Hybrid ARM Prepayment Model

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We are releasing a new hybrid ARM prepayment model for agency and non-agency collateral[1]. It projects prepayment speeds for products ranging from hybrid 10/1s to pure ARMs as well as balloons, including level-pay and interest only (IO). Below are the main characteristics of the new model and the main changes from the previous version:

- **Updated HPA effect leads to generally slower speeds before reset:**
  - **Stronger HPA sensitivity:** In the current HPA environment, this leads to generally slower speeds away from reset. The model also uses HPA based on the actual geographical composition (11 states) of each pool.
  - **Slower HPA projection:** We update the HPA projections to the same ones used for the fixed-rate model. These generally imply slower growth.
- **More pronounced reset profile:** The new model has both an earlier ramp-to-reset effect and faster reset speeds. Post-reset speeds, though, decline at a faster rate.
- **Lower burnout deep in-the-money increases callability for seasoned premiums:** The new model burnout profile preserves callability at high rate incentives whereas the old model burnout flattens the entire S-curve.
- **Flatter S-curve for credit impaired collateral.** We account for tightening lending conditions since origination by looking at credit spreads.
- **New loan size effect:** similar to the current fixed-rate model, we introduce a loan size effect that boosts refinancing and lock-in of larger loan size collateral.
- **Four refinancing alternatives:** We assume prospective refinancers consider four different products alternatives: the same product, a 5/1 hybrid ARM, a pure ARM, and a 30-year fixed rate.
- **New state effect:** We now account for differences in transactions costs among 11 states and the rest of the United States.
- **Additional product-dependent effects:**
  - Faster turnover for short resets.
  - Short fixed-period products are more responsive to HPA vs. long resets.
  - Longer fixed-period collateral is more callable vs. short resets.
  - Slower IO turnover vs. level-pay.

[1] *A user guide to the calculator as well as a glossary of the available model knobs can be found in the appendix.*

PREPAYMENT PROJECTIONS

First, we go over the differences in prepayment projections between our new hybrid ARM model and the previous version (Figure 1). You can observe the effects listed on the front page:

- **Speeds are faster for 3/1s and 5/1s that approach reset.** This is largely driven by the earlier ramp-to-reset in the new model, which was absent in the previous version, as well as considerably faster reset speeds in the new model. Since the previous model release, more agency reset data became available, especially for 5/1s, which displayed first reset peaks in 2007 as high as 80% CPR.
- **Discounts are otherwise slower in the new model (see unseasoned 7/1s and 10/1s).** This is largely due to increased sensitivity to low HPA combined with a slower HPA projection, which extends the turnover seasoning ramp and reduces long-term turnover.
- **Premiums are generally slower before reset**. The new model captures the effect of the considerably tighter credit environment since summer 2007 by adjusting the refinance threshold according to the change of credit conditions since origination. With credit-impaired collateral mostly affected, the slowdown in prepayments is especially noticeable in the prepayment projections of coupon 6.0s of unseasoned 7/1s and 10/1s where the ramp-to-reset effect is negligible at low WALA. An extended refinance ramp in the new model also contributes to slower refinance speeds of unseasoned premium collateral.
- **New model burnout preserves deep in-the-money callability**. Therefore, premium prepayments are faster in the new model for -150 bp to 200 bp rate shifts. Moreover, moderate in-the-moneyness exhibits less burnout for unseasoned collateral and greater burnout for seasoned. As a result, callability is higher for unseasoned premium cohorts and less so for seasoned lower coupon collateral.

Figure 1. Prepayment Projections (1y CPR) for FNMA Hybrid Cohorts

	Cpn	Orig	New Version (%1y CPR)									2005 Version (%1y CPR)								
Product		Year	-200	-150	-100	-50	Base	50	100	150	200	-200	-150	-100	-50	Base	50	100	150	200
3/1	5	2005	86.1	82.6	77.3	69.8	**59.8**	48.6	38.8	31.8	28.1	74.7	71.7	68.4	64.8	**59.1**	50.1	36.9	29.0	26.7
	5.5	2007	77.5	74.0	68.4	60.1	**49.5**	38.0	28.0	20.8	17.5	69.7	66.9	64.0	60.6	**55.6**	48.6	37.9	29.7	25.9
		2006	86.2	83.4	78.9	72.2	**62.8**	51.3	40.7	32.2	27.4	74.2	71.4	68.3	64.9	**60.2**	53.1	41.4	32.0	28.2
		2005	87.3	84.6	80.3	74.0	**65.1**	55.7	47.6	40.6	35.4	73.5	70.5	67.4	63.8	**58.3**	49.9	37.3	29.3	26.9
	6	2006	74.4	69.3	62.9	55.3	**47.3**	39.8	33.6	29.2	26.6	67.7	65.3	62.8	60.1	**56.0**	51.4	43.9	35.7	30.1
5/1	4	2004	79.2	71.1	59.7	47.1	**35.5**	27.3	22.7	19.7	17.7	72.0	68.0	55.4	37.9	**22.6**	19.1	17.6	16.9	16.3
		2003	84.0	79.0	71.4	61.6	**54.0**	47.2	41.8	37.5	31.0	70.8	68.5	61.1	46.0	**29.5**	20.9	18.6	17.7	17.1
	4.5	2005	82.1	75.5	65.3	51.6	**37.9**	27.0	22.1	18.7	16.6	74.7	72.4	69.7	58.5	**42.7**	25.4	20.4	18.3	17.4
		2004	81.3	74.6	64.7	51.9	**39.2**	29.0	23.6	20.4	18.0	73.7	71.4	66.5	52.6	**35.1**	22.2	19.2	17.9	17.1
		2003	81.9	76.2	68.1	58.6	**50.4**	43.1	37.3	32.9	28.7	71.0	68.7	62.1	47.8	**31.6**	21.3	18.9	17.9	17.2
	5	2005	83.3	78.0	69.7	58.1	**44.5**	32.4	24.3	20.7	17.9	74.0	72.1	69.9	62.9	**51.3**	38.0	25.2	20.6	19.0
		2004	79.3	73.3	64.9	54.1	**42.5**	32.8	26.1	22.9	20.1	72.7	70.5	68.4	61.2	**47.5**	32.2	22.1	19.4	18.3
	5.5	2007	71.7	68.1	61.9	52.3	**40.3**	28.3	18.8	13.7	11.3	71.0	69.4	67.5	62.0	**54.2**	44.5	34.0	24.0	20.2
		2006	83.3	79.3	72.6	62.2	**48.4**	34.6	23.6	18.6	15.5	74.0	72.3	70.5	66.1	**57.6**	46.4	34.1	24.7	21.4
	6	2007	74.3	71.8	67.2	59.9	**49.8**	38.1	27.3	18.9	14.6	68.2	66.8	65.4	61.8	**55.8**	48.6	40.8	32.0	25.2
		2006	84.6	81.5	76.2	68.0	**56.4**	42.7	30.8	23.0	19.4	72.6	71.0	69.4	67.1	**60.7**	52.0	42.1	30.8	25.1
7/1	4.5	2005	80.9	72.9	60.1	43.4	**28.0**	18.7	15.3	13.1	11.5	75.2	71.1	66.8	53.8	**30.5**	19.7	16.4	14.9	14.2
		2004	75.7	66.3	53.3	38.9	**26.7**	19.8	16.7	14.6	13.1	72.4	68.4	62.4	44.5	**25.8**	18.3	15.6	14.6	14.0
		2003	79.3	71.8	60.8	46.7	**33.3**	23.7	19.4	16.6	14.7	68.5	64.7	58.4	40.1	**24.4**	18.2	15.7	14.8	14.2
	5	2005	80.4	73.3	62.5	48.2	**33.9**	22.8	17.9	15.1	13.3	75.4	71.7	67.9	61.5	**42.1**	26.0	19.2	16.2	15.1
		2004	75.4	67.3	56.2	42.8	**30.8**	22.2	18.6	16.0	14.2	74.5	70.6	66.6	59.5	**39.5**	23.9	18.2	15.8	14.9
		2003	75.4	68.4	59.1	47.2	**35.0**	26.0	21.4	18.9	16.4	66.1	62.6	59.0	52.6	**36.6**	24.4	18.4	16.0	15.3
		2002	83.0	77.7	70.4	60.7	**47.7**	34.7	26.5	22.5	19.6	64.2	60.4	56.7	50.5	**33.5**	21.7	17.7	15.9	15.3
	5.5	2007	72.3	69.4	63.7	54.0	**41.0**	27.3	16.5	11.2	9.0	71.1	68.2	65.2	61.8	**52.0**	36.5	26.5	19.4	15.9
		2006	84.9	81.3	75.0	64.9	**50.4**	34.9	22.6	16.9	13.8	74.9	72.1	68.9	65.6	**58.3**	42.2	29.1	21.5	17.9
		2005	84.0	79.4	72.0	60.9	**46.2**	32.2	21.8	17.4	14.6	75.4	72.5	69.1	65.7	**57.3**	39.4	27.1	20.6	17.5
	6	2007	69.1	67.3	63.5	56.6	**46.1**	33.6	22.0	13.7	10.1	69.2	66.6	63.8	60.8	**54.8**	42.8	29.7	21.6	16.6
		2006	83.9	81.0	75.7	67.3	**55.1**	40.5	27.9	19.8	16.3	73.8	71.3	68.6	65.5	**62.1**	51.2	36.0	26.7	21.2
10/1	4.5	2004	72.7	61.3	45.8	30.7	**19.3**	14.9	12.5	11.1	9.9	74.5	69.7	59.9	44.4	**26.8**	19.4	15.3	12.4	11.7
		2003	75.1	63.0	45.8	29.0	**17.9**	14.2	12.1	10.6	9.4	70.8	63.5	51.0	31.4	**22.4**	16.8	13.2	11.9	11.4
	5	2005	80.7	72.7	60.1	43.3	**27.5**	16.9	13.3	11.3	10.0	77.9	74.0	66.8	54.9	**35.7**	25.3	18.8	14.7	12.9
		2004	71.7	61.4	47.7	33.4	**22.1**	16.3	13.7	11.9	10.7	75.9	72.0	65.4	53.5	**35.3**	23.7	17.8	14.3	12.6
	5.5	2006	82.9	78.8	71.4	59.3	**42.6**	26.4	15.2	11.4	9.4	77.0	73.9	69.3	61.0	**49.7**	32.6	25.7	19.8	15.2
		2005	82.4	76.6	67.3	53.4	**36.9**	22.9	15.4	12.4	10.7	76.2	72.9	67.2	58.4	**45.4**	29.9	24.0	18.4	14.6
	6	2007	68.6	65.6	59.9	50.4	**37.8**	24.7	14.4	8.9	6.9	71.2	67.8	61.7	53.6	**43.2**	30.3	23.5	18.5	13.6
		2006	83.2	79.1	72.1	61.1	**46.0**	30.6	19.2	14.0	11.5	75.8	72.9	68.9	61.5	**51.8**	37.9	27.7	22.1	17.2

Source: Lehman Brothers.
Note: Projection as of January 18, 2008 at unchanged mortgage rates: 3/1 – 4.52%, 5/1 – 4.74%, 7/1 – 4.79%, 10/1 – 4.95%

IMPACT ON VALUATION

Before going into the details of the new hybrid ARM prepayment model, we look at the impact of the update on valuation.

Effect of Changes on TBAs and Seasoned Collateral

Figure 2 compares valuation metrics between the new model and its predecessor for generic TBAs. Given that base case speeds are in general slower in the new model before reset, it should come as no surprise that premiums look cheaper while discounts look richer on a ZV basis.

However, with optionality, the weaker deep-in-the-money burnout of the new model increases option cost, which makes differences in OAS less pronounced than ZV spreads as we move up the coupon stack. In the extreme case, for coupon 6.0s in 5/1 TBAs, the new model widens ZV spread but tightens OAS.

Looking across products, the impact of slower pre-reset speeds is mitigated in 3/1s and 5/1s because of their earlier ramp-to-reset and faster reset spike. As a result, OAD extends more in longer resets than in shorter resets. In addition, as faster reset spikes leave less balance at reset, tail values are generally lower in the new model.

