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Recent Trends in Hybrid ARMs

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We cover recent trends in origination, securitization, and prepays in hybrid ARMs in this paper. We find definite trends in the mortgage origination market and borrower demographics which indicate that the hybrid market will continue to expand.

As the sector matures and new products are added, prepayment data help us understand differences in borrower behavior within the hybrid market. Although pricing and prepayment data in the hybrid market is still extremely sparse, we point out several aspects of valuation, based on recent trends.

Executive Summary

I. Hybrid Market Highlights

The hybrid market has continued to evolve over the past two years.¹ In this paper, we analyze recent trends and outline the prospects for the sector. We highlight some new developments:

- Hybrids continue to grow in popularity among borrowers and investors. In terms of origination and issuance, the hybrid sector remains one of the few growing ARM sectors.
- There are new participants in the market. In addition to a growing number of lenders offering conforming hybrid loans, a significant number of private-label issuers have originated and securitized jumbo hybrid collateral. Recently, the Department of Housing and Urban Development (HUD) sought budget approval for developing Federal Housing Authority (FHA) hybrids.
- Product types have multiplied during the past few years. In addition to the various types of cap structures, reset schedules, and conversion windows that are now available, new product types include LIBOR and moving average indexes. In the jumbo collateral market, cash flows are tranching to suit investors' needs.
- The focus on prepaids and increasing liquidity has helped rationalize the pricing across products.

With that brief introduction, we'll now take a closer look at the market.

¹ For an introduction see *Hybrid ARMs*, Salomon Smith Barney, May 2000.

II. Origination, Securitization, and New Product Types

Figure 1 shows recent hybrid issuance by product types.

Figure 1. Issuance of Hybrids (Dollars in Millions)

Origination Year	CMT Hybrids				LIBOR Hybrids	Total Agency Hybrids	Private-Label Hybrids
	3X1	5X1	7X1	10X1			
1996	2,857	3,000	1,300	900		8,057	
1997	4,519	4,520	2,000	450		11,489	
1998	3,044	5,800	2,330	1,585		12,759	
1999	3,054	5,500	2,800	2,146		13,500	
2000	5,720	14,583	3,532	3,631	120	27,586	15,000
2001 (YTD Sep 01)	4,478	12,377	3,254	2,547	3,205	25,861	18,000

Sources: *Inside MBS/ABS* and Salomon Smith Barney.

Hybrid issuance has increased irrespective of the shape of the yield curve.

A steep yield curve and accompanying low hybrid rates help hybrid issuance. For example, the current 5x1 hybrid rates, which are almost 60bp below 30-year mortgage rates (compared with the spread of about 25bp–30bp between 30-year mortgage and 5x1 hybrid rates about a year ago), have helped hybrid issuance this year both for purchased and refinanced loans. However, there are broader market factors that have driven the rise in hybrid volumes. For example, issuance has been robust this year (as it was in 1999), in relatively steep yield-curve environments. Nevertheless, both 2000 and 1998 saw year-on-year increases in issuance in flatter yield-curve environments.

We also note that the recent spurt in issuance of LIBOR-indexed hybrids and nonagency ARMs does not seem to have come at the cost of other hybrid products.

We take a closer look at the borrowers and issuers to understand the increasing market-wide preference for hybrids. Data in the mortgage origination market, especially in the ARM market is loosely connected at best.² We try to make reasonable assumptions and use origination market data and demographic data side-by-side to estimate the issuance prospects for hybrids.

Borrowers

Compared to borrowing a fixed-rate mortgage, borrowing an ARM (especially a hybrid) might need additional considerations, however . . .

Most ARM borrowers are looking to reduce their payments with lower interest rates. However, many other considerations influence ARM-borrower behavior — especially with respect to hybrid ARMs.

For example, a hybrid ARM borrower is looking for a lower rate than 30-year mortgages. He must also be willing to tolerate the speculative risk in the adjustable part, either because he expects lower interest rates in the future or he expects to take out a new loan before he breaks even (versus a fixed-rate loan). Clearly, he needs to

² For example, although MBA surveys originators nationwide, it publishes only the overall ARM share of the origination market, and although FHFB publishes separate overall ARM and hybrid shares, it surveys only Federal Home Loan Bank members. Again, for example, when FHFB shows that 40% of newly built homes are financed through ARMs, it does not break the numbers down to one-year ARMs and hybrids.

weigh in a variety of factors that would lead him away from a one-year ARM or a fixed-rate loan. Some recent trends in the market show that even if it is difficult to provide hard links between the borrower profile and the success of hybrid products, it is likely that borrowers are now more geared to making these types of decisions more successfully. We highlight a few of these trends.

More Financially Savvy Borrowers

... borrowers are becoming more financially savvy and ...

The cash-flow considerations that typically lead a borrower to an ARM can certainly arise from financial *necessity*. But we focus more on the financial *strategy* component, which might have a role to play in the current popularity of hybrid ARMs.

The Fannie Mae National Housing Survey 2001 found that the number of respondents who are saving money to buy a home dropped from 20% to 16% over the past three years. Rather than signaling increasing financial hardship, this drop suggests that potential homebuyers are becoming increasingly financially savvy. Out of those respondents, 40% (a more robust number than previous surveys) said they have invested in financial assets as an alternative to investing in real estate.

Two other findings from the same survey indicate that along with increasing financial awareness, borrowers are more comfortable with the home-buying process. During the last year alone, the number of homeowners who said they have control over the process of buying a home increased from 39% to 46%, while the number of those who said they can afford a mortgage on a home they like went up from 41% to 47%.

These facts would point to a population that is increasingly aware of the mortgage products available to them and that would appreciate the advantages of investing in financial assets with money saved in low-interest-rate loans. Not all of these borrowers will take out hybrid loans, but they are more *likely* to consider hybrid loan advantages.³

By the same token, jumbo borrowers would find savings on higher loan sizes attractive as they begin to take into account the advantages of longer resets of hybrid ARMs, compared to the extremely speculative nature of one-year ARMs.

More Young Borrowers

... hybrid ARMs are popular among a growing population of young homeowners.

ARMs are also popular with borrowers for starter homes and newly built houses. First-time homeowners (for starter homes) who anticipate moving relatively soon would tend to take out an ARM because of the lower rate, especially a hybrid ARM if they expect to move close to the end of the fixed period. Furthermore, for all newly built houses, a Federal Housing Finance Board (FHFB) survey finds that 40% of the loans originated in 2000 were ARMs (as opposed to 20% for previously owned homes). The same study finds that about 40% of all ARM loans were hybrids

³ For example, a home borrower today is more likely to understand that for a 5x1 with a 2% periodic cap, at a rate of 50bp lower than the 30-year fixed-rate, the cash-flow advantage lasts for significantly longer than the initial 60 months of fixed coupons. Let's say the monthly cash flows for a 30-year mortgage at 7% are about \$665.30 for a \$100,000 loan. For a 5x1 at 6.5%, the cash flows for the fixed-rate period are about \$632.10. Even if the interest rates go up by the full 2% for the next two resets, the cash flows will be \$753.80 and \$883.80, respectively. On a cumulative basis, under some reasonable discounting-rate assumptions, the breakeven between the fixed-rate cash flows and the hybrid cash flows will be around 80 months. On top of that, if the hybrid borrower paid less points, which is typically the case, the breakeven period would extend a few months. (Recent quotes from various sources like Freddie Mac Survey and Bankrate.com are a 30-year at 6.6%, with 0.9 points and a 5x1 at 6.1%, with 0.5 points, respectively.)

in 2000, and that the share of hybrids has steadily increased over the years. Clearly, growing markets for starter homes and newly built houses can help the hybrid ARM market. What can we say about these markets from the US demographic data?

