Prepayments on Agency Hybrid ARM MBS

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- This primer explores some of the characteristic patterns observed in Hybrid ARM MBS prepayments. The focus is on ARM MBS collateralized by 3/1s and 5/1s, although our discussion and conclusions can easily be extrapolated to 7/1s and 10/1s. Our approach is to try to understand ARM prepayment behavior by comparing and contrasting it to fixed-rate mortgage (FRM) prepayment behavior.
- The key to understanding the difference between ARM and FRM prepayment behavior lies in understanding the differences between homeowners who take out an ARM versus those who take out a FRM. An ARM makes sense for borrowers who know they are likely to relocate soon and are consequently willing to trade off uncertainty about future monthly payments for a lower monthly payment now. Other reasons driving the choice of an ARM might be an inability to afford the higher payments on a fixed-rate mortgage, or a belief that rates will head lower soon. Generally speaking, ARM borrowers expect to stay in their home for a shorter period of time (have a "shorter tenure horizon") than FRM borrowers.
- The shorter tenure horizon for ARM borrowers leads to higher baseline and out-of-the-money prepayment speeds on ARM MBS relative to FRM MBS. In general, the shorter the initial fixed-rate period on an ARM MBS, the faster the turnover rate of the underlying borrowers.
- The shorter tenure horizon for ARM borrowers also leads to a more muted refinance response than for FRM borrowers. Another distinctive characteristic of ARM prepayment behavior is the jump in prepayment speeds around rate resets.

I. INTRODUCTION

The goal of this primer is to delve into the cash flow profile of Agency ARM MBS. As discussed in our earlier publication,[1] virtually all Agency ARM MBSs are ARM pools with pass-through cash flows so there is little mystery to ARM MBS from the perspective of cash flow structuring. Hence, the key to understanding ARM MBS cash flows lies in understanding the prepayment behavior of homeowners who take out an ARM. This primer summarizes and explains some of the distinctive features of ARM prepayment behavior by comparing and contrasting the tendencies of homeowners who take out an ARM to those who choose a 30-year fixed-rate mortgage (FRM).[2] 30-year FRMs are chosen as the reference point simply because their prepayment behavior is relatively well understood as we now have over two decades of prepayment history on 30-year pools. This is somewhat in contrast to the situation in ARM MBS where the data available on ARM MBS is much less rich since many of the types of Hybrid ARMs that currently collateralize the most liquid ARM MBS were not originated in any significant volume till the mid- to late-90s.

The first natural question, then, is to ask whether the prepayment behavior of an ARM borrower is different from that of a 30-year borrower and, if so, why? To answer the first part of the question (Do ARM MBS prepay differently from fixed-rate MBS?), we walk through a simple example. Figure 1 is a time-series plot of prepayment rates on 3/1, 5/1, and 30-year Fannie Mae (FNMA) pools issued in 1997 versus (lagged) 30-year mortgage rates. The figure visually illustrates how the prepayment rates on these different types of MBS react to different interest rate environments. There are several interesting trends that jump out from an examination of the figure:

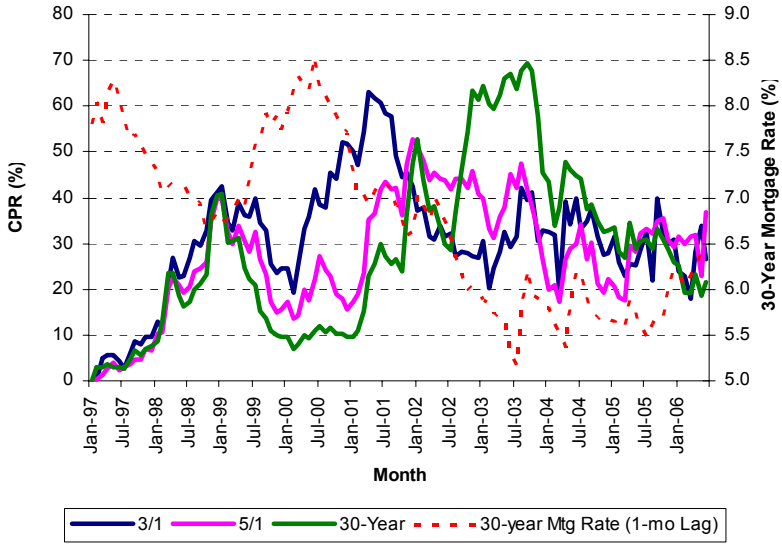
- **January 1997 – January 1998**: 3/1 pools season faster than 5/1s which, in turn, season quicker than 30-years. The trend is somewhat obscured by the fact that mortgage rates fell steadily over 1997 leading to an acceleration in refinance-related activity.
- **January 1998 – January 1999**: Elevated refinance response in all three sectors as mortgage rate hit multi-year lows. While peak speeds in 1998 look roughly similar across the different sectors, 3/1s appear to be faster than 5/1s and 30-years before and after the peak.
- **1999-2000**: Rates sell off leading to a general slow down in prepayments. In this "out-of-the-money" environment, speeds on 3/1s dominate 5/1s which in turn are faster than 30-years. Notice the very interesting behavior exhibited by 3/1 pools: Even though rates are rising, speeds ramp up sharply towards the middle of 2000 as the underlying borrowers hit their rate resets.
- **2001-2003**: Prepayment rates start to increase again as rates begin an extended period of decline resulting in several waves of refinancing. The early 2002 refinance wave sees speeds on 30-years and 5/1s peaking in the low 50's CPR.