Figure 2. Valuation Effect of Model Changes on TBAs (0 WALA synthetic pools)

		New Hybrid ARM Prepayment Model							Previous Hybrid ARM Prepayment Model						
			LIBOR							LIBOR					
Prod.	Security	Treas. OAS	OAS	ZV	Option Cost	OAD	OAC	Tail Price (32nds)	Treas. OAS	OAS	ZV	Option Cost	OAD	OAC	Tail Price (32nds)
3/1	**FH 3.5s C226**	124	58	81	23	2.33	-0.70	4	126	61	88	27	2.14	-0.80	7
	FH 4.0s C226	131	65	89	24	1.99	-0.70	5	129	64	91	27	1.76	-0.70	8
	FH 4.5s C226	129	62	89	27	1.58	-0.80	7	121	55	83	28	1.35	-0.60	10
	FH 5.0s C226	124	57	85	28	1.16	-0.70	8	112	47	62	15	1.06	-0.30	11
	FH 5.5s C226	112	46	71	25	0.80	-0.60	9	103	39	45	6	0.97	-0.20	12
	FH 6.0s C226	115	49	67	18	0.60	-0.40	8	118	54	59	4	0.99	-0.20	11
5/1	**FH 4.0s C525**	100	37	73	36	3.27	-1.20	-6	110	48	79	30	2.66	-1.10	7
	FH 4.5s C525	105	41	81	40	2.61	-1.30	-2	106	43	81	38	2.01	-1.10	8
	FH 5.0s C525	108	44	88	44	1.87	-1.30	1	98	36	72	37	1.39	-0.90	8
	FH 5.5s C525	113	48	89	42	1.22	-0.90	2	104	41	67	26	1.13	-0.60	7
	FH 6.0s C525	112	47	80	33	0.84	-0.50	3	112	49	65	16	1.05	-0.40	6
7/1	**FH 4.5s C525**	99	36	76	40	3.54	-1.40	-3	95	38	79	42	2.91	-1.60	4
	FH 5.0s C525	110	46	94	49	2.72	-1.50	-1	98	39	90	50	2.08	-1.60	4
	FH 5.5s C525	117	52	102	50	1.86	-1.20	0	101	41	84	43	1.44	-0.90	4
	FH 6.0s C525	118	53	94	41	1.23	-0.80	1	109	49	75	25	1.25	-0.50	4
10/1	**FH 4.0s C525**	48	-4	37	42	5.65	-1.50	-12	63	12	49	37	4.73	-1.30	-2
	FH 4.5s C525	73	19	64	46	4.92	-1.70	-8	80	28	73	46	4.01	-1.60	-1
	FH 5.0s C525	91	35	89	54	3.93	-2.10	-5	89	34	91	56	3.07	-1.90	0
	FH 5.5s C525	107	48	110	62	2.74	-1.90	-3	98	42	102	60	2.20	-1.80	1
	FH 6.0s C525	108	47	104	56	1.68	-1.30	-1	110	53	103	50	1.75	-1.30	1

Risk metrics are based on prices as of the close of January 18, 2008. Rates: 3/1 – 4.52%, 5/1 – 4.74%, 7/1 – 4.79%, 10/1 – 4.95%.
Source: Lehman Brothers

For seasoned cohorts (Figure 3), the situation changes with more collateral closer to reset and more accumulated HPA. With an earlier ramp to reset and faster reset spike, the new model tightens ZV and option-adjusted spreads for 3/1s of 2005 and 5/1s of 2003–04. In longer resets such as 7/1s and 10/1s, the stronger HPA sensitivity of the new model speeds up pre-2005 vintages due to their accumulated equity and tightens both ZV and option-adjusted spreads.

Figure 3. Valuation Effect of Model Changes on FNMA Seasoned Collateral

			New Hybrid ARM Prepayment Model					Previous Hybrid ARM Prepayment Model				
			LIBOR					LIBOR				
Product		Year	OAS	ZV	Opt. Cost	OAD	OAC	OAS	ZV	Opt. Cost	OAD	OAC
3/1	5.0	2005	57	62	6	0.49	-0.20	64	67	3	0.64	-0.10
	5.5	2007	32	52	20	0.41	-0.29	35	39	4	0.66	-0.10
		2006	31	40	10	0.22	-0.13	48	50	1	0.52	0.00
	6.0	2006	58	67	8	0.45	-0.27	45	46	1	0.58	0.00
5/1	4.0	2004	51	72	21	0.74	-0.40	66	90	24	0.82	-0.59
		2003	44	64	20	0.41	-0.30	74	93	19	0.44	-0.40
	4.5	2005	48	77	30	0.75	-0.60	54	82	28	0.67	-0.56
		2004	50	74	24	0.64	-0.48	62	86	24	0.59	-0.56
		2003	69	88	19	0.53	-0.26	73	92	19	0.56	-0.35
	5.0	2005	38	69	32	0.51	-0.56	45	65	20	0.50	-0.36
		2004	57	77	20	0.56	-0.40	56	72	16	0.44	-0.26
	5.5	2007	48	86	38	0.72	-0.56	40	59	20	0.72	-0.38
		2006	41	76	35	0.44	-0.50	44	59	15	0.53	-0.23
	6.0	2007	37	67	30	0.47	-0.32	48	60	12	0.78	-0.28
		2006	35	64	29	0.23	-0.27	48	55	7	0.55	-0.10
7/1	4.5	2005	34	76	42	1.34	-1.28	42	87	45	1.23	-1.38
		2004	35	69	34	1.21	-0.93	52	89	38	1.13	-1.26
		2003	17	46	29	0.79	-0.65	57	88	32	0.95	-1.05
	5.0	2005	41	83	42	1.04	-1.11	42	86	43	0.82	-1.03
		2004	53	87	34	1.11	-0.94	52	91	39	0.78	-0.92
		2003	34	61	27	0.73	-0.63	58	85	28	0.71	-0.69
		2002	2	23	20	0.37	-0.38	62	86	24	0.60	-0.54
	5.5	2007	39	87	48	0.83	-0.85	39	72	33	0.84	-0.59
		2006	35	81	46	0.43	-0.74	42	65	23	0.62	-0.28
		2005	44	88	44	0.60	-0.87	44	69	26	0.61	-0.36
	6.0	2006	41	81	40	0.33	-0.46	49	56	8	0.68	-0.08
10/1	4.5	2004	35	79	45	2.20	-1.70	36	84	47	1.82	-1.80
		2003	28	71	43	2.03	-1.67	41	82	41	2.02	-1.60
	5.0	2005	39	94	55	1.81	-2.02	37	93	56	1.49	-1.83
		2004	51	96	45	2.06	-1.67	41	92	50	1.44	-1.68
	5.5	2006	42	101	60	1.03	-1.53	41	92	51	1.13	-1.20
	6.0	2007	40	99	58	1.03	-1.18	48	98	50	1.23	-1.26

Risk metrics are based on prices as of the close of January 18, 2008. Rates: 3/1 – 4.52%, 5/1 – 4.74%, 7/1 – 4.79%, 10/1 – 4.95%.
Source: Lehman Brothers

Effect on the Lehman Brothers Hybrid ARM Index

As of January 18, 2008, the new model shortens the duration of the Lehman Brothers Hybrid ARM index by 0.14 year and tightens OAS by 9.5 bp (Figure 4). With most of the index universe in premiums, the slower base projections of the new model widen ZV spread. However, less deep in-the-money burnout inflates the option cost in the new version, which results in tightening of OAS and shortening OAD.

The same pattern can be observed across products except for 7/1s, which are the most seasoned and have the most accumulated HPA of hybrid products making up the index. Since the new model has a stronger HPA effect, both ZV and option-adjusted spreads in 7/1 are tightened.

Figure 4. Valuation Effect of Model Changes on the Hybrid Index

	New Hybrid ARM Model				Previous Hybrid ARM Model			
	LIBOR				LIBOR			
Product	OAS	ZV	Opt. Cost	OAD	OAS	ZV	Opt. Cost	OAD
3/1	45.3	61.2	15.9	0.47	45.1	50.1	5.0	0.66
5/1	41.6	70.3	28.8	0.50	50.6	66.5	15.9	0.66
7/1	34.5	73.5	39.1	0.81	48.4	78.5	30.1	0.88
10/1	40.2	98.6	58.4	1.22	45.7	94.7	49.1	1.29
Hybrid ARM	40.0	73.8	33.8	0.64	49.5	71.7	22.2	0.78

Risk metrics are based on prices as of the close of January 18, 2008.
Rates: 3/1 – 4.52%, 5/1 – 4.74%, 7/1 – 4.79%, 10/1 – 4.95%.
Source: Lehman Brothers.

MODEL OVERVIEW

The hybrid ARM model comprises two parts: turnover and refinancing. Turnover prepayments are essentially discount speeds. They mostly include property sales, but also defaults and cash-outs. Refinancing prepayments can be viewed as the difference between premium and discount speeds. Thus, they refer to borrowers exercising their interest rate option by prepaying their current mortgage to get a new one at a lower rate while typically staying in the same house. In this section, we provide an overview of the factors driving prepayments in both turnover and refinancing.

Turnover

Turnover prepayments exhibit the following features:

- **Turnover seasoning curve:** Borrowers who have just got a new mortgage and possibly just moved into their property are not immediately inclined to sell their real estate and get a new mortgage. The turnover seasoning refers to the resulting ramp-up period observed in turnover prepayments.
- **Home Price Appreciation (HPA):** A hot housing market encourages borrowers' mobility (trade-up), especially for credit impaired borrowers. It boosts long-term prepayments and shortens the seasoning ramp.
- **Fixed period:** A borrower with a shorter fixed-period hybrid ARM mortgage (such as a 3/1 vs. a 10/1 borrower) has a shorter horizon and shows a higher tendency to move.

- **Lock-in:** Lock-in refers to the disincentive for borrowers to move if this would imply getting a higher rate mortgage. Lock-in is the only rate-related effect in turnover.
- **Seasonality:** The largest component of turnover is home sales. These are highly seasonal with higher sales in warmer-weather months before school year starts.
- **SATO:** The Spread AT Origination (SATO) is defined as the difference between the collateral original WAC and the average original WAC of similar products with the same origination date. SATO is used as a proxy for the borrowers' credit quality.
- **State:** Purchase transaction costs can vary by state and affect turnover prepayment speeds.

Refinancing

Refinancing covers all prepayments associated with interest rates (except lock-in). We assume that borrowers decide on the exercise of their prepayment option by looking at the present value of the savings they would achieve when refinancing. The savings are computed under the following assumptions:

- **Four Refinancing Alternatives:** Borrowers have the option to refinance into four different products: the same product, a 5/1 hybrid ARM, a pure ARM, and a 30-year fixed rate. They don't simply go for the product with higher savings, though. The initial choice may reveal a preference for their current product if it would have been more advantageous at that point to take another one. So, for example, taking a 10/1 when the yield curve was steep reveals a preference for longer products, but doing the same when the curve is flat does not.
- **Forward looking behaviour:** As a result of borrowers' anticipation of an upcoming rate reset, speeds start ramping several months prior to reset with steeper spike around reset.
- **PV of savings is based on above-market rates:** This ensures that borrowers have a preference for low payment products (e.g., IOs).

Refinancing prepayments have the following characteristics:

- **Refinance ramp:** Borrowers who have just closed their mortgages are less prone to refinance shortly given the hassle and costs of taking out another mortgage. The refinance ramp refers to the initial disinclination to refinance even if the mortgage is in the money.
- **Loan size:** Given the same fixed cost, large loan sizes have a lower dollar average refinancing cost and have faster refinancing speeds. (Benefit is larger as the loan size increases).
- **SATO:** High SATO borrowers' refinancing activity is hampered by their lower credit quality.
- **Credit Environment:** In a tight credit environment, credit-impaired borrowers may have difficulty qualifying for a refinance mortgage after controlling for SATO. This effect adjusts for the changes in the availability of the credit between origination and current factor date.
- **State:** Refinancing transaction cost variations across states alter refinancing behavior.

- **Prepayment Penalties:** These result in a "hold-and-release" prepayment pattern as borrowers postpone their refinancing activity until after the prepayment penalty term expires.
- **Burnout:** Borrowers who have passed on a given refinancing opportunity are less likely to refinance in the future if a similar or worse opportunity were to be available again. The burnout effect, therefore, accounts for both the changes in the pool composition and the additional information revealed by actual prepayments and how those affect the refinance threshold and the responsiveness to a saving opportunity.

DETAILED CHANGES

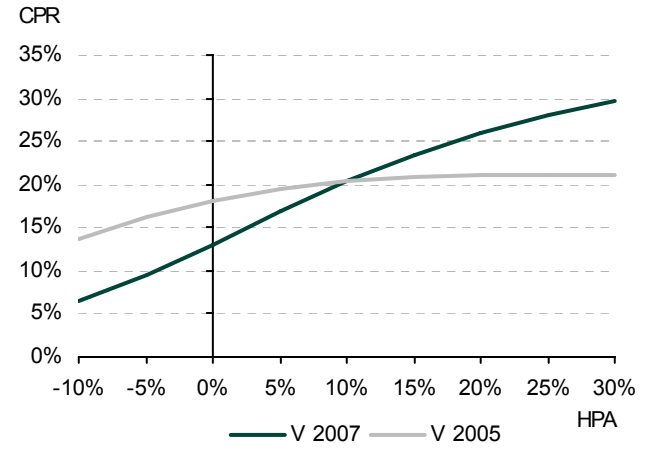
Home Price Appreciation (HPA) Effect

We both revisit the HPA effect in our model and update our HPA model projection to the one used in our fixed-rate prepayment model (see HPA projection model discussion below).

Two different measures of HPA enter our projections. First, we consider the "recent" HPA that corresponds to the collateral geographic distribution. Recent HPA moves in the same way, regardless of seasoning, and captures the general change in economic conditions in the area where the borrower lives. Second, we take into account the accumulated HPA for a given pool. With this measure, seasoned pools are a lot less sensitive to changes in the housing market, as they already have sizeable accumulated equity. This measure is more borrower/loan specific and captures changes in the LTV of the loan.

We increased turnover sensitivity to HPA in the new model (Figure 5). In flat to negative HPA, the new model is now 6%-8% CPR slower than the older version.