A United States Census Bureau study finds that homeownership rates have increased by about 1.5% during the past two years: the largest jump (about 3.5%–4% during the past two years) has been in the age groups of less than 25 years old and 25–29 years old. This group of young home borrowers is also expected to grow at a higher rate over the next decade, compared to all other age groups under 50, according to the same study.

We expect that increasing homeownership in a growing young population would lead to an increase in demand for both starter homes and new homes⁴ and, in turn, ARMs and further, hybrid ARMs.

Origination and Securitization

A Freddie Mac survey in 1999 showed that at least 75% of the lenders offered 5x1 products and at least 60% offered other types of hybrids. We expect the numbers to be at least 10% higher in each case now. However, all types of ARMs (including hybrids) have historically shown poor securitization rates. Most hybrids in the past have been either retained in portfolios or traded occasionally as whole loans.

Higher ARM Securitization Rates

Recently, we have seen a shift in the practice of retaining ARMs in bank portfolios.

- With increasing consolidation in the industry,⁵ issuers have re-evaluated their balance-sheet strategies. Downsizing mortgage portfolios through securitization has become an integral part of these strategies. In addition, banks have traditionally supplemented core deposit growth with repos and Federal Home Loan Bank advances (for FHLB members) to fund their growing businesses of commercial, real estate, and home-equity lending. Again, market trends show that securitization now forms an attractive additional funding source. These factors would lead to better overall securitization rates, including those for ARMs.
- Interest-rate risk management has historically led banks to hold on to ARM portfolios and sell fixed-rate loans. However, hybrids, which have initial fixed-rate periods, do not fit the bill of floating interest-rate products as well as one-year ARMs do. Hence, we might see higher securitization rates among hybrids compared with one-year ARMs.

Increased focus from originators on reducing their balance sheets and selling products with fixed-rate characteristics are conducive to higher hybrid ARM securitization rates.

⁴ The demand for new homes could be an indirect effect, since the older population with more disposable income would build new homes (which typically cost more) to accommodate overall increase in demand. The direct demand for new homes can also come from the growing home ownership rates of older demographics.

⁵ For example, the acquisitions of PNC Mortgage, Bank United Corp., and Fleet Mortgage has significantly expanded WAMU's mortgage portfolio and pushed its total assets to well over \$200 billion. More details are available in Standard and Poor's analysis and the credit rating report on Washington Mutual, July 2001.

- Jumbo hybrids, which have gained popularity because of substantial savings for borrowers on higher loan sizes, also require larger capital outlays from issuers. These loans will also see improved securitization rates.
- Short-durations, good carry, and relatively low prepays have typically helped demand for hybrid securities. In addition, recent promising trends in liquidity (\$0.5 billion–\$1 billion worth of bid-lists on average during every week for the past few months), partly a result of less conservative pricing assumptions, have led to good demand in the secondary markets and should lead to better execution and higher securitization rates in the long run.

These trends are borne out by recent ARM securitization numbers in Figure 2, which show trends in the ARMs' share of the total mortgage market, as well as the share of hybrid products, and securitization rates.⁶

Figure 2. Securitization Rates and Market Share for ARMs

Origination Year	Origination		Securitized Market			Securitization Rates	
	ARM Share of Total	Hybrid Share of ARM	ARM Share of Total	Hybrids as a % of		Overall Rates for all Mortgages (%)	Calculated Rate for ARMs (%)
	Orig. (%)	Orig. (%)	MBS Mkt (%)	Conventional ARMs (%)	Total Agency ARMs (%)		
1996	23	26	11	36	18		
1997	22	28	15	38	18		
1998	12	27	4	60	40		
1999	22	35	5	70	45	61	14
2000	27	37	15	54	40	50	27
2001(YTD 9/01)	11	39	6	90	84	55	26

Sources: FHFB, "Inside ABS/MBS," and Salomon Smith Barney.

See Appendix A for details on computation of securitization rates on ARMs. Based on these calculations, the securitization rate of ARMs has increased from 14% in 1999 to about 27% in recent months. This year, for example, the securitization rate of 26% continues to be strong, despite poor origination numbers (11% market share).

Higher Share of Hybrids

The share of ARMs in the origination and secondary markets has been erratic — reaching the lowest point in 1998 in a flat yield-curve environment with extremely low mortgage rates. The share of ARMs in both markets also showed poor numbers this year because of low Ginnie Mae production. However, the share of hybrid products has shown a steady increase.

See Appendix B for more details on the computation of the hybrid share of the ARM market. Based on these calculations, we find that the hybrid share has increased substantially in 2001. Even though the FHFB reported it to be only about 39% for the first quarter of 2001, we believe it is going to be significantly higher for the whole year.

All in all, we expect to see a rising share of hybrids in the ARM market and rising securitization rates in the ARM market.

⁶ In the current context, the mortgage market refers to the prime market including conforming and jumbo loans. The origination market shares are published by FHFB. The securitized market shares are from Salomon Smith Barney data. The overall securitization rates are published by *Inside MBS/ABS* and the ARM securitization rates are computed.

Hybrid share of the ARM market has been steadily increasing.

Origination Rates for Hybrids

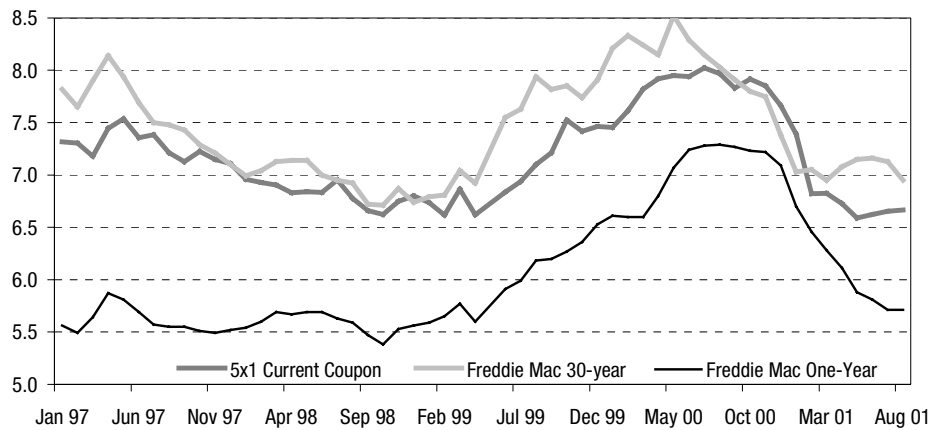
Hybrid origination rates are not as widely available as rates for fixed-rate products or one-year ARMs. In search of an appropriate substitute, we settled for a weighted-average gross coupon of all Fannie Mae pools (for each product type — e.g., for a 3x1 nonconvertible, a 5x1 nonconvertible, etc.) to approximate the monthly current-coupon rates to the borrower.

See Appendix C for more details on the computation of the origination rates.