[1] See "The Agency ARM MBS Sector," *RMBS Trading Strategy*, June 2, 2006.
[2] We use the phrase "ARM prepayment" as a convenient shorthand for saying "the aggregate prepayment behavior of ARM borrowers in ARM MBS." The phrase "FRM prepayment behavior" is used similarly. A general introduction to homeowner prepayment behavior can be found in "Residential Mortgages: Prepayments and Prepayment Modeling," *RMBS Trading Strategy*, September 18, 2006.

3/1 speeds are noticeably slower. As rates stabilize for a couple of months, prepayments on 30-year pools decline while 5/1 speeds remain elevated with a number of 5/1 pools resetting in early- to mid-2002. Rates start declining again and reach multi-decade lows in the middle of 2003. Prepayment speeds on 30-year pools now average in the low 60's CPR and reach as high as 70% CPR in September of 2003. Both 3/1 and 5/1 pools appear to be relatively burnt out at this juncture with peak speeds in the low- to mid-40's CPR

- **2004-Current**: Speeds decline again as rates move up but remain relatively elevated. With low factors on many pools, prepayment rates are very noisy and it is not particularly easy to detect any trends.

Figure 1. Prepayments on 1997 Vintage FRM and ARM Pools



Source: Banc of America Securities

We can summarize some of the trends we see in Figure 1 as follows:

- The seasoning ramp for ARMs is elevated relative to FRMs. In general, the shorter the initial reset, the steeper the ramp and the higher the long-term turnover rate.
- "Out-of-the-money" speeds on Hybrid ARM MBS are higher than for 30-years. In general, the shorter the initial fixed-rate period on the ARM, the higher "out-of-the-money" speeds are.
- As the underlying homeowners near their rate resets, Hybrid ARM MBS see a big jump in prepayment speeds.
- Prior to reset, peak speeds on Hybrid ARMs in refinancing waves tend to be similar to those on 30-year MBS. After reset, speeds on Hybrid ARMs tend to be somewhat slower than 30-years during refinancing episodes.

To understand why these differences between ARM and FRM borrowers exist, we need to address the following question: How are ARM borrowers different from FRM borrowers?

II. UNDERSTANDING ARM BORROWERS

The modern day menu of mortgage products offers a number of different options for potential borrowers. Borrowers can choose between ARMs with various reset terms (1/1s, 3/1s, 5/1s, 7/1s, 10/1s) and FRMs with different terms (10-, 15-, 20-, and 30-years). Recent product innovations now allow borrowers to choose between fully-amortizing, interest-only (IO) or even negatively-amortizing variants of the above mortgages. The crucial concept behind the mortgage choice of borrowers is that of "self-selection." In basic terms, the borrower's choice of a particular mortgage from the menu of available product types provides us with information about the borrower on a number of different fronts including:

- The borrower's current financial situation and their expectations for future income growth;
- How long the borrower intends to stay in the house ("tenure horizon");
- How comfortable the borrower is with the mortgage payment changing and;
- The cost of the mortgage relative to other available mortgage products.

For example, if a borrower knew with a high degree of certainty that they would be moving within the next five years then they would always pick a 5/1 Hybrid ARM mortgage over a 30-year mortgage since 5/1 Hybrid ARM rates are typically lower.

