7-Yr	3.7	–0.2	3.7	–6.0	100	–0.2	5.1	–6.8	88	1.3	10.0	–6.8	63
GOLD 5-Yr	1.3	–3.5	2.8	–12.3	90	–1.5	3.8	–12.3	84	1.1	11.7	–12.3	57

VII. CONCLUSION

We believe that this new LIBOR-based model provides a good look at the basis between current-coupon mortgages and the swap market. While the model is not meant to provide an automatic trading rule, it can, and does, suggest whether mortgages are rich or cheap relative to fundamental factors that drive spreads. We believe this revised model will prove to be a valuable tool for mortgage portfolio managers.

ENDNOTE

*When we first investigated the relationship between mortgages and longer-dated volatility in Goodman and Ho [1996], we did not find much of anything. In fact, historical volatility and shorter-dated over-the-counter option volatility did a better job of explaining behavior of mortgage products than either cap or swaption volatility. We justified this by the explanation that many mortgage investors who rehedge frequently are dealer desks or hedge funds. These tend to hedge dynamically (alter hedge ratios on a continuous basis rather than buy back the options that they are short). When we repeated the results more recently, we found that longer-term volatility now actually works better than shorter-term volatility. This reflects the increased importance of longer-dated volatility for hedging by both hedge funds and dealer desks, as well as the increased importance of the FNMA/FHLMC portfolio.

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