Market Share and Profitability in the Origination Market

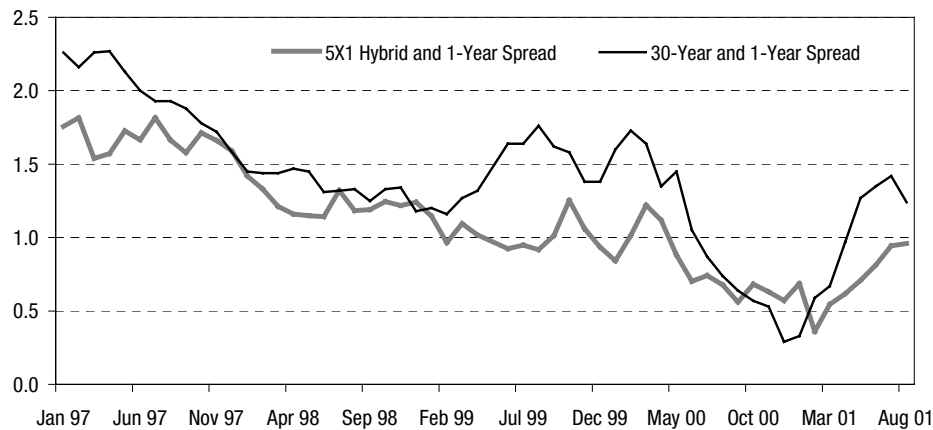
We present the information in a series of graphs. Figure 3 shows the 5x1 hybrid current-coupon rate versus the Freddie Mac Survey rate for 30-year mortgages and the Freddie Mac Survey rate for one-year ARMs. Figure 4 shows the spread between the 30-year mortgage rate and the 5x1 current-coupon rate to the one-year ARM rate. The relative changes in these rates from the beginning of 1999 (after the 1998 refi wave) to date, signal that hybrid lenders have behaved efficiently and competitively in terms of guarding their market share and profitability.

Figure 3. 5X1 Hybrid Current-Coupon Rates and FHLMC Survey Rates



Source: Salomon Smith Barney.

Figure 4. Spread of the 5X1 Hybrid Current-Coupon and the 30-Year FHLMC Rate to the One-Year FHLMC Survey Rate



Source: Salomon Smith Barney.

Market Share

Hybrid originators guarded market share when profitability was high . . .

From the beginning of 1999 to the end of 1999, 30-year mortgage rates increased about 125bp, one-year mortgage rates rose about 100bp, and hybrid rates increased about 75bp. Hence, lenders raised hybrid rates more slowly than they increased the 30-year mortgage and the one-year ARM rates. The resistance to an increase in 5x1 rates possibly indicates an attempt to maintain hybrid market share in a rising and steepening rate environment and may be one of the reasons that hybrid market share jumped from 27% to 35% between 1998 and 1999 (see Figure 2).⁷ This indicates maturity in the lenders' market, since lenders decided to increase market share at the cost of profitability, when coupons (and profitability) were *already* rising.

Profitability

. . . and profitability when market share was high.

During 2000, 30-year mortgage rates fell about 100bp (mostly in the final two months), whereas hybrid and one-year rates ended the year roughly unchanged. During 2001, to the end of August,⁸ 30-year mortgage rates fell about 30bp, one-year rates fell about 140bp, and hybrid rates fell around 80bp. Hence, after an initial lag in the fall in rates,⁹ hybrids actually fell more than 30-year rates, though not nearly as much as one-year ARM rates. Lenders needed to decrease hybrid rates (relative to 30-year rates) to prevent losing market share to one-year ARMs, but not decrease them *as much as* the one-year ARM rates, since the demand for hybrids was good to begin with. (As mentioned, we expect the hybrid share in the origination market this year to be significantly higher than previous years.) This might be a good example of preserving profitability in the hybrid sector at the cost of market share when market share is *already* high.

Efficient Pricing in the Origination Market

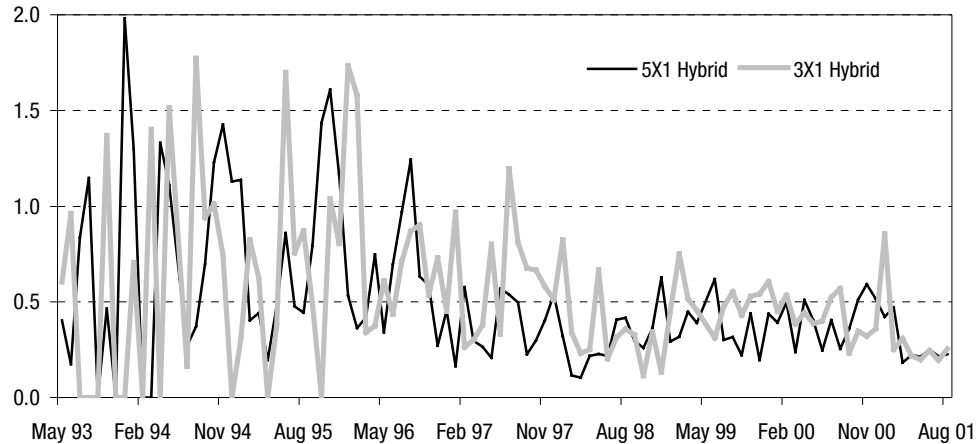
Hybrid originators have also become more competitive in lending rates.

We further support the conjecture that the hybrid market is developing as a viable product for lenders (see Figure 5, which shows the interquartile range for hybrid WACs). Figure 5 uses the same set of pools that were used to compute the 5x1 current coupons. Note that this graph shows pool-level weighted average gross coupon (WAC) dispersion for all Fannie Mae pools issued in a month. Loan-level dispersion would be greater. We find that since 1996, when hybrid volumes picked up, the dispersion in WACs has been steadily decreasing. In the recent past, dispersion has reduced to as low as 25bp from a one-time high of 1.5%–2%. This is true for both 3x1 and 5x1 hybrids.

⁷ In fact, as shown in Figure 4, the narrowing spread between the hybrid and one-year rates shows an increase in hybrid teasers with respect to one-year ARM teasers during this period, since gross margins for both products are in the range of 275bp–300bp.

⁸ Since FNMA pools are issued with WALAs between one and two months on average, to date we have good information for all the pools with underlying loans *originated* in August 2001.

⁹ In general, the 5x1 hybrid rates are lower than 30-year mortgage rates, by about 25bp–50bp on average. There is a brief period at the end of 2000 and the beginning of 2001 when the hybrid rates look a little higher than the 30-year rates. This could be because of various reasons. It could be that in reality, hybrid rates are more sticky than 30-year rates and that they have a lag when rates are falling sharply. The loan age for hybrids could have been underestimated and that could make a difference when rates are falling sharply. In general, because points paid down for hybrids are smaller than average points on Freddie Mac Survey rates, this might lead to higher-than-actual equivalent current-coupon rates for hybrids.

Figure 5. Interquartile Range for Hybrid WACs (Pct.)

Source: Salomon Smith Barney.

Together, these trends suggest that the health of the hybrid origination industry is improving. The lenders are rational in adjusting their rates against other mortgage products. Also, increased competitiveness and the increased level of information in the market have led to more uniform pricing among the lenders.

New Product Types

LIBOR Hybrids

To date, about \$17 billion of LIBOR-indexed ARMs have been issued by Fannie Mae and Freddie Mac over the years. But until recently, most of those were six-month or annual reset pools mainly targeted at LIBOR-funded money managers, who did not want to manage CMT-LIBOR-basis risk. Since this risk is smaller the further away the reset is, it makes sense that these pools were mostly in the annual reset category.