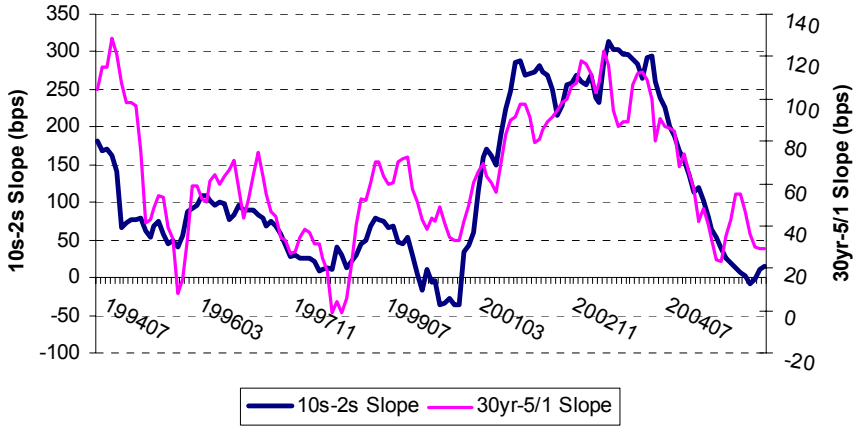
Within the context of a choice between ARMs and FRMs, the key to understanding what information this decision reveals about the homeowner lies in thinking through the monthly payment profile of an ARM versus a FRM, and the different financial risks these different mortgage products pose for the homeowner. For example, an ARM holder is exposed to the risk that their income may not keep pace with increases in real interest rates and/or inflation while these risks are not an issue for FRM holders. And, although fixed-rate mortgagors are exposed to the risk that rates may decrease, nearly all (prime) mortgage holders can refinance into a lower rate by paying a transaction fee of about 1 point (1% of the loan balance).

Another difference between the monthly payment profile of ARM and FRM borrowers arises from the rate differentials between these two product types. ARM borrowers are charged a lower rate because the yield curve is typically upward sloping (ARM MBSs have a shorter duration) and because the value of the prepayment option on an ARM is less valuable than the one available to fixed-rate borrowers. The historical relationship between ARM and FRM rates can be seen in Figure 2 which illustrates the FRM-ARM premium over the last several years. Fundamentally then, ARM borrowers are homeowners who are willing to make the gamble that over the period of their expected tenure, they will pay less on their monthly payments than if they took a fixed-rate mortgage and that increases in their mortgage rates will not outstrip increases in income. More formally, ARM borrowers are different from FRM borrowers in one (or more) of the following ways:[3]

[3] See "Consumer Profiles and Acceptance of ARM Features: An Application of Logit Regression," *The Journal of Real Estate Research*, Vol. 2, Issue 2, pp. 63-74 (1987).

- Younger borrowers with lower incomes;
- Borrowers with relatively low initial wealth who need the ARM discount to obtain the house they want;
- Borrowers with expectations of moderate to high income growth;
- Borrowers with a fair degree of certainty about future income;
- Borrowers who expect to move early in the life of the mortgage; and
- Borrowers who do not expect interest rates to increase.

Figure 2. The FRM-ARM Rate Slope



Source: Banc of America Securities

The ARM borrower profile presented above can be simplified into three idealized borrower types:[4]

- **Movers**: These borrowers plan to move in the near future and believe that interest rates will not increase enough over their tenure to make the initial choice of a fixed-rate mortgage a better one.
- **Choosers**: These borrowers choose an ARM because they are comfortable that they can manage the interest rate risk associated with an ARM and have no particular desire to look at a fixed-rate mortgage.
- **Switchers**: These borrowers choose an ARM because of affordability constraints but would prefer to switch to a fixed-rate loan as soon as possible.

Coming up with this classification of ARM borrower types helps provide us with a conceptual foundation for understanding the turnover and refinancing behavior of ARM borrowers relative to FRM borrowers.

[4] This categorization was first suggested in "Prepayments and the Valuation of Adjustable Rate Mortgage-backed Securities," *Journal of Fixed Income*, No. 1, Volume 1, 1990. Borrowers were mapped to three classes which are identical to ours but named somewhat differently, and, at least to our ears, less euphoniously: Relocators, Refinancers, and Switchers.