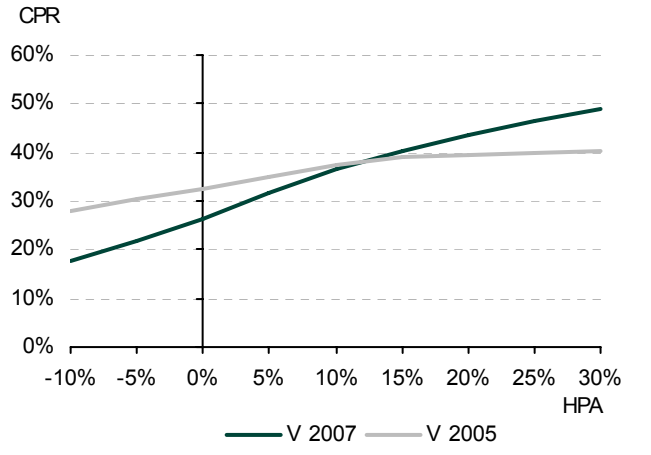
Figure 5. Stronger HPA Effect on Turnover…



Source: Lehman Brothers.

Note: Prepayments on hypothetical FNMA 5/1 collateral with -50 bp rate incentive, 175k loan size, 0 bp SATO, 13-month WALA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

Figure 6. …And Refinancing



Source: Lehman Brothers.

Note: Prepayments on hypothetical FNMA 5/1 collateral with 50 bp rate incentive, 175k loan size, 0 bp SATO,13-month WALA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

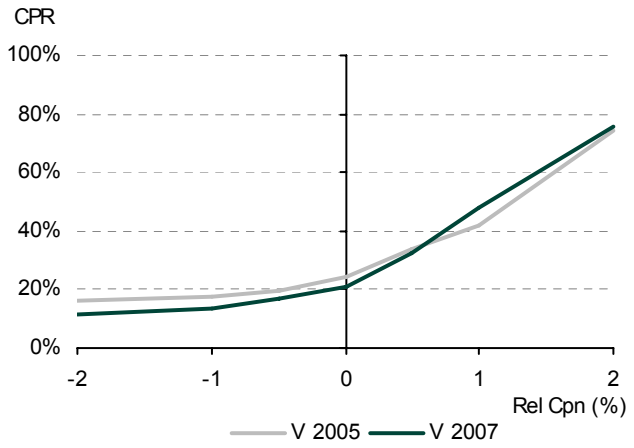
The new model also features more HPA sensitivity on in-the-money speeds. Accumulated HPA lowers LTVs and moves the refinancing threshold lower. Recall that the refinancing threshold is defined as the minimum rate incentive that would trigger rate-sensitive refinancing. The resulting effect on prepayment speeds is an increased HPA sensitivity for par and premium collateral. Another feature of the new model is the HPA "curing" of SATO: Borrowers with accumulated equity overcome their impaired SATO and are more likely to refinance.

S-Curve

The new S-curve is quite different in the new model, especially for discounts. Figure 7 shows the updated S-Curve profile of the new model at 0% HPA. Speeds are 4%-5% CPR slower for negative rate incentives at WALA 19 in 5/1s. This is largely due to a stronger HPA effect on turnover. On the refinancing side, the new S-Curve is more callable in the 0-100 bp rate incentive range but less callable past 100 bp in-the-money.

In addition, the new model features a slower refinancing ramp. The refinance ramp is the ramp-up period for borrowers who have just entered a mortgage to fully respond to positive rate incentives. In the new model at 0% HPA, we extend the ramp from 12 to 21 months. Note that in the previous version of the model, the refinance ramp is not product-dependent: In Figure 8, 3/1 and 5/1 refinancing ramps in the previous model are superposed.

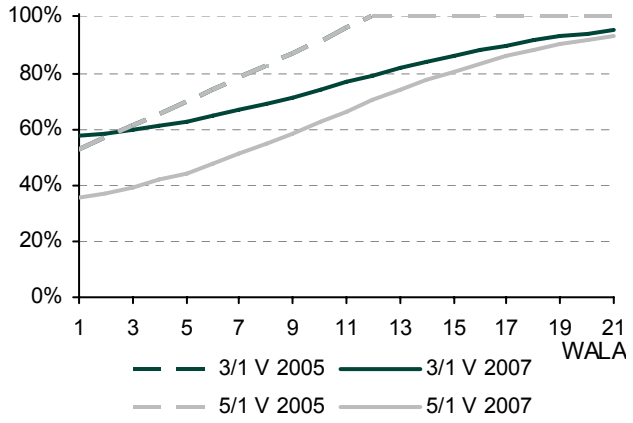
Figure 7. S-Curves at WALA 19



Source: Lehman Brothers.

Note: Prepayments on hypothetical FNMA 5/1 collateral with no rate incentive until WALA 18, 175K loan size, 0 bp SATO and 0% HPA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

Figure 8. Difference in Refinancing Ramp



Source: Lehman Brothers.

Note: Prepayments as % of fully seasoned on hypothetical FNMA 5/1 and 3/1 collateral with 50 bp rate incentives at each WALA, 175K loan size, 0 bp SATO and 0% HPA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

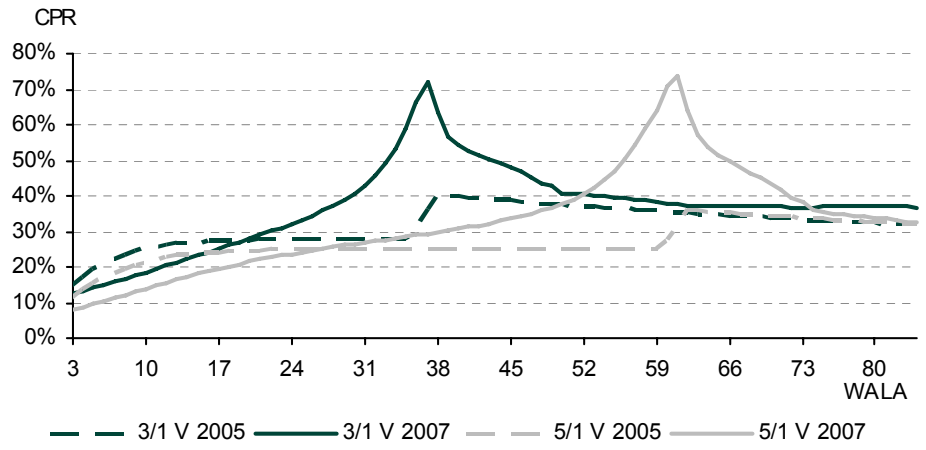
Forward-Looking Behavior Prior to Reset

Both hybrids and balloons display a significant ramp up in speeds toward the end of the fixed-rate period. The model (Figure 9) captures this effect as a forward-looking behavior of borrowers[2] who essentially perceive their mortgage rate as a blend of their current and fully indexed rates. In this blending, the weight of the fully indexed rate increases as the reset approaches, creating the ramp to reset. We also assume that

[2] *When looking at large cohorts, dispersion in reset dates around the average date also plays a strong role.*

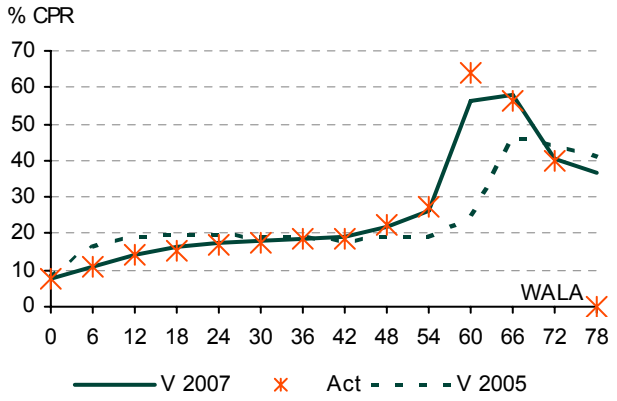
borrowers have an "aversion" for the floating rate period and try to refinance even if the fully indexed rate is similar to the current rate. The resulting projections are shown in Figure 10 for 5/1s and Figure 11 for 3/1s. Finally, the prepayment upshot at reset is amplified by a "payshock" effect proportional to the change in monthly payments experienced by borrowers.

Figure 9. Rate Reset Effect



Source: Lehman Brothers.
Note: Prepayments on hypothetical FNMA 3/1 and 5/1 collateral with 0 bp rate incentive, 175K loan size, 0 bp SATO and 0% HPA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

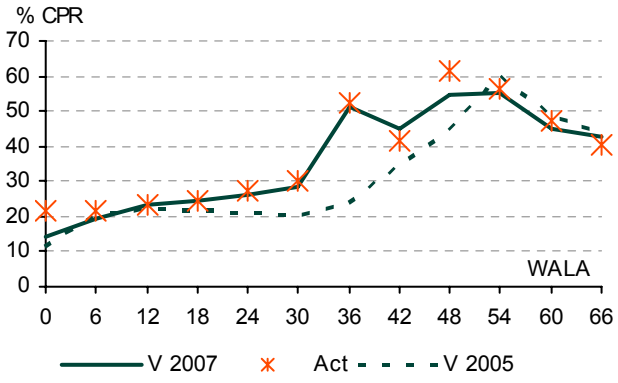
Figure 10. 5/1 Model Fits – Aug. 2006 to Dec. 2007



Source: FNMA, FHLMC, Lehman Brothers.

Notes: Actual vs. Model prepayments at negative rate incentives for 5/1 level-pay, non-ppp, conventional collateral, August 2006-December 2007 period.

Figure 11. 3/1 Model Fits – Aug. 2006 to Dec. 2007



Source: FNMA, FHLMC, Lehman Brothers.

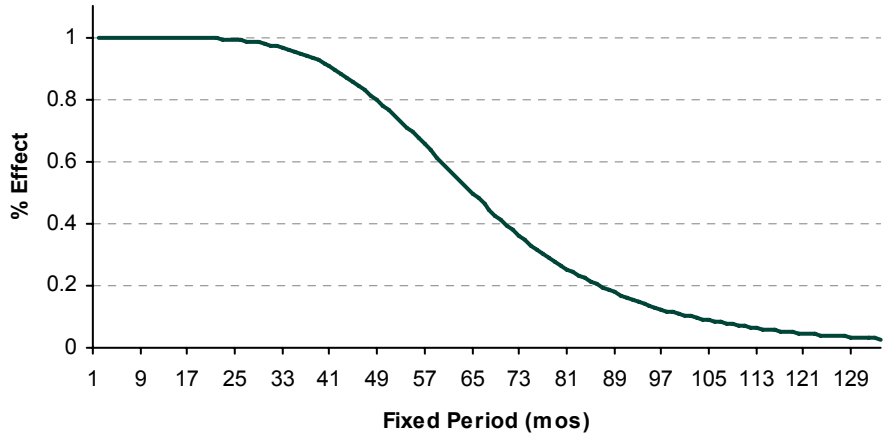
Notes: Actual vs. Model prepayments at negative rate incentives for 3/1 level-pay, non-ppp, conventional collateral, August 2006-December 2007 period.

Product-Dependent Effects

The prepayment profile of hybrid ARMs varies greatly by product type. A large portion of hybrid ARMs borrowers take advantage of lower initial monthly payments and intend to refinance or move before their rate resets. Hence, borrowers with shorter-reset products tend to have a shorter horizon than longer-resets or fixed-rate borrowers.

A significant change over the current version of the model is the inclusion of several additional product-dependent effects in both turnover and refinancing. Recall that the only fixed-period effect in the older hybrid ARM prepayment model was in turnover seasoning. We now have more effects that kick in for short resets and gradually disappear for products closer to fixed rates (Figure 12). We also let these fixed-period dependent effects decay as the collateral seasons.

Figure 12. Fixed Period Effect Scaling

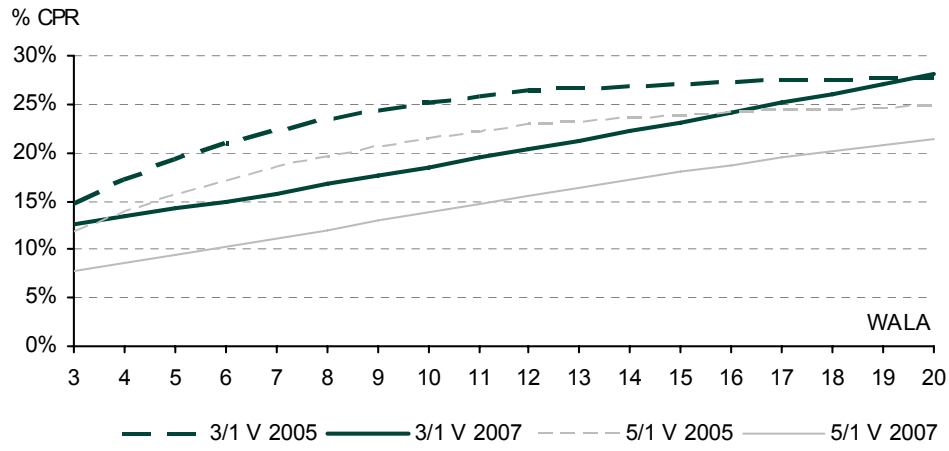


Source: Lehman Brothers

Product-dependent effects appear in:

- **Turnover: Initial, Seasoning, and Long Term**. We extend the previous model fixed-period effect to the entire age range of the turnover seasoning curve. The pre-reset seasoning is steeper for shorter resets, whereas long-term turnover is lower for longer resets.
- **Refinance Incentives and Potential.** The new model allows fixed-period effects in refinancing as well. When evaluating potential net savings from refinancing, the model uses a larger discount rate for the holders of shorter reset collateral to reflect their shorter horizon. Consequently, borrowers with longer reset products are more responsive to interest rate changes than shorter resets.
- **HPA sensitivity.** Borrowers with shorter resets tend to be more responsive to HPA in turnover. Because of their propensity to have more mobility, they will more readily take advantage of faster HPA and be more affected by a slower HPA environment.