It was only recently that the secondary market saw about \$3.5 billion of LIBOR hybrids — mostly in the 3x1 and 5x1 categories. This increase is partly a result of the recent dissolution of the one-year bill, which used to drive the one-year CMT.¹⁰ In addition, given that the seasoned hybrid market has become more liquid — drawing attention to index-basis risk and thus the resale value of new hybrids — there has been an increased level of interest in the LIBOR hybrid market.

Though indexed on LIBOR, these hybrids should not have significantly different valuation from CMT-based indexes for the first few years of seasoning. We show some relative value analysis in Section IV.

Jumbo Hybrids

According to the FHFBS's analysis of jumbo loans for the year 2000, only about 3.7% of fixed-rate loans were jumbos, whereas almost 9.9% of all loans were

¹⁰ Currently, the one-year CMT will be calculated as a nonlinear interpolation of on-the-run Treasuries. See *Bond Market Roundup: Strategy*, Salomon Smith Barney, June 26, 2000, for more details.

jumbos. Because ARMs had almost a 24% share of the total market in 2000,¹¹ almost 30% of ARM loans were jumbos.¹² It is not a surprise that there are at least six to seven major issuers in that market, including Bank of America Mortgage Securities, Bear Stearns ARM Trust, Merrill Lynch Mortgage Investors, Washington Mutual Bank, and GMAC Mortgage Corp. to name a few.¹³ Most of these products have been a mix of CMT and LIBOR based 3x1 and 5x1 collateral, with average loan sizes between \$400,000–\$600,000. Average FICO scores for the deals range between 710 and 730, loan to value ratios (LTVs) range between 67% and 75%. Triple-A subordination level averages around 3%, triple-B averages around 0.9%, and single-B averages around 0.3%.¹⁴ Recently, these deals have shown a slight downward trend in LTV, most likely showing evidence of financial assets being transferred to real estate assets. This is possibly the fastest-growing hybrid sector, given the popularity of hybrids among wealthy and savvy borrowers.

Alt-A Hybrids

Recently, there has been some issuance of Alt-A type deals backed by 5x1 and 7x1 hybrid loans with FICO scores of around 690, slightly lower than those for prime collateral and an LTV of around 75%, slightly higher than those for their prime counterparts. Correspondingly, the AAA subordination levels were higher at about 8.25%. Impac Funding Corp. and Structured Asset Securities Corp. were two of the issuers.

FHA Hybrids

After a year of dismal Ginnie Mae ARM production, the recent VA/HUD Appropriations Bill, which will provide for FHA/VA hybrid ARMs, creates a silver lining. The bill is now in conference or, in other words, the dissimilarities in the House and Senate versions of the bill are being reconciled. FHA hybrids are going to have periodic caps of 1%. We expect FHA hybrids to provide a tremendous boost to the Ginnie Mae market because they will provide low-income borrowers with much awaited protection against annual rate resets. They will also provide a new category of hybrids with more homogenous pools (as all Ginnie Mae pools are) and lower prepaids (both compared to one-year Ginnie Maes and conventional hybrids).

¹¹ $(9.9 - [0.037 * 76]) / 24 = 30\%$.

¹² All the share percentages are by number of loans (sources: FHFB, MBA). Most outstanding market share numbers by volume indicate about a 15%–20% share of jumbos overall. (Sources: "Inside MBS/ABS," Housing Statistics of the United States). The FHFB issuance share for 2001, when multiplied by a factor of 2.5 (roughly the multiplier for jumbo loan size relative to conforming loans), would bring the share closer to commonly believed volume share. However, since we are increasing both ARMs and fixed-rate shares by the same factor, it would not change the jumbo share of the ARMs market share much, if we calculate the share by volume.

¹³ We have a list of all the deals issued since the third quarter of 2000. Interested customers can obtain it from us.

¹⁴ Sources: Bloomberg and Standard and Poor's.

We expect hybrid issuance to remain robust and the market size to reach \$100 billion in the near future.

Outlook for Hybrid Production

About \$217 billion of ARM securities is outstanding (as of September 2001), about \$55 billion of which is in hybrids. We have seen issuance of close to \$45 billion last year and this year we will see higher volumes than that. Market conditions, demographics, and the ongoing development of the mortgage origination market will continue to propel the growth of the hybrid sector.

In order to estimate the size of the hybrid market going forward, we break down the hybrid production into purchased loans and refinanced loans in Appendix D.

We show that out of about \$40 billion annual hybrid production in 2000 and 2001, about \$32 billion–\$35 billion has originated from purchased loans and the rest from refinanced loans.

The future size of the hybrid market is mainly dependent on the hybrid share of origination and hybrid securitization rates. We expect the hybrid market to exceed \$100 billion in the foreseeable future.

III. Recent Trends in Hybrid Speeds

We discussed in detail what we learned from the agency hybrid prepay history in our previous publication.¹⁵ We mostly supplement our earlier findings on agency hybrid speeds in this section. At the end of the section, we point out the principal differences between agency and jumbo hybrid speeds.

Most of the trends that we have seen this year conform to our previous findings, which include the following: longer initial reset bonds pay down more slowly and hybrids experience prepayment spikes at the first reset as the coupons reset up.

Product Types

Figure 6 compares speeds of 2000 origination 7% coupons for hybrids of various initial resets. Speeds were higher for 3x1s compared to all other reset types.

However, we expect speeds to converge in upcoming months, as refinancing related speeds increase.

Figure 6. Comparison of Hybrid Speeds Over the Past 12 Months (as of Sep 01)

Origination Year/ Origination Coupon	Product Type	WACs (%)	Apr 01–Sep 01 (CPR %)	Oct 00–Mar 01 (CPR %)
2000 7.0s	3x1	7.58	53.4	26.1
	5x1	7.58	43.8	20.9
	7x1	7.60	41.5	17.5
	10x1	7.80	40.3	17.3

Source: Salomon Smith Barney.

Resetting Coupons

Figure 7 shows 5x1 hybrid speeds in 2000 for 6.5% coupons originated in 1995 and 1996 production. As they approached reset, the speeds for the 1995 resetting coupons showed a steady increase relative to the nonresetting 1996 production counterparts. As the coupons reset up in August 2000, the 1995 production speeds showed a sharp spike. This is a well-known behavior, which is modeled in Salomon Smith Barney's prepay model.

Figure 7. Comparison of Resetting and Nonresetting Speeds for 5x1 Hybrids in 2000

Origination Year/ Origination Coupons	Dec 99–Feb 00			Mar 00–Jul 00			Aug 00–Dec 00		
	Average Age	Average WAC (%)	CPR (%)	Average Age	Average WAC (%)	CPR (%)	Average Age	Average WAC (%)	CPR (%)
1995 6.5%	53	7.14	17.6	57	7.15	31.3	62	7.80	40.1
1996 6.5	42	7.15	14.4	46	7.15	21.4	52	7.21	17.8

Source: Salomon Smith Barney.