III. PREPAYMENT BEHAVIOR OF ARM BORROWERS

Earlier, we had summarized some of the key differences between ARM and FRM prepayment behavior as follows:

- ARMs have an elevated seasoning ramp relative to FRMs. In general, the shorter the initial reset, the steeper the ramp and the higher the long-term turnover rate.
- "Out-of-the-money" speeds on Hybrid ARM MBS are higher than for 30-years. In general, the shorter the reset the higher "out-of-the-money" speeds are.
- As the underlying homeowners near their rate resets, Hybrid ARM MBS see a big jump in prepayment speeds.
- Prior to reset, peak speeds on Hybrid ARMs in refinancing waves tend to be the same as for 30-year MBS. After reset, speeds on Hybrid ARMs appear to be slower than 30-years during refinancing episodes.

Understanding these differences is equivalent to understanding what types of borrowers prefer ARMs to FRMs. As we discussed in the previous section, ARM borrowers come in three flavors. An ARM makes sense for borrowers who know they are likely to relocate soon and are consequently willing to trade off uncertainty about future monthly payments for a lower monthly payment now ("Movers").[5] Other reasons driving the choice of an ARM might be an inability to afford the higher payments on a fixed-rate mortgage ("Switchers"), or a belief that rates will head lower soon ("Choosers"). As a result of self-selection, ARM borrowers should tend to have higher mobility rates and be sensitive to the "spread" between ARM and FRM mortgage rates.

In addition, the choice of an **initial fixed-rate period**[6] (one, three, five, seven or ten years) by an ARM borrower conveys some additional information about their propensity for prepayment. The longer the initial term, the longer the borrower's expected horizon for holding their housing and the greater the degree of their aversion with respect to interest rate risk. Clearly, the longer the term of the fixed-rate portion of the ARM, the more closely the ARM borrower lines up with the fixed-rate borrower in terms of their motivations.

Calculating Incentive for ARMs

The first and most important issue in understanding prepayments on Hybrid ARM mortgages is to link observed prepayment rates to the appropriate measure of refinancing incentive. The "correct" incentive would compare the ARM borrower's note rate to the market rates available on mortgage products that the hybrid ARM borrower would typically refinance into. Apart from other hybrid ARMs, popular refinance products for ARM borrowers include 30-years and 15-years. To simplify matters, in the graphs below we compute the refinance incentive for an ARM MBS by calculating the difference between the weighted-average coupon (WAC) on the MBS and prevailing

[5] In a positively sloped mortgage rate environment.
[6] The period over which the mortgage rate on the ARM is fixed.

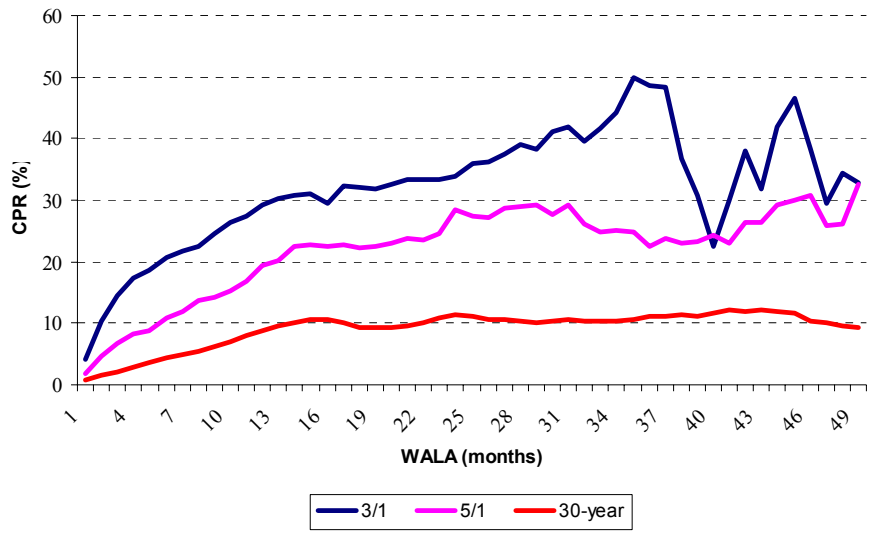
hybrid ARM rates (lagged by one month).

Comparing Turnover on ARM and FRM MBSs

How do the long-run mobility rates of homeowners who take out an ARM compare with those who take out an FRM? Because of the phenomenon of self-selection described above, we already suspect that ARM borrowers are going to have higher mobility rates. Figure 3 shows that the empirical data are consistent with our initial guess. The figure shows prepayment rates on out-of-the-money ARM and FRM MBS pools in order to isolate the turnover driven component of prepayments. For