Figure 13. Turnover Seasoning at 0 Rate Incentives and 0% HPA



Source: Lehman Brothers.
Note: Prepayments on hypothetical FNMA 3/1 and 5/1 collateral with 0 bp rate incentive, 175K loan size, 0 bp SATO and 0% HPA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

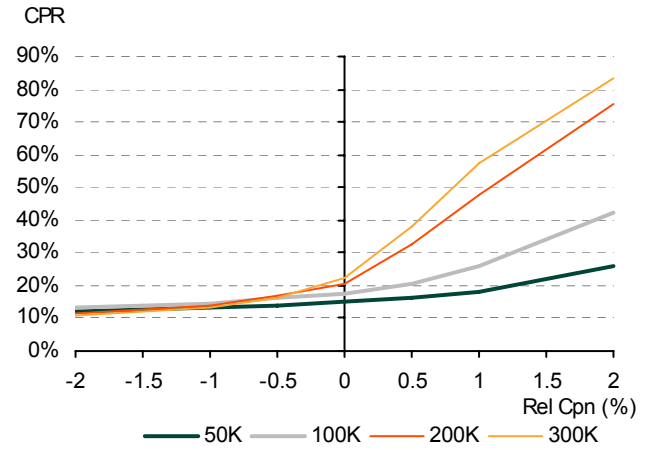
Loan Size Effect

Borrowers display different prepayment behaviors depending on their mortgage size. In the case of refinancers, a larger loan size implies that fixed refinancing costs represent a smaller portion of the outstanding balance. Hence, borrowers with larger loan size tend to be responsive to refinancing incentives than their smaller-size counterparts.

We introduce a new loan size effect in our new hybrid ARM model in both refinancing and turnover (Figure 14 and Figure 15). The loan size effect is similar to that in our fixed rate model even if we do not account for variations in loan size dispersion. There are two main loan size effects:

- Callability is dramatically lower for low loan sizes. This means both a higher refinancing threshold and a flatter s-curve and affects both refinancing and lock-in.
- Turnover for low loan sizes is a little lower, possibly reflecting a higher share of second homes.

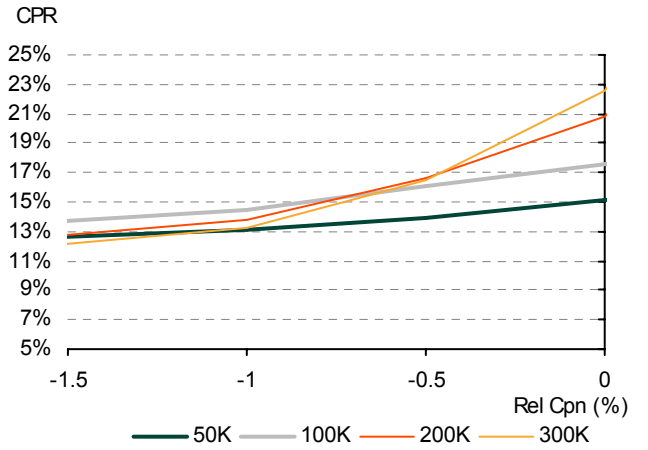
Figure 14. S-Curve by Loan Size



Source: Lehman Brothers.

Note: Prepayments on hypothetical FNMA 5/1 collateral, 0 bp SATO, 0% HPA, 19-month WALA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

Figure 15. Loan Size Effect on Discounts



Source: Lehman Brothers.

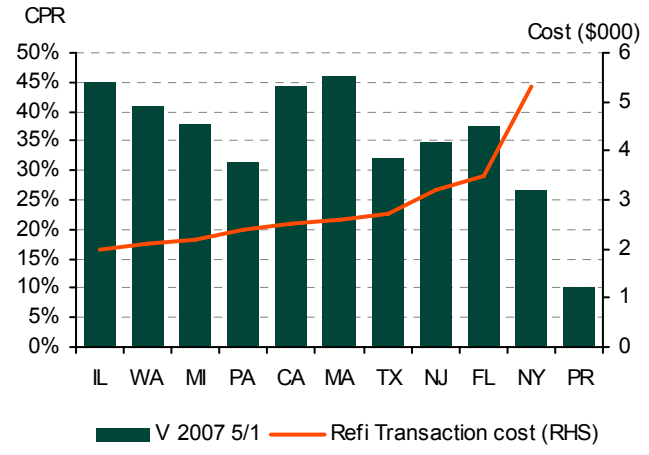
Note: Prepayments on hypothetical FNMA 5/1 collateral, 0 bp SATO, 0% HPA, 19-month WALA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

Geography Effect

There are considerable variations in the prepayment profiles between states. In addition to variations in housing market conditions, purchase and refinance transaction costs as well as regulations differ greatly and can further alter prepayment speeds. As opposed to the previous model, in which state effects are absent, the new hybrid ARM model reflects the empirical prepayment profile differences between states using the same 11-state breakdown described in the HPA section. The main geography effects are as follows:

- **States with significantly higher refinance transaction costs display muted in-the-money speeds.** This is the case for states like Texas, New Jersey, Florida, and, especially, New York (Figure 16).
- **Separate geography effect on turnover.** Since state transactions and regulations are not limited to refinancing activities but also impact home sales, we also introduce a state effect in long-term turnover and turnover seasoning (Figure 17).

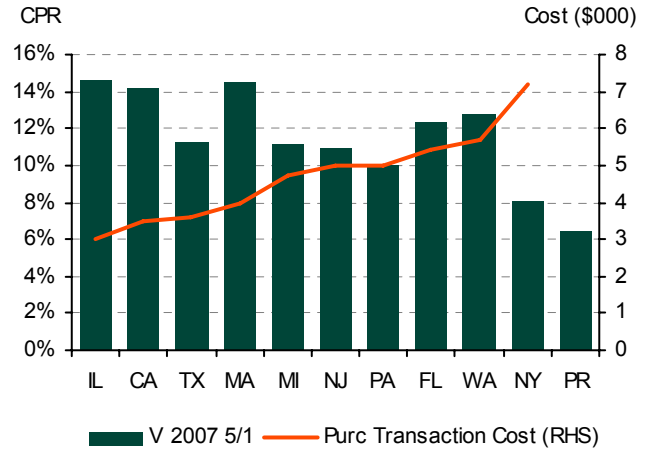
Figure 16. State effect on premiums (+100 bp)



Source: Lehman Brothers

Note: Prepayments on a hypothetical FNMA 5/1 collateral with 100 bp rate incentive, 13-month WALA, 175K loan size, and 0% HPA for various states.

Figure 17. State effect on discounts (-50 bp)



Source: Lehman Brothers

Note: Prepayments on a hypothetical FNMA 5/1 collateral with -50 bp rate incentive, 13-month WALA, 175K loan size, and 0% HPA for various states.

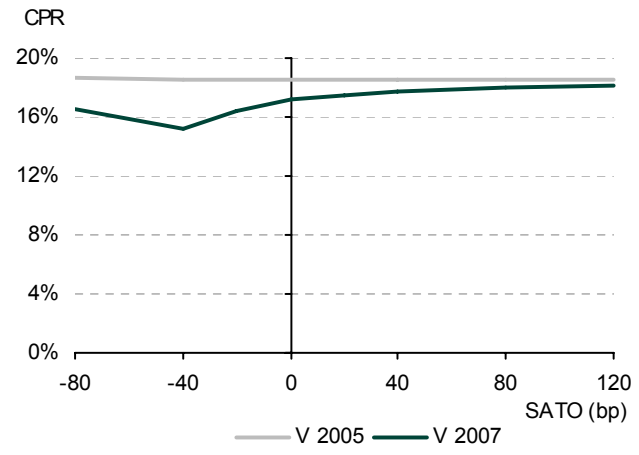
Spread at Origination (SATO) Effect

Credit quality has a significant effect that can greatly alter borrowers' prepayment behavior. Credit-impaired borrowers exhibit less callability as they are likely to have fewer refinancing options while being offered higher mortgage rates. In our model we use SATO as a measure of credit quality. Recall that SATO refers to the difference between the collateral WAC and the average WAC of similar loan products originated in the same month. We upgrade the SATO effect in our model by introducing:

- **HPA curing of SATO:** Accumulated equity lets borrowers overcome their credit impairment and increases their sensitivity to interest rate changes.
- **Impact of credit conditions at origination:** Controlling for SATO, borrowers holding mortgages originated amid tight credit standards are likely to have better credit quality. In our model update, SATO is adjusted depending on the tightness/ease of credit at origination.
- **SATO in both long-term turnover and turnover seasoning:** We differentiate the SATO effect on long-term turnover and on turnover seasoning.
- **Positive and negative SATO are treated differently:** Points paid to lower mortgage rates alter the use of SATO as a credit quality proxy. Since this is more prevalent for negative SATO, we differentiate the effects of positive and negative SATO.

As positive SATO collateral has a higher concentration of young, more mobile borrowers, discount speeds increase for positive SATOs (Figure 18). On the refinancing side, in-the-money speeds are muted in the positive SATO range (Figure 19) as credit-impaired borrowers have fewer refinancing options and are therefore less callable.

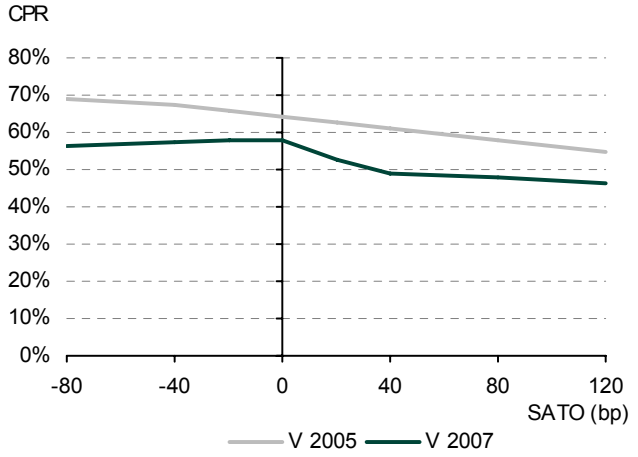
Figure 18. SATO Effect on Discounts



Source: Lehman Brothers

Note: Prepayments on a hypothetical FNMA 5/1 collateral with -100bp rate incentive, 19-month WALA, 175K loan size, and 5% HPA.

Figure 19. SATO Effect in Refinancing



Source: Lehman Brothers

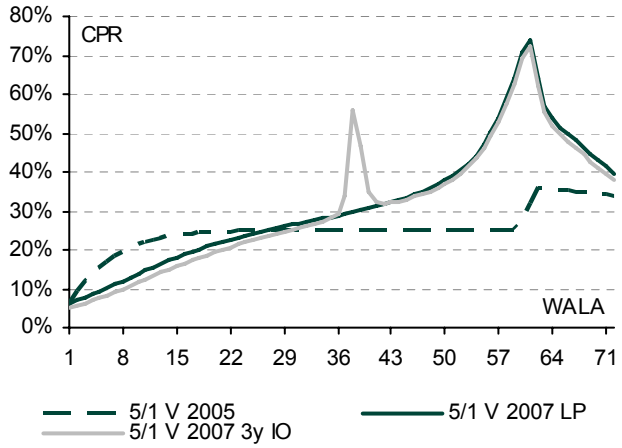
Note: Prepayments on a hypothetical FNMA 5/1 collateral with 100bp rate incentive, 25-month WALA, 175K loan size, and 5% HPA.

Interest-Only (IO) Effect

Borrowers who have entered an interest-only (IO) mortgage pay only interest for a specified time period (IO term) before amortization begins. Interest-Only Hybrid ARMs have significantly grown in popularity as they provide additional affordability while maximizing tax deduction. In 2007, agency Hybrid ARM IO mortgages represented 82% of the conventional hybrid ARM issuance (as opposed to 10% for agency fixed rate).

The new hybrid ARM model incorporates Interest-Only effects, which were absent in the previous model. The IO impact on prepayment speeds is primarily captured through the product-dependent effects discussed earlier: initial and long-term turnover, refinance ramp and refinance potential and net savings calculation are adjusted for IO collateral. In addition, the model includes a refinancing spike at IO term expiration due to the resulting payment shock when amortization payments are added to interest payments. Since most hybrid IO mortgages have an IO term that coincides with their fixed period, this results in a higher refinance spike at reset when borrowers not only face a higher mortgage rate but also increased monthly payments with amortization. In Figure 20 and Figure 21, we use an IO term different than the fixed period length on purpose, in order to separate the effects of reset and amortization shock.