However, the recent steepness of the yield curve and the accompanying prospect of coupons resetting down have brought on fresh concerns about speeds at reset. At the current CMT rate of about 2.5%, the WACs would reset to 2.5% + 3%, or 5.5% on average, *down* from anywhere between 6.5% and 7% for most coupons. Should we

¹⁵ See "Hybrid ARMs," May 2000, Salomon Smith Barney.

still expect a spike in speeds when coupons reset down? To understand what we should expect, we compared resetting and nonresetting coupons this year. In the limited data set for hybrids there are not too many examples of large pools resetting down. In Figure 8, we show speeds for 1996 and 1997 originations over the past nine months. The 1996 origination 6.5% coupons (which had WACs of 7.30% before reset) started resetting in June 2001. With one-year CMT at 4.25% around mid-April (applicable because of the 45-day look back), WACs reset to around 7.25% for pools, with gross margins around 300bp. Hence, the WACs on these pools did not change much. In fact, they declined a bit. However, their speeds showed a modest increase. In order to understand how much of this increase was prompted by the recent low 30-year mortgage rates, we look at the 1997 pools with similar WACs, which are still roughly nine months away from resets. Their speeds for similar WACs, which were a little lower, showed very similar increases — indicating that most of the speed increase so far in the resetting coupons is related to recent refinancing activity.

The Salomon Smith Barney prepay model has modeled prepay speeds around reset based on how much and how sharply the WACs reset up or down. In particular, if WACs reset down, the prepay speeds are *not* modeled to rise sharply. However, there are other components that speed up paydowns after reset, such as faster turnover rates.¹⁶

Figure 8. Comparison of Resetting and Nonresetting for 5x1 Hybrid Pools in 2001

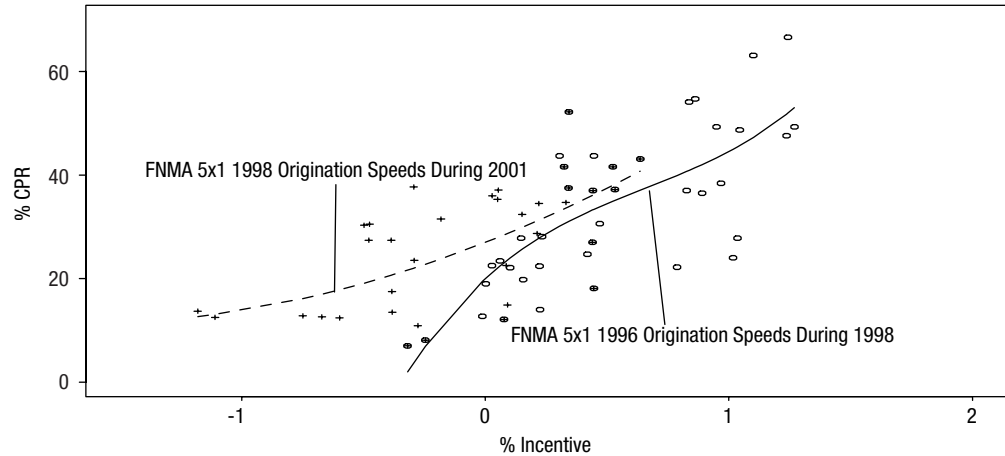
Origination Year/ Origination Coupon	Jan 01–May 01			Jun 01–Sep 01		
	Average Age	Average WAC (%)	CPR (%)	Average Age	Average WAC (%)	CPR (%)
1996 6.5%	57	7.30	35.5	62	7.28	39.6
1997 6.5	43	7.10	34.1	48	7.10	40.5

Source: Salomon Smith Barney.

Refinancing Efficiency

We studied refinancing activity between the 1998 refinancing wave and the present one so far. Figure 9 shows a comparison of speeds for 1996 originations during 1998 and speeds for 1999 originations during 2001. We plotted refi incentive (the WAC 30-year mortgage rate) versus speeds for the first nine months of 1998 and of 2001. The graphs of speeds during 1998 and 2001 show that even though prepays were slightly higher at lower incentive levels in 2001 (indicating more streamlined refinancing this year and lower refinancing costs), there is much less distinction at higher incentive levels. Consequently, even though we expect a surge in prepayments in the coming months, speeds are likely to be only moderately faster than 1998 speeds for similar incentives.

¹⁶ Of course, one might still see high speeds because of refinancing activity, but the high speeds would *not* be limited to resetting coupons.

Figure 9. Comparison of 5x1 Hybrid Speeds During 1998 and 2001

Source: Salomon Smith Barney.

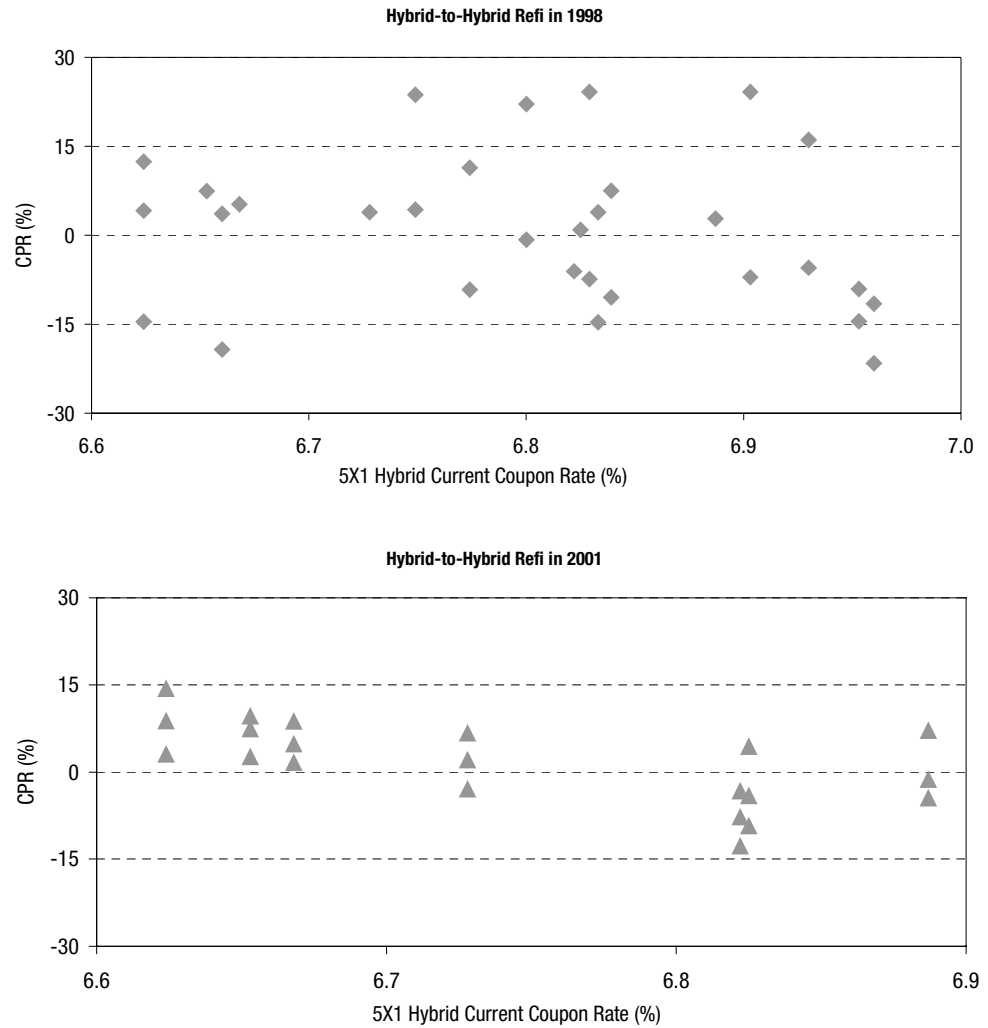
Hybrid-to-Hybrid Refinancing

Another aspect of refinancing that has raised questions recently is whether there is a higher level of ARM-to-ARM refinancing in the current environment, which is characterized by a steep yield curve and low-hybrid rates. We use the same data as in the previous section (namely, speeds for 1996 originations during 1998 and speeds for 1999 originations during 2001) and attempt to capture the impact of 30-year mortgage rates and 5x1 hybrid current-coupon rates (as calculated in Section II) separately. Figure 10 shows plots of the residuals from a regression of the speeds against the 30-year mortgage rate versus the hybrid current-coupon rates.¹⁷ We find that the scatter plot shows distinct directionality in 2001 (unlike in 1998 where the scatter plot shows no significant correlation). We conclude that this year the ARM-to-ARM component (or in this case the hybrid-to-hybrid component) of refinancing has been more significant.¹⁸

All in all, we conclude that there is not much difference in agency hybrid prepay behavior now compared to earlier periods. However, we do see some higher level of speeds resulting from reductions in costs and an increase in the number of refi vehicles, specifically other hybrids.

¹⁷ The regression is done on the speeds versus the 30-year mortgage rates. The residuals capture the variation in speeds resulting from factors *other* than the 30-year mortgage rate. We plot the residuals versus the 5x1 current-coupon rates, to determine if the 5x1 rates played a role in hybrid speeds in 1998 and 2001.

¹⁸ This gives even more support to our theory that borrowers are becoming increasingly savvy and given the right incentive would stay with a hybrid rather than move to a 30-year mortgage.

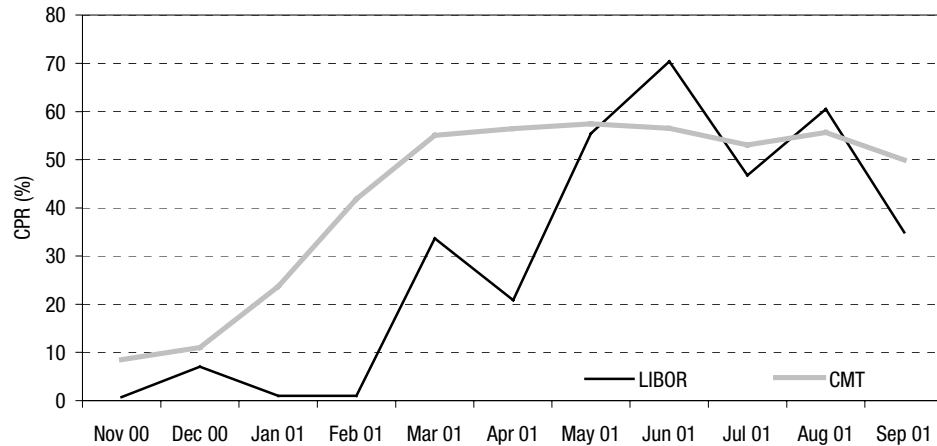
Figure 10. Regression Residuals Versus 5X1 Current-Coupon Rate in 1998 and 2001

Source: Salomon Smith Barney.

Speeds for CMT Versus LIBOR-Indexed Hybrids

Figure 11 shows speeds for FNMA 2000 6.5% coupons off CMT versus LIBOR indexes. Overall, LIBOR-indexed hybrid speeds seem to be a little slower than CMT-indexed hybrid speeds, although the speeds seemed to converge during the recent refinancing wave. In general, we have no reason to expect very different speeds for LIBOR-based hybrids and CMT-based hybrids for similar coupons, although around resets, the difference in speeds will depend on the LIBOR-CMT spread. For example, if the LIBOR-CMT spread (which has been as low as 25bp recently) is lower than the gross margin difference (which is anywhere between 50bp–60bp),¹⁹ LIBOR-hybrid speeds could be a little slower than CMT hybrids close to resets.

¹⁹ Gross margins for CMT and LIBOR hybrids are around 275bp and 225bp, respectively.

Figure 11. Comparison of Fannie Mae 2000 6.5% 5X1 Hybrid Speeds — CMT Versus LIBOR

Source: Salomon Smith Barney.

Jumbo Versus Agency Speeds

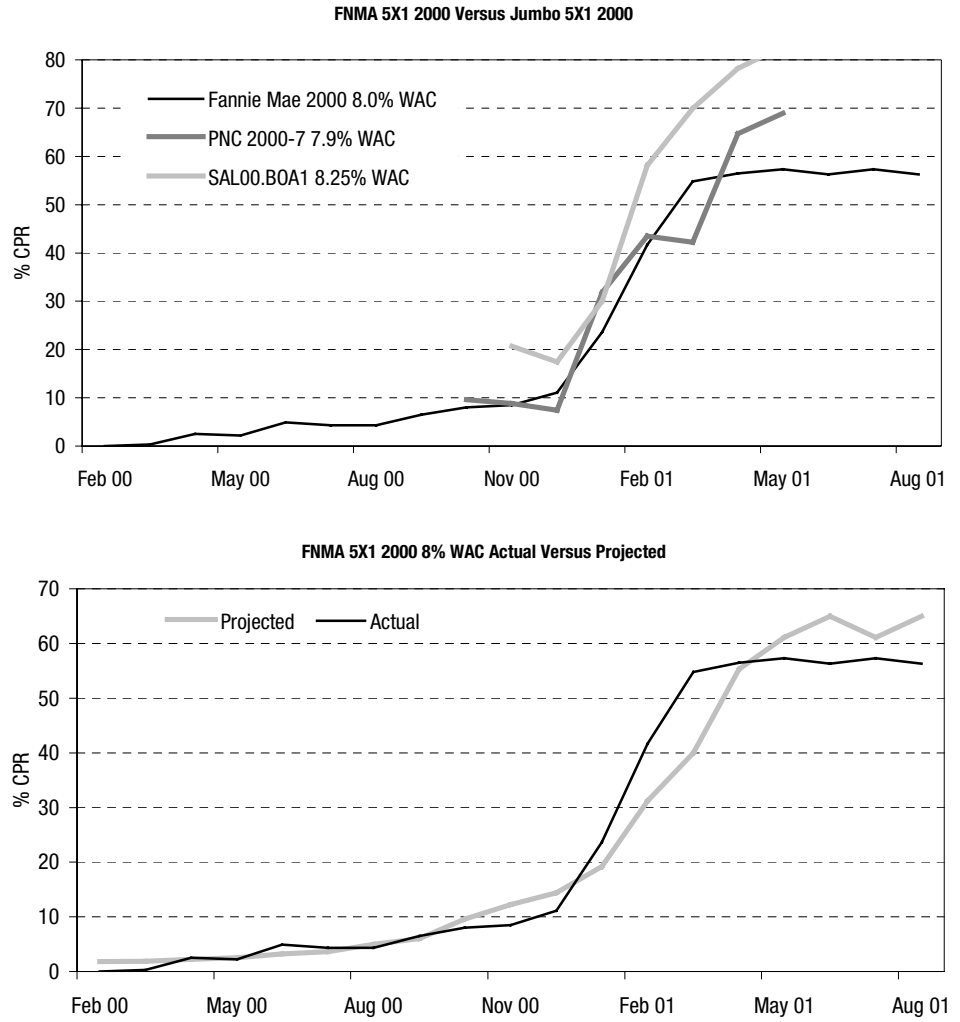
We compare speeds of jumbo and agency collateral in Figure 12.