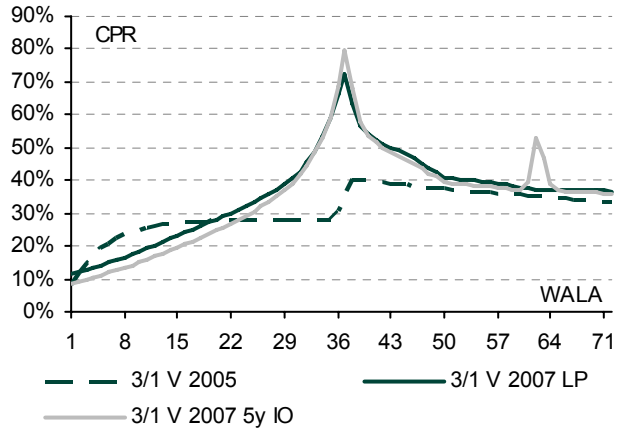
Figure 20. 5/1 Prepayment Projections, LP vs. 3y IO



Source: Lehman Brothers.

Note: Prepayments on hypothetical FNMA 5/1 3-year IO collateral with 0 bp rate incentive, 175K loan size, 0 bp SATO and 0% HPA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

Figure 21. 3/1 Prepayment Projections, LP vs. 5y IO



Source: Lehman Brothers.

Note: Prepayments on hypothetical FNMA 3/1 5-year IO collateral with 0 bp rate incentive, 175K loan size, 0 bp SATO and 0% HPA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

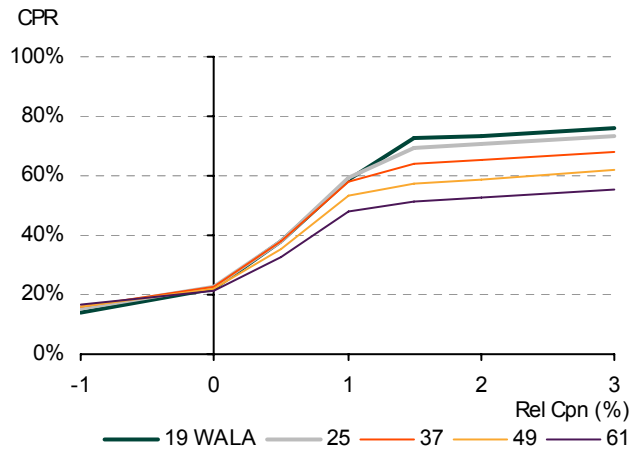
Burnout Effect

Our expectation of a given pool callability changes as the pool goes through different rate environments. Borrowers left in the pool after a 100 bp rally are less likely to respond when given only a 50 bp incentive further down the road, but they may very well refinance at 150 bp. This is not simply due to the fact that the more callable borrowers leave the pool, but also to the revealed preferences of the borrowers that choose to remain.

The burnout effect in our model can be noticed as the refinancing threshold appears to move out after a pool is continuously exposed to rate incentives. In Figure 22 and Figure 23, we plot the S-curve projections under both the new and previous models at various WALA for a hypothetical 10/1 pool that has been subject to 100 bp rate incentives from WALA 19 onwards. As the pool ages, the chances of the remaining borrowers to respond to 100 bp incentives drops, though response to higher incentives declines a lot less. We revisit the burnout effect in the new model:

- **S-Curve burnout:** As we mentioned, the burnout should act almost as a shift in refinancing threshold, but in the old model this was simply an overall multiplier. Moreover, mild rate incentives preserve deep-in-the-money callability.
- **Weaker short-term burnout:** The new model has a slightly weaker burnout in the short run that turns into a stronger effect in the medium run.

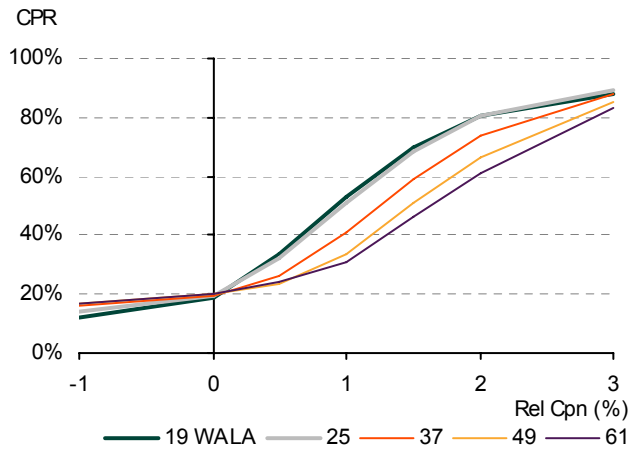
Figure 22. Projected Burnout v 2005



Source: Lehman Brothers

Note: Prepayments on a hypothetical FNMA 10/1 collateral with no incentives for the first 18 months and 100 bp rate incentives from then on for various WALA, 175K loan size, and 0% HPA.

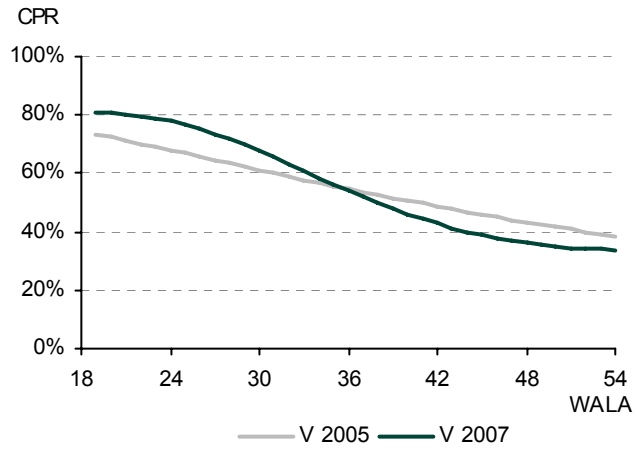
Figure 23. Projected Burnout v 2007



Source: Lehman Brothers

Note: Prepayments on a hypothetical FNMA 10/1 collateral with no incentives for the first 18 months and 100 bp rate incentives from then on for various WALA, 175K loan size, and 5% HPA.

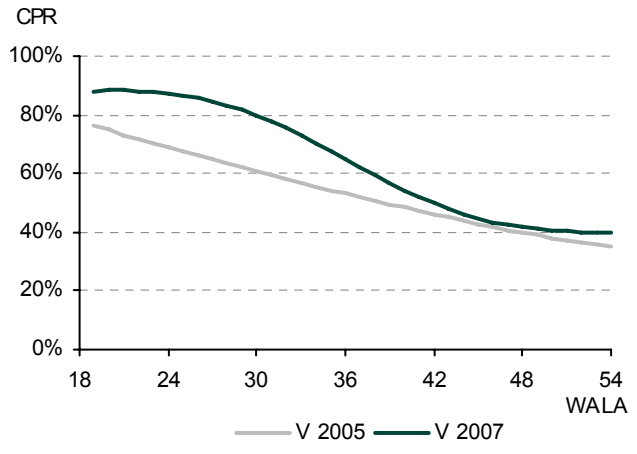
Figure 24. Burnout Comparison at 100 bp Rate Incentives



Source: Lehman Brothers

Note: Prepayments on a hypothetical FNMA 10/1 collateral with no incentives for the first 18 months and 100 bp rate incentives at 19-month WALA onward, 175K loan size, and 5% HPA.

Figure 25. Burnout Comparison at 200 bp Rate Incentives



Source: Lehman Brothers

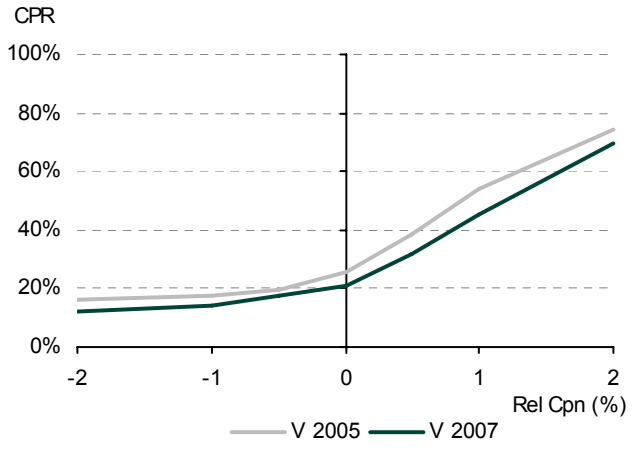
Note: Prepayments on a hypothetical FNMA 10/1 collateral with no incentives for the first 18 months and 100 bp rate incentives at 19-month WALA onward, 175K loan size, and 5% HPA.

NON-AGENCY UPDATES

The new hybrid ARM model also has the capability to project prepayment speeds of non-agency prime Jumbo and alt-A (jumbo and conforming) collateral. Instead of using a separate model, non-agency effects are built on top of the agency model described earlier and retain its features. The major adjustments for non-agency collateral are as follows:

- **Flatter S-curve and longer refi ramp**: At 0% HPA, the new model has a slightly flatter S-Curve for Alt-A collateral than agencies. Moreover, refinance ramp is extended for non-agency collateral.
- **Tapered size effect for large loan sizes**: The new model mutes the loan size effect for very large loan sizes.
- **Stronger SATO effect:** The SATO effect on premiums and discounts is stronger for non-agency collateral than for agencies.

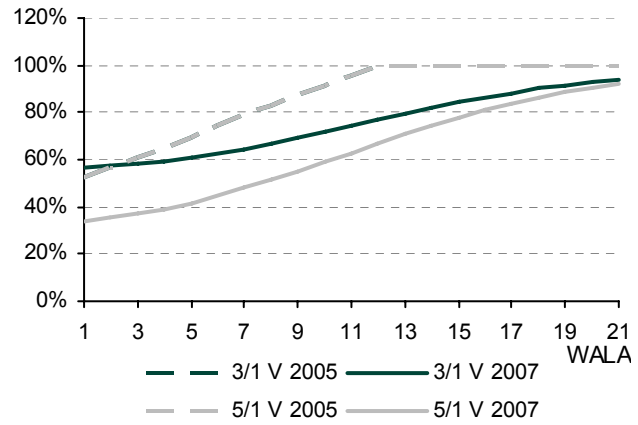
Figure 26. Conforming Alt-A 5/1 S-Curve at WALA 19



Source: Lehman Brothers.

Note: Prepayments on hypothetical Conforming Alt-A 5/1 collateral with no rate incentive until WALA 18, 175K loan size, 0 bp SATO and 0% HPA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

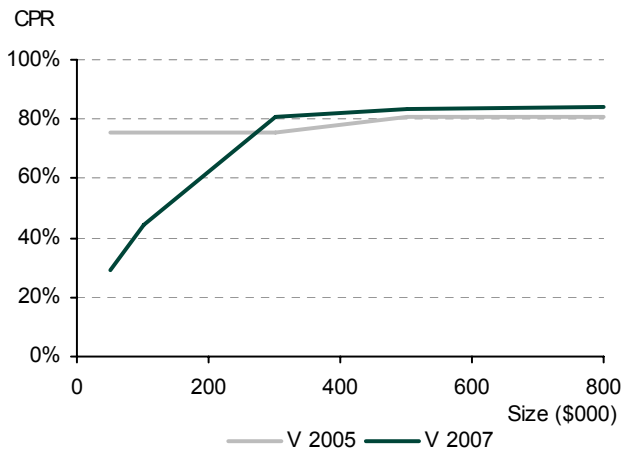
Figure 27. Conforming Alt-A Refinance Ramp



Source: Lehman Brothers.

Note: Prepayments as % of fully seasoned on a hypothetical Conforming Alt-A 5/1 and 3/1 collateral with 50 bp rate incentives at each WALA, 175K loan size, 0 bp SATO and 0% HPA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

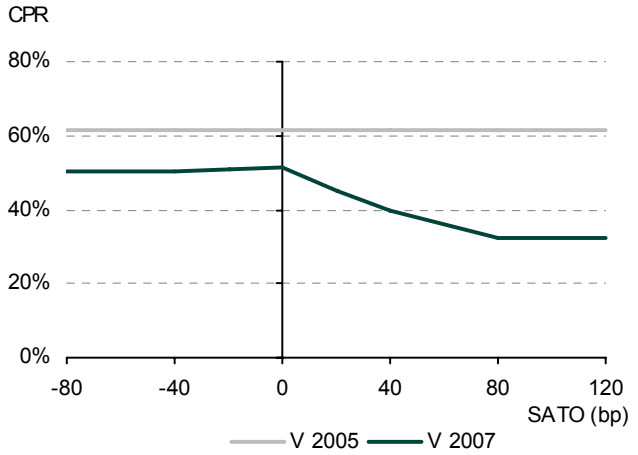
Figure 28. Loan Size Effect 200 bp incentive



Source: Lehman Brothers.

Note: Prepayments on hypothetical Conforming Alt-A 5/1 collateral with no rate incentive until WALA 18, 0 bp SATO and 0% HPA at 19-month WALA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

Figure 29. Stronger SATO effect on Premium



Source: Lehman Brothers

Note: Prepayments on a hypothetical Conforming alt-A 5/1 collateral with 100 bp rate incentive, 19-month WALA, 175K loan size, and 5% HPA. For other characteristics such as geographic distribution, we use typical profile for November 2005 origination.