The top panel is a graph of recent jumbo hybrid speeds versus agency hybrid speeds and the bottom panel is a comparison of speeds projected by the Salomon Smith Barney agency prepay model and actual agency speeds. The model projections are reasonably close to the actual agency speeds. But the jumbo hybrids have paid faster than the agencies during the refinancing wave and a little slower for a few months in the early stages. This might argue for slightly slower speeds for jumbo loans in stable scenarios because of higher jumbo current coupons²⁰ and significantly faster speeds for jumbo loans during refinancing waves because of higher loan sizes,²¹ leading to worse convexity characteristics for jumbo hybrids. In our preliminary studies with the limited data available, we also find more negative prepayment convexity for higher loan sizes and higher FICO score loans.

²⁰ Jumbo current coupons are usually about 50bp higher than conforming current coupons.

²¹ The average loan sizes of the jumbo loans considered here are between \$500,000 and \$600,000 compared with \$225,000–\$240,000 for the agency pools.

Figure 12. FNMA 5X1 2000 Versus Jumbo 5X1 2000 and FNMA 5X1 2000 Actual Versus Projected



Source: Salomon Smith Barney.

IV. Comments on Valuation

We have discussed general valuation methodology in our previous publications. Here, we limit our comments to a few key valuation concerns for investors when comparing different type of hybrids, namely 3x1 versus 5x1 (or short-initial-reset versus long-initial-reset), LIBOR versus CMT products, and agency versus jumbo products.

Short Initial Reset Versus Long Initial Reset

The short reset securities offer a shorter wait for a potential increase in net coupon, but they also have the accompanying risk of faster prepayments, especially around resets. These considerations become more involved when the curve is extremely steep and mortgage rates are at historical lows — since under an unchanged scenario assumption, the coupons would reset down at the first reset and speeds are more likely to be fast now than closer to resets. We try to understand the future rate assumptions *implied* by the current pricing of new 3x1 and 5x1 hybrids.

Figure 13 shows the valuation of two hybrid pools: a 3x1 and a 5x1 with similar characteristics except for the months to roll. We price the pools at a pricing CPR with unchanged index assumption. We also price the pools at the same pricing CPR with the index set to forward rates at the reset. Then we compare both based on standard OAS measures.

Figure 13. Comparison of a 5x1 and a 3x1 Hybrid (as of 17 Oct 01)

Pool Description	Coupon (%)	WAC (%)	Months to Roll	Net Margin (bp)	Gross Margin (bp)	Price	Yield @ 25% CPR		100% Model					
							Unch. Index (%)	Fwd Index (%)	Yld Unch. Index (%)	Yield			1-Yr CPR (%)	LT-CPR (%)
										Curve Margin (bp)	Cvx. Cost (bp)	OAS (bp)		
3x1	5.789	6.384	59	215	275	102-30	4.196	5.010	4.044	68	57	11	37.0	24.8
5x1	5.789	6.384	35	215	275	102-18	4.571	5.032	4.499	80	74	6	24.1	22.7

Source: Salomon Smith Barney.

The yield for the 5x1 to the pricing CPR with unchanged index is higher than that for the 3x1, because the coupons reset *down* to 4.36% (2.21% index + 2.15% net margin) two years later for the 5x1 than they do for the 3x1. However, if the forward index is used (4.84% for the one-year rate five years forward and 4.56% for the one-year rate three years forward), the yields are very similar. Since the 3x1 resets *up* to 6.77% from 5.78% (4.56% one-year rate three years forward + 2.21% net margin) two years before the 5x1 resets to 7.05% (4.84% one-year rate five years forward + 2.21% net margin), the 3x1 justifiably has the higher price. We find the OASs for the two hybrids to be reasonably close. Both the static and OAS analysis show that the investors are appropriately pricing the shape of the yield curve (taking into account the forward scenario rather than the unchanged scenario).²²

CMT Versus LIBOR Indexed Hybrids

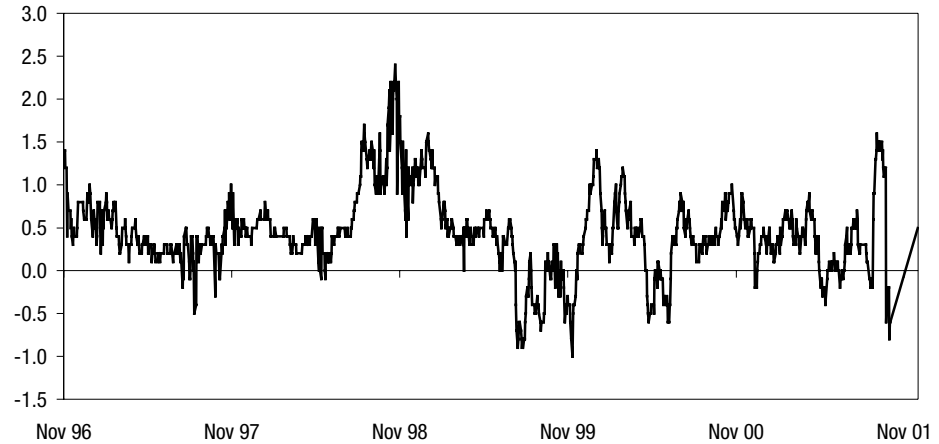
Since the initial reset periods are at least three years long, for a new hybrid the choice of index at the first reset (if the indexes are highly correlated) would have minimal impact. Figure 14 shows the difference between basis point volatility during the past five years between one-year CMT and one-year LIBOR. We computed the absolute value of the daily change of one-year CMT and one-year

²² The OAS analysis implicitly uses the forward curve as the base curve for valuation.

LIBOR and then took the difference of the 20-day moving averages of both series. On average, basis point volatility is within a few basis points, indicating that, in a cap-pricing context, three or five years from now it would not make a significant difference in valuation.

However, the spread between LIBOR and CMT can vary quite a bit. Hence, if an investor takes a view on LIBOR-CMT spread, he might currently find LIBOR products attractive because the one-year LIBOR to one-year CMT spread is now at the 25th percentile over the past five years.

Figure 14. One-Year LIBOR Versus One-Year CMT — Daily Basis Point Volatility, 19 Nov 96–18 Oct 01



Source: Salomon Smith Barney.

Agency Hybrids Versus Jumbo Hybrids

As we discussed in a previous section, in stable interest rate scenarios, we expect seasoned jumbo speeds to be a little slower than seasoned agency speeds for similar WACs because of higher jumbo current coupons and higher costs. However, jumbos tend to be significantly faster during refinancing waves, because of their higher loan sizes.²³ Jumbos, therefore, would show worse convexity characteristics than the agencies. These differences suggest that the thresholds for jumbo borrowers are higher (a positive elbow shift), but the propensity to refinancing is also higher (a refinancing multiplier of greater than one). Figure 15 shows how these two adjustments can capture collateral-specific characteristics to show higher negative convexity with marginal increases in long-term speeds. (For example, without the elbow shift, the increase in long-term speeds is substantial).

Figure 15. Simulating Jumbo Hybrid Characteristics With Elbow Shift and Refinancing Multiplier

Pool Description	Coupon (%)	WAC (%)	Months to Roll	Net Margin (bp)	Gross Margin (bp)	Price	Elbow Shift	Refinancing Multiplier	Yield Curve	Convexity Cost (bp)	OAS (bp)	Dur.	Conv.	1-Yr CPR (%)	LT CPR (%)
5x1	5.789	6.384	35	215	275	102-18	0	1.00	80	74	6	2.34	-1.67	24.1	22.7
							0	1.50	69	85	-16	1.83	-1.89	32.8	31.0
							50	1.75	73	82	-9	2.08	-1.74	29.4	26.0

Source: Salomon Smith Barney.

²³ Another way of to explain this would be that a small refinancing incentive might not induce a borrower with a large loan size to refinance, because the cost for him to refinance would be higher than that for a small loan. On the other hand, in an environment with a high refinancing incentive, a much larger number of jumbo borrowers are likely to refinance, because the absolute level of savings is much greater than that for a smaller loan.

Conclusion

We expect the hybrid ARM market to grow rapidly in the coming years, given increasing borrower awareness about the range of available mortgage products and increasing pricing efficiency in the origination market. Along with the increased size of the market, we expect the new hybrid products to gain substantial market share — especially LIBOR products and jumbo hybrids, which will be fueled by investor and borrower demand, respectively. Prepay characteristics of these new products are still emerging, but we expect the market to offer a wide range of products — from short-reset hybrids with good convexity characteristics to more negatively convex and higher-yielding jumbo hybrids.

Appendix A. Computation of ARM Securitization Rates²⁴

The securitization rates for ARMs have increased in the recent past. In 2000, for example, the total volume of ARMs securitized was about \$80 billion, and the total volume of mortgages securitized was around \$560 billion. At an average rate of 50% securitization, the total mortgage origination was \$560 billion/0.5 = \$1,120 billion. At a 27% share of total originations, ARM origination volume was around \$305 billion. Hence, the securitization rate was roughly $80/305 = 26\%$.²⁵

²⁴ Refer to Figure 2 for numbers used in this set of calculations.

²⁵ This number is the same as the ARMs share in the securitized market*overall securitization rate/ARMs share in the origination market, or $14\% * 50\% / 27\% = 26\%$, in this case.

Appendix B. Computation of Hybrid Share for 2001²⁶

For the first quarter of 2001, the FHFB reported that the hybrid share of the ARM origination market was close to 39%. We expect that this number will be significantly higher for the year as a whole, because hybrid origination and issuance has picked up considerably since the first quarter. For example, for 2001 (through September), the total volume of ARMs securitized has been about \$44 billion, most of which (about \$42 billion) was hybrids, and the total volume of mortgages securitized was about \$825 billion. At an average securitization rate of 55%, total mortgage originations were about $\$825 \text{ billion} / 0.55 = \$1,500 \text{ billion}$. At 11% market share, the total ARM origination would be about \$160 billion. A hypothetical 40% hybrid share would put the hybrid origination at \$65 billion and hybrid securitization rate at $\$42 \text{ billion} / \$65 \text{ billion} = 65\%$, and the one-year ARM securitization rate at a negligible level of $\$2 \text{ billion} / \125 billion , or 2%. Both of these securitization rates (for hybrids and one-year ARMs) are unrealistic. Hence, unless the hybrid securitization rates are unusually high and the one-year ARM securitization rates are unusually low, the hybrid share in the origination market would be significantly higher than 40% this year.²⁷

²⁶ Refer to Figure 2 for numbers used in this set of calculations.

²⁷ A higher share of hybrids in the origination would bring *down* the hybrid securitization rates to more reasonable levels.

Appendix C. Computation of Hybrid Origination Rates

- The current coupon for a month is the average of the WACs of all the pools originated in a month weighted by the original pool balance.²⁸
- We computed the averages by loan origination month.²⁹
- The hybrid current coupons are not adjusted for points paid, because there is no such information available.

²⁸ It is debatable whether a weighted average is a better approximation than a simple average — because a few large loans in a pool could potentially skew the average away from a more representative number. On the other hand, if a large pool consists of many even-sized loans, a simple average would weigh a small outlier pool the same way it would weigh the more representative larger pool. We decided to use the weighted average because the pools are already weighted by loan balances, and there is no way to undo that.

²⁹ The origination month is computed from original WAM and WAM at issuance. We have restricted the computation to pools with WAMs close to 360, since mixed WAMs can lead to an incorrectly calculated loan age at issuance. Even then, the computation of loan age at issuance is approximate.

Appendix D. Source of Hybrid Products and Estimated Hybrid Market Size

We attempt to put hybrid origination and securitization volumes in the context of broad mortgage market measures like purchasing and refinancing activity. This will help us estimate future hybrid issuance volumes.

We first look at purchase activity. We take 1.6 million of housing starts,³⁰ 5.1 million existing home sales, and 0.9 million new home sales per annum and multiply these by 6% (which is roughly the share of hybrids in the origination market).³¹ We then multiply by an average home price of \$300,000³² and an average securitization rate of 25%.³³ That comes to about \$34 billion of issuance.

We then look at refinancing activity. Of \$1 trillion of outstanding ARMs (\$217 billion outstanding security at a historical securitization rate of roughly 20%), approximately 20%³⁴ may refinance every year on average, 6% of which will go into hybrids. Finally, at a securitization rate of 25%, the hybrid-to-hybrid refinancing component would come to about \$3 billion. A similar calculation for the \$4,000 billion fixed-rate market would yield another \$3 billion of fixed-to-hybrid refi component. The total (\$34 billion + \$3 billion + \$3 billion), or \$40 billion, adds up to close to the 2000 production.

The objective was *not* to reconcile the numbers but rather to get a sense of where the sources of new securities lie and how sensitive the issuance might be to different market factors. Because we do not expect an enormous shift in the total ARM share of the market, hybrid issuance in the medium term will depend most significantly on the hybrid share of the market and the securitization rate. For example, if the securitization rate improves to 30%, the issuance would increase to about \$50 billion. Again, if the FHA hybrid program succeeds in increasing Ginnie Mae volume even by a mere \$10 billion a year, annual hybrid production would amount to close to \$60 billion. We believe that \$40–50 billion on average for the next few years is a reasonable estimate.

If we assume average production of \$45 billion a year and a 25% paydown for outstanding loans and a 10% average paydown for new loans originated during the year, the market size could reach $\$45 \text{ billion} * 0.9 / 0.25 = \162 billion (since the market size grows until $\$162 \text{ billion} * 0.25 = \40.5 billion of paydown cancels $\$45 \text{ billion} * 0.9 = \40.5 billion of new issuance, approximately). Some simple calculations show that it might take about five to six years to achieve that market size. Clearly, the assumptions are critical. For example, if one assumes a 20% paydown rate for new hybrids, the projected market size declines to \$140 billion. All in all, we expect the hybrid market to approach \$100 billion over the next few years.

³⁰ There is some overlap between housing starts and new home sales numbers, although it is not clear how much. Housing starts will include multifamily loans and loans to builders that the new home sales figures may not include. We do not expect the overlap to distort our projections for hybrid issuance.

³¹ $15\% \text{ (ARM share)} * 40\% \text{ (hybrid share)} = 6\%$. Approximate averages used from Figure 2.

³² This is the average price for homes funded by ARMs. Source MBA, FHFB.

³³ Approximate averages are from Figure 2.

³⁴ Average historical ARM speeds are close to 25% CPR. Netting about 5% CPR attributed to turnover, we are left with about 20% CPR of refinancing. The loans due to turn over are accounted for in the purchasing activity.

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