To gauge the effect of non-agency adjustments, we display in Figure 30 the impact of the new model on prepayments for a hypothetical one-month WALA par-coupon collateral for each non-agency sector. The slower turnover speeds observed in the short run are mostly due to the more pronounced HPA effect and new HPA projections of the new model. Similar to what we described in the agency section of this publication, the new model features an earlier ramp-to-reset with a more pronounced reset spike for non-agency that makes long-term turnover speeds increase. Compared with agencies, the new hybrid ARM model slows conforming alt-A collateral more drastically than the previous model, primarily owing to a stronger SATO effect on refinancing. Finally, while Jumbo turnover speeds are muted, their refinancing is enhanced by a stronger size effect in the new model.

Figure 30. Prepayment Projections for Hypothetical Non-agency 5/1 Collateral

				Orig	2007 Version									2005 Version								
Sector	**WAC**	**WALA**	**SATO**	**Size**	**-200**	**-150**	**-100**	**-50**	**0**	**50**	**100**	**150**	**200**	**-200**	**-150**	**-100**	**-50**	**0**	**50**	**100**	**150**	**200**
					1-year CPR									1-year CPR								
FN/FH	5.01	1	0	200K	49.0	38.8	28.1	19.1	***13.1***	10.8	9.1	8.0	7.1	55.8	48.3	38.9	29.1	***17.9***	14.1	13.0	12.2	11.6
Jumbo	5.01	1	0	600K	77.7	69.9	55.6	35.8	***18.1***	10.3	8.1	6.7	5.6	64.6	54.3	42.0	27.0	***17.2***	14.0	13.0	12.2	11.6
Jumbo alt-A	5.01	1	60	600K	71.9	62.3	47.4	29.9	***15.6***	9.8	7.8	6.6	5.6	55.9	46.5	36.7	24.5	***16.8***	14.0	13.0	12.2	11.6
Conf. alt-A	5.01	1	60	200K	45.2	35.1	25.4	17.4	***12.2***	10.3	8.8	7.8	7.0	52.2	45.1	36.9	27.8	***17.8***	14.0	13.0	12.2	11.6
					Long-term CPR									Long-term CPR								
FN/FH	5.01	1	0	200K	51.2	44.4	37.2	31.3	***27.2***	25.1	23.3	22.2	21.4	50.7	47.0	41.0	33.3	***23.5***	21.0	20.0	19.4	19.0
Jumbo	5.01	1	0	600K	71.1	63.5	52.7	40.5	***31.0***	25.9	23.5	22.2	21.2	60.7	53.6	43.8	31.0	***22.0***	19.4	18.7	18.2	17.7
Jumbo alt-A	5.01	1	60	600K	65.8	57.4	47.3	36.8	***29.2***	25.3	23.1	22.0	21.0	52.0	46.1	38.5	28.4	***21.4***	19.2	18.5	17.9	17.5
Conf. alt-A	5.01	1	60	200K	47.7	41.0	34.5	29.6	***26.1***	24.3	22.9	21.8	21.0	47.7	43.9	38.9	32.1	***23.3***	20.8	19.8	19.2	18.8

Source: Lehman Brothers
Note: Projection as of January 10, 2008 at an unchanged 5.01% 5/1-year mortgage rate.

CHANGES IN HPA MODEL

Significant changes were implemented in how HPA is computed and projected for a given collateral.

- **State-dependent HPA:** One of the shortcomings of the previous model is that it considered only the U.S. nationwide HPA as an input, regardless of the geographic distribution of the underlying collateral. As HPA varies greatly by geography, the new model accounts for state-level HPA for 11 states (CA, IL, MA, MI, WA, NY, NJ, PA, TX, FL, and PR) and the rest of the United States.
- **Updated HPA projection model:** In the previous hybrid ARM prepayment model, HPA is projected to linearly reach a long-term constant level of 4% after one year. In the new hybrid ARM prepayment model, we borrow the HPA projection from our fixed rate model. HPA is projected using a combination of short-term cycles and a "risk-neutral" long-term projection at LIBOR minus 3%. Figure 31 highlights the differences between the new HPA model and its predecessor. For a more detailed discussion please refer to the report titled "Home Price Appreciation for Mortgage Pricing," published February 9, 2007, on LehmanLive for more details.

Figure 31. HPA Model Comparison Summary

	Previous Model (V 2005)	New Model (V 2007)
Geographic HPA	Nationwide	11 states and the rest
Short Term Projection	Linear from current level to long-term	Cyclical
Long-Term Projection	4% Annualized	"Risk-Neutral" at LIBOR minus 3%

Source: Lehman Brothers

APPENDIX: ACCESSING THE MODEL ON LEHMANLIVE

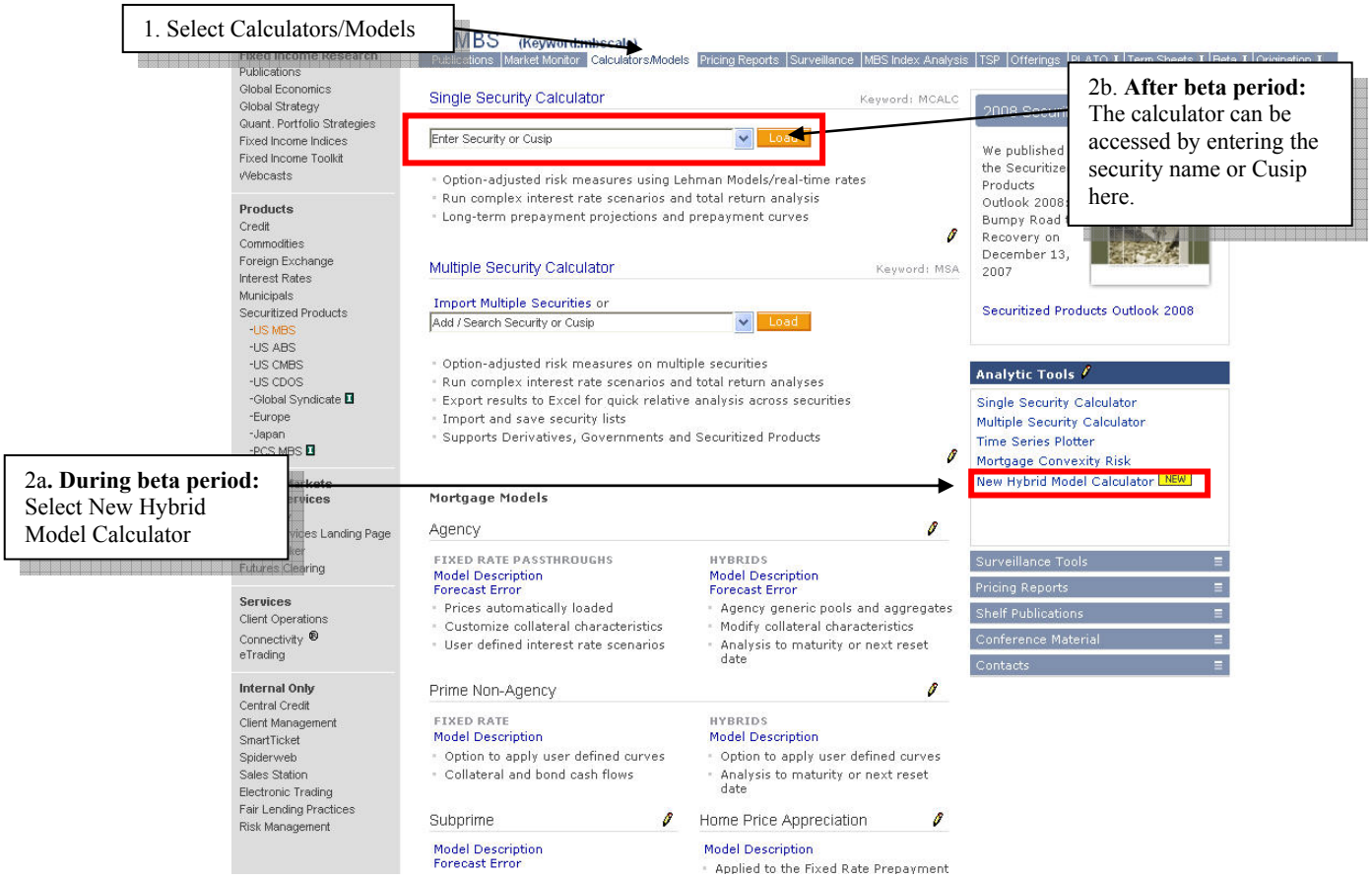
Following is a concise guide on how to use our model on LehmanLive. The interactive calculator enables users to obtain the OAS on a given bond and provides the flexibility to change the underlying assumptions of the model.

1) Accessing the Price/Yield/OAS Calculator

From the LehmanLive home page, click on **Fixed Income → Securitized Products → US MBS → Calculators/Models**

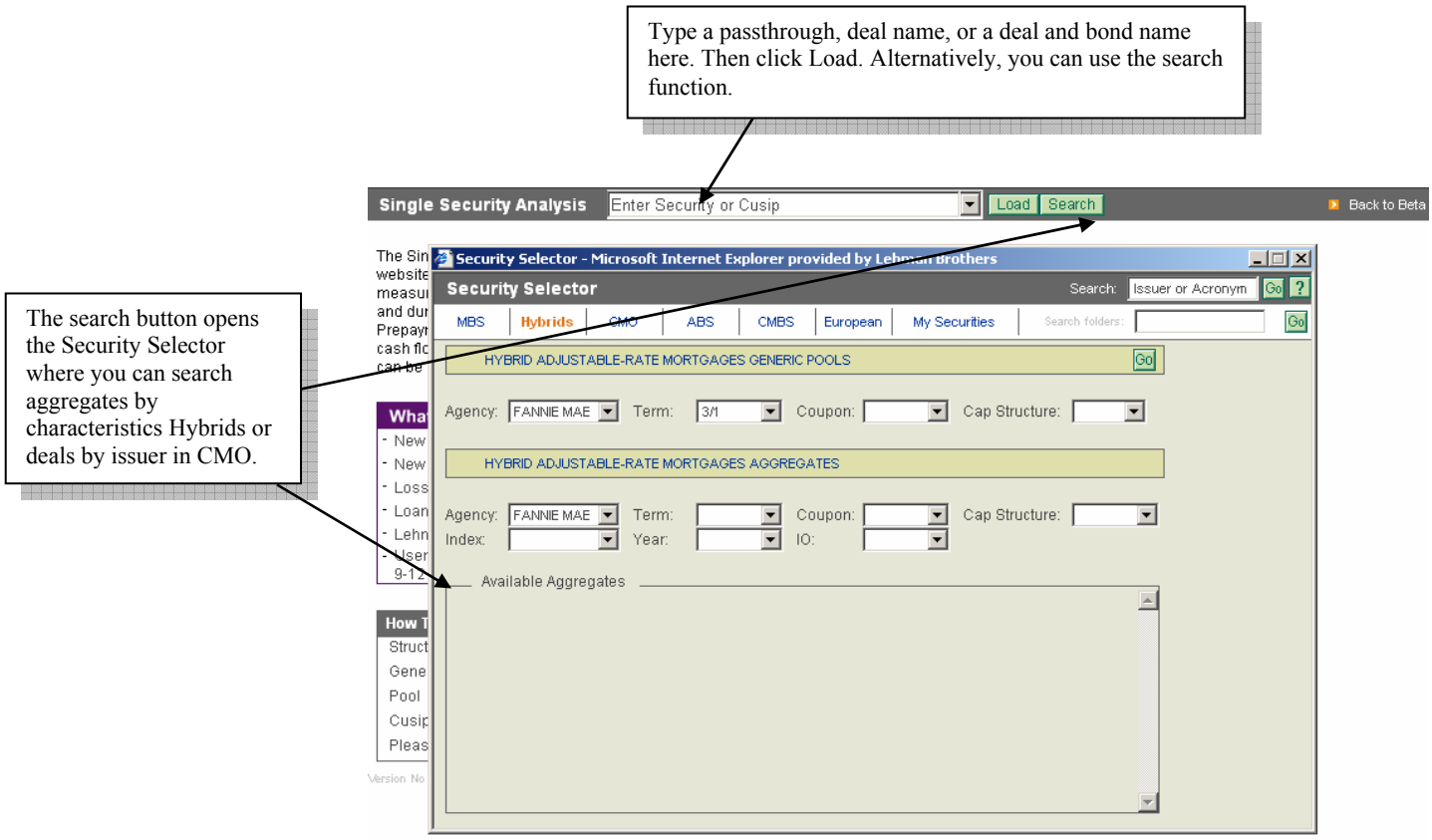
At first, a beta calculator will be available for a couple weeks from the date of this publication. To access the beta calculator, on the right side of the **Calculators/Models** page under **Analytic Tools,** click **on New Hybrid Model Calculator**.

Once the new model is released into production, it can be accessed by entering a security name or Cusip in the drop down **under Single Security Calculator** or using the LehmanLive keyword **mcalc**.



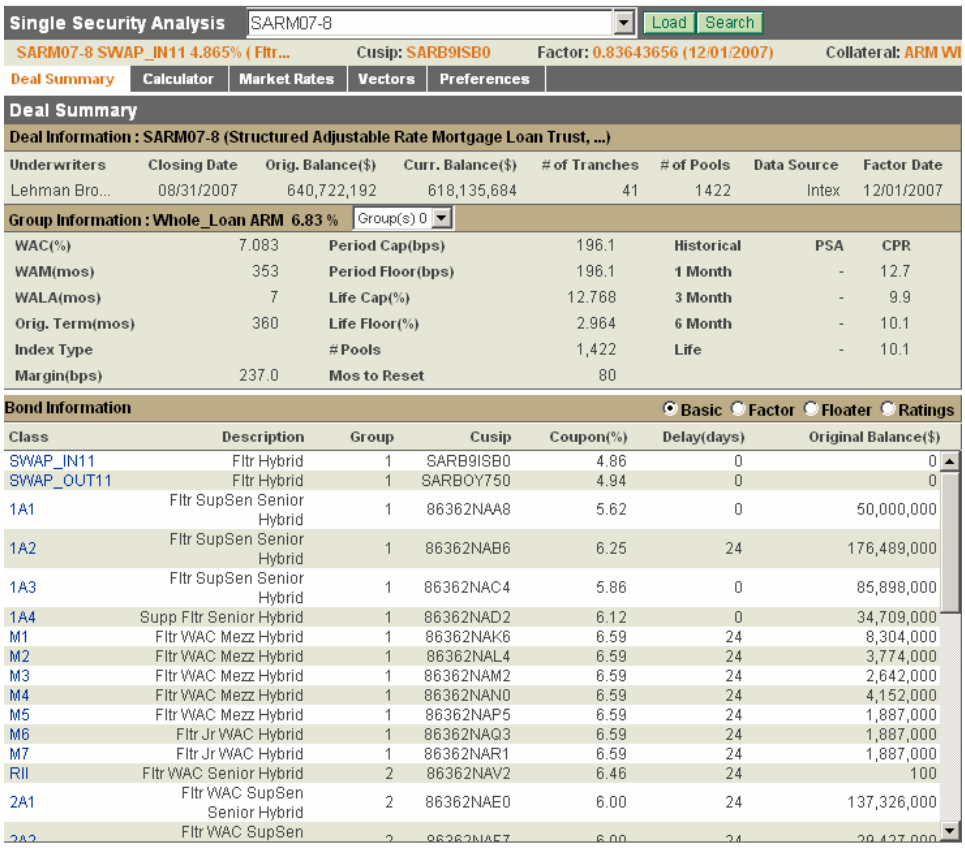
2) Loading a Deal or a Passthrough

Enter the security name or cusip in the appropriate box and click **Load.** Alternatively, users can click the **Search** button to select a passthrough by agency in MBS or a deal by issuer in CMO. Note that deal names are assigned by Lehman Brothers, but are typically similar to Bloomberg and INTEX acronyms.



3) Deal Summary Information

After a deal is loaded, the summary page shows information of the deal at various levels. To obtain the OAS on a particular security, click on the appropriate bond class under **Bond Information.** If a passthrough is loaded, the user will be directed to the main calculator page as shown on the next page.



Single Security Analysis SARM07-8 Load Search

SARM07-8 SWAP_IN11 4.865% (Fltr... Cusip: SARB9ISB0 Factor: 0.83643656 (12/01/2007) Collateral: ARM WI

Deal Summary | Calculator | Market Rates | Vectors | Preferences

Deal Summary

Deal Information : SARM07-8 (Structured Adjustable Rate Mortgage Loan Trust, ...)

Underwriters	Closing Date	Orig. Balance($)	Curr. Balance($)	# of Tranches	# of Pools	Data Source	Factor Date
Lehman Bro...	08/31/2007	640,722,192	618,135,684	41	1422	Intex	12/01/2007

Group Information : Whole_Loan ARM 6.83 % Group(s) 0

WAC(%)	7.083	Period Cap(bps)	196.1	Historical	PSA	CPR
WAM(mos)	353	Period Floor(bps)	196.1	1 Month	-	12.7
WALA(mos)	7	Life Cap(%)	12.768	3 Month	-	9.9
Orig. Term(mos)	360	Life Floor(%)	2.964	6 Month	-	10.1
Index Type		# Pools	1,422	Life	-	10.1
Margin(bps)	237.0	Mos to Reset	80			

Bond Information Basic Factor Floater Ratings

Class	Description	Group	Cusip	Coupon(%)	Delay(days)	Original Balance($)
SWAP_IN11	Fltr Hybrid	1	SARB9ISB0	4.86	0	0
SWAP_OUT11	Fltr Hybrid	1	SARBOY750	4.94	0	0
1A1	Fltr SupSen Senior Hybrid	1	86362NAA8	5.62	0	50,000,000
1A2	Fltr SupSen Senior Hybrid	1	86362NAB6	6.25	24	176,489,000
1A3	Fltr SupSen Senior Hybrid	1	86362NAC4	5.86	0	85,898,000
1A4	Supp Fltr Senior Hybrid	1	86362NAD2	6.12	0	34,709,000
M1	Fltr WAC Mezz Hybrid	1	86362NAK6	6.59	24	8,304,000
M2	Fltr WAC Mezz Hybrid	1	86362NAL4	6.59	24	3,774,000
M3	Fltr WAC Mezz Hybrid	1	86362NAM2	6.59	24	2,642,000
M4	Fltr WAC Mezz Hybrid	1	86362NAN0	6.59	24	4,152,000
M5	Fltr WAC Mezz Hybrid	1	86362NAP5	6.59	24	1,887,000
M6	Fltr Jr WAC Hybrid	1	86362NAQ3	6.59	24	1,887,000
M7	Fltr Jr WAC Hybrid	1	86362NAR1	6.59	24	1,887,000
RII	Fltr WAC Senior Hybrid	2	86362NAV2	6.46	24	100
2A1	Fltr WAC SupSen Senior Hybrid	2	86362NAE0	6.00	24	137,326,000
2A2	Fltr WAC SupSen	2	86362NAF7	6.00	24	29,427,000

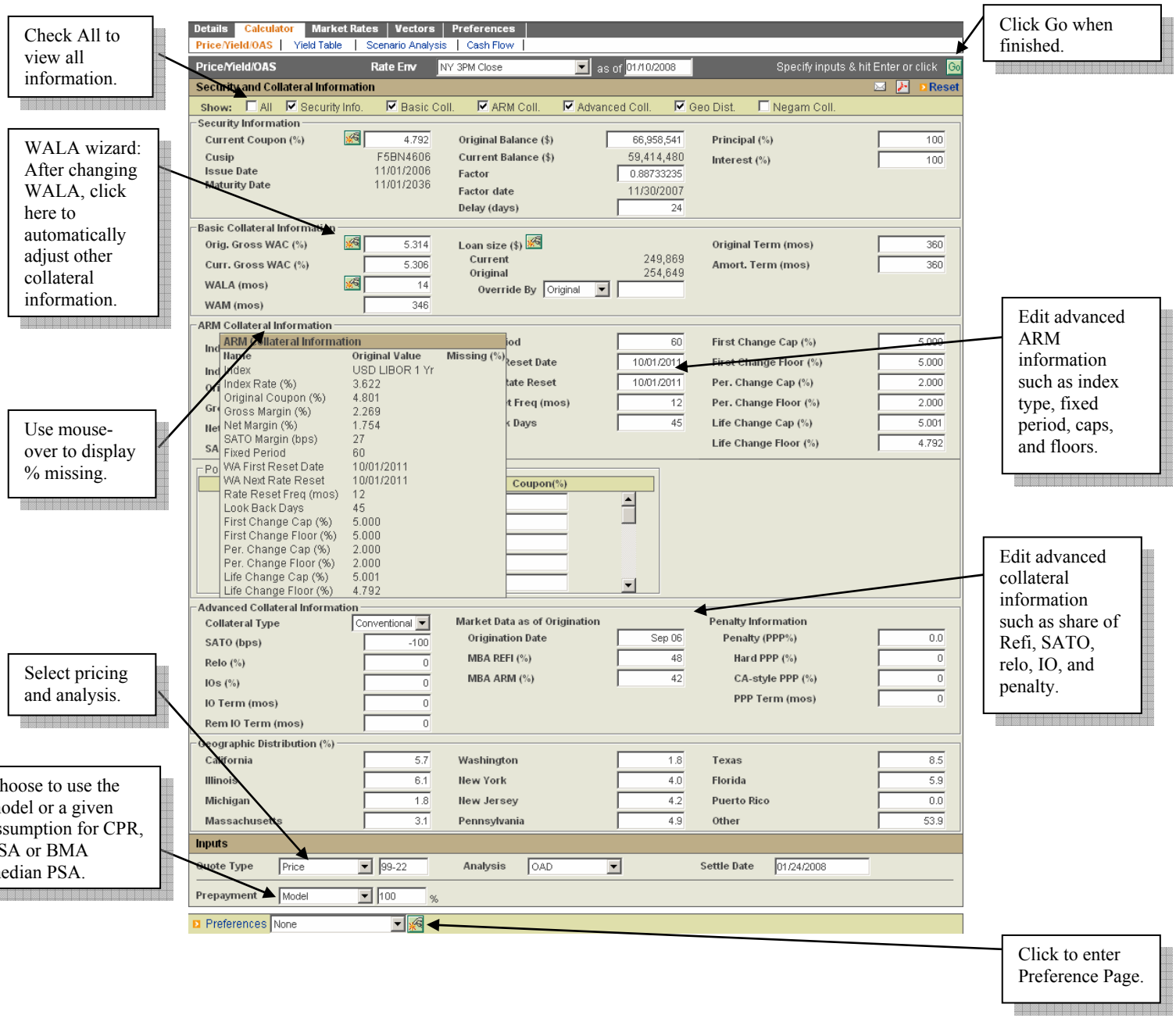
4) Modifying Collateral Characteristics

Once collateral is loaded, the main calculator page displays both security and collateral information. As a default, we only show security information and basic collateral information which includes WAC, WALA, WAM, loan size, and historical prepayments. To view all information, simply check the box **Show: All.** Users can edit collateral information by clicking **Edit** on the upper right corner of the screen. Modified passthroughs can be saved on LehmanLive as User Defined Instruments (UDIs), which users can retrieve later on. However, users cannot create UDIs from a CMO.

For each collateral characteristic in **Advanced Collateral Information**, users can get more information on the definition by moving the mouse over the field name of interest. We also provide information on the accuracy of the data (indicated by % Missing) which can be accessed by moving the mouse over the header of each section (e.g., **Basic Collateral Information**, **ARM Collateral Information**, **Advanced Collateral Information** and **Geographic Distribution.**) We also highlight the field in red if data are missing for more than 5% of balance.

Most of the modifiable characteristics are straightforward. For instance, users can override loan size with either original loan size at origination date or original loan size at current date by selecting either "Original" or "As of Today" with the pull-down menu in the loan size section.

After modifiying some characteristics such as WALA or Original Gross WAC, the user can click on a "wizard" button that will automatically adjust other collateral characteristics for consistency. For instance, after adjusting WALA, clicking on WALA wizard will automatically adjust WAM, Origination Date, First Reset Date, Next Reset Date, SATO, MBA Refi (%), MBA ARM (%) and Remaining IO term.



5) Selecting Pricing and Analysis Options

Once collateral characteristics have been modified, users can run a price-to-OAS or OAS-to-price calculation using the pricing options displayed on the input screen. In addition, users can choose analysis type for the desired level of details for the output.

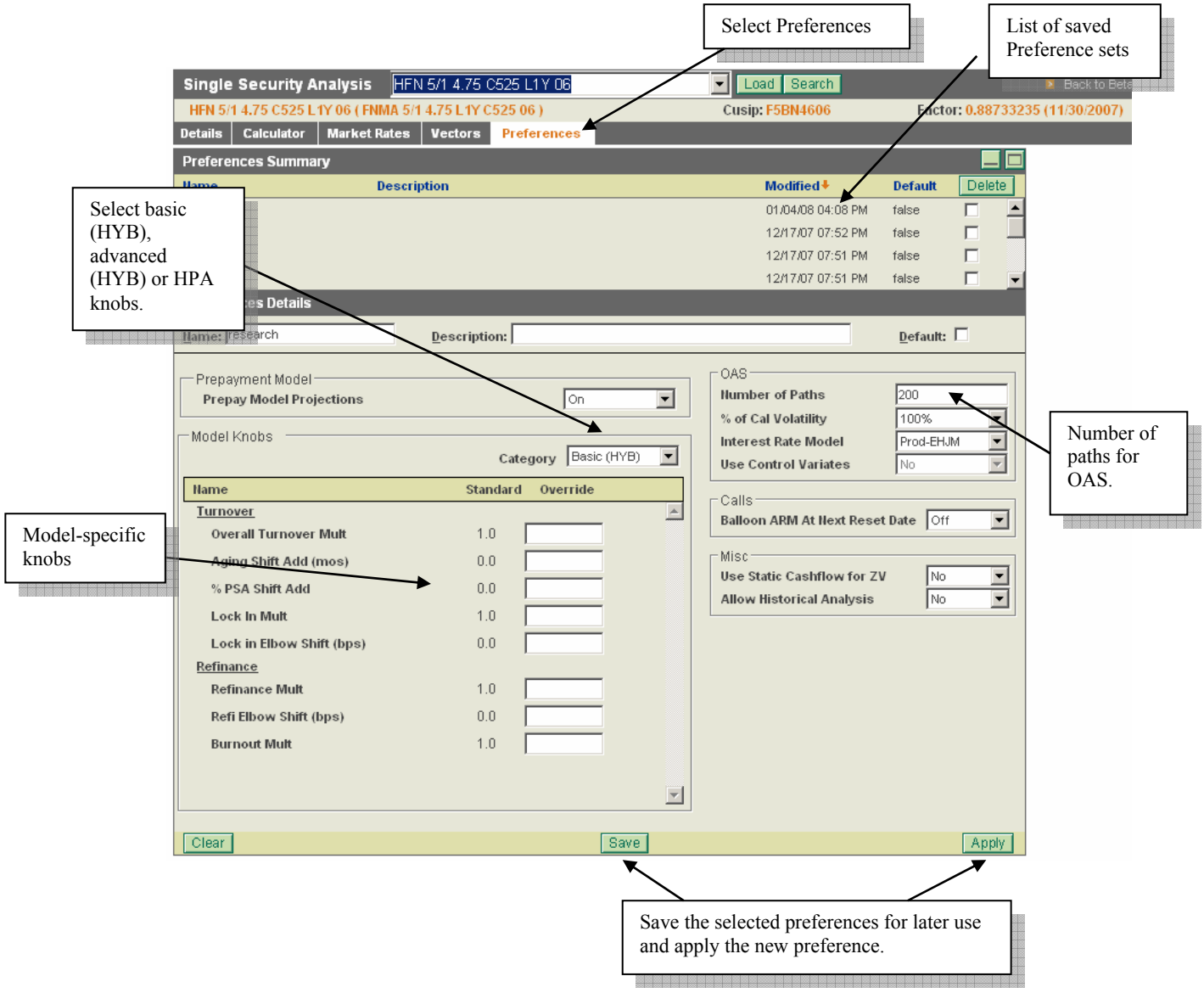
6) Default Analysis Options (only available for non-agency CMOs)

If the pull-down menu **Prepayment** is set to 100% "Model," the projected prepayments will include both voluntary prepayments and defaults. Thus, when using the Lehman prepayment model, users should normally set **Default** to "None" to avoid double counting defaults.[3]

3 Advanced users can use the model knobs to reduce model prepayments (e.g., by applying a negative PSA shift) and specify a CDR ramp so that total prepayments are unchanged.

7) Selecting Preferences and Knobbing the Model

In addition to obtaining valuation under the standard model assumptions, users can interactively alter the turnover and refinancing assumptions to assess the sensitivity of a security to alternative prepayment assumptions. To access the set of available knobs, click on the icon next to **Preferences** to select **Basic (HYB)** or **Advanced (HYB)** knobs. Users can also change the HPA-related knobs[4]. The basic knobs are simple but powerful knobs that users can change to modify the key model assumptions. The advanced knobs grant users the ability to change most of the model assumptions. Below is a detailed description of how basic knobs and some selected advanced knobs work.



[4] *See more details in the HPA Article.*

Basic Knobs

% PSA Shift Add: Adjusts turnover up or down by the given PSA ramp. Setting the % PSA shift additive knob to 10 increases the projected turnover with a ramp starting from 0.02% CPR to reach the maximum of 0.6% CPR after 30 months.

Overall Turnover Mult: Adjusts overall turnover up or down by a constant percentage. For example, setting the overall turnover multiplier to 1.10 increases projected turnover by 10%.

Overall State Effect Turnover Mult: Can be used to turn off or amplify the state effect on turnover.

Aging Shift Add (mos): Adjusts the starting age of the collateral. Setting aging shift additive to 2, for example, would in effect increase the collateral age by two months.

Lock In Mult: Affects the sensitivity of turnover on discount collateral to changes in mortgage rates. Setting the lock-in multiplier to 1.10 would increase the effective rate disincentive for discount collateral by 10%.

Lock In Elbow Shift (bps): Adjusts projected mortgage rates used for lock-in calculation. For example, setting the lock-in elbow shift to 25 increases all projected mortgage rates by 25 bp, and thus increases lock-in.

Refinance Mult: Adjusts overall refinancing up or down by a constant percentage. A refinance multiplier of 1.10 increases projected refinancing by 10%.

Refinance Elbow Shift (bp): Adjusts projected mortgage rates used for refinancing incentive calculation. For example, setting the refinance elbow shift to 25 increases all projected mortgage rates by 25 bp, and thus decreases refinancing.

Burnout Mult: Affects the degree of path dependency, which results in a pool composition consisting of a greater share of borrowers with less propensity to prepay given a rate incentive. Setting the multiplier to 1.10 increases the burnout rate by 10%, making the pool less responsive to rate incentives that it has experienced before.

Overall State Effect Refi Mult: Can be used to turn off or amplify all state effects on refinancing.

Overall Non-Agency Effect Mult: Can be used to turn off effects specific to non-agency such as non-conforming limit effect and SATO amplification.

Overall HPA Effect Mult: Adjusts the overall effect of home price appreciation on both turnover and refinancing. Setting this multiplier to 1.10 increases the effect of HPA by 10%.

Daycount Adj Mult: The model takes into account differences in the number of business days in a given month, which is a source of monthly fluctuation in prepayments. This multiplier can be used to turn off the daycount adjustment.

Monthly Seasonality Mult: Can be used to turn off the monthly seasonality effect.

Selected Advanced Knobs

Knobs Affecting Turnover:

Product Effect Mult: Long-term Turnover: Adjusts long-term turnover up or down by a constant percentage. Setting this knob to 1.5 increases projected turnover by 50%.

Product Effect Mult: Initial Turnover: Adjusts the initial turnover speed at WALA 0 up or down by a constant percentage. Setting this knob to 1.1 increases WALA 0 turnover by 10%.

Recent HPA Turnover Mult: Adjusts the effect of recent HPA on long-term turnover speed up or down by a constant percentage. Setting this multiplier to 1.10 increases the effect of recent HPA on turnover by 10%.

% Refi at Orig Turnover Mult: Adjusts the effect of the share of refinancers at the origination month (MBA data) on seasoning rate up or down by a constant percentage.

Overall Seasoning Rate Mult: Adjusts the seasoning rate up and down by a constant percentage.

Product Effect Mult: Seasoning Speed: Adjusts the seasoning rate up and down by a constant percentage.

HPA Effect Seasoning Rate Mult: Adjusts the effect of HPA on seasoning rate up and down by a constant percentage.

Product Effect Mult: HPA Effect: Adjusts the effect of home price appreciation on turnover seasoning and long-term turnover.

SATO Mult (seasoning + level): Adjusts the effect of SATO on turnover, both long-term and seasoning rate, up and down by a constant percentage.

Knobs Affecting Refinancing:

PV of Savings Mult: Adjusts the present value of net savings up and down by a constant percentage.

Product Effect Mult: PV: Adjusts the present value of net savings up and down by a constant percentage.

Product Effect Mult: Refi Potential: Adjusts the potential to refinance when in the money by a constant percentage.

Product Effect Mult: Discount Rate: Increases or decreases the discount factor in computing rate incentives. Typically, shorter resets in a flat curve environment have a higher discount rate.

Floating Rate Penalize Mult: Adjusts the dislike-ness of floating rate period up or down by a constant percentage.

% Refi at Orig. Refi Mult: Adjusts the effect of the share of refinancers at the origination month (MBA data) on refi ramp and refi potential up or down by a constant percentage.

SATO (<0) Effect Refi Mult: Adjusts the effect of negative SATOs on refinancing sensitivity, up and down by a constant percentage.

SATO (>0) Effect Refi Mult: Adjusts the effect of positive SATOs on refinancing sensitivity, up and down by a constant percentage.

SATO Decay Refi Mult: Adjusts the curing effect of SATOs due to cumulative HPA and seasonality.

Size Effect Refi Mult (small): Adjusts the effect of loan size on refinancing sensitivity up and down by a constant percentage. Only applies to loans with original size less than 90K.

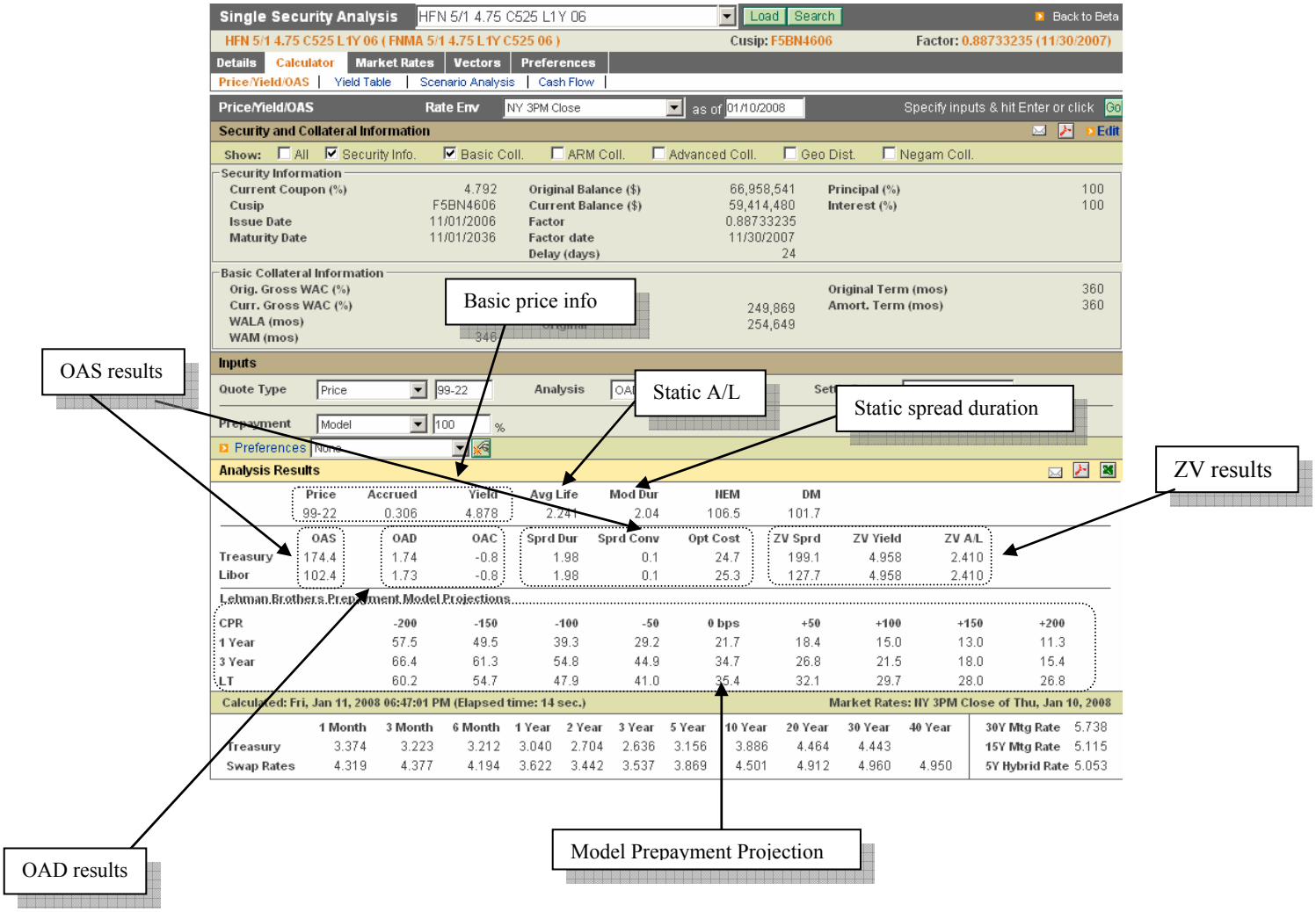
Size Effect Refi Mult (medium): Adjusts the effect of loan size on refinancing sensitivity up and down by a constant percentage. Only applies to loans with original size between 90K and 180K.

Size Effect Refi Mult (large): Adjusts the effect of loan size on refinancing sensitivity up and down by a constant percentage. Only applies to loans with original size between 180K and 300K.

Size Effect Refi Mult (jumbo): Adjusts the effect of loan size on refinancing sensitivity up and down by a constant percentage. Only applies to loans with original size greater than 300K.

8) Analysis Results

After clicking **Go**, the calculator can take anywhere from a few seconds to several minutes to produce the results, depending on the analysis requested and the number of OAS paths. The calculator displays the analytical results ranging from prepayment projection to OAS and OAD results.



Explanation of the Lehman Brothers Mortgage Model
The Lehman Brothers Mortgage Valuation Model allows investors to analyze mortgage-backed (MBS), asset-backed (ABS) and commercial mortgage-backed securities (CMBS). The model collects pertinent and material information needed to evaluate and calculate the risk measures of the security. The model provides option-adjusted spreads and durations along with other risk measures using Lehman Brothers' Prepayment, Default, and Term Structure Models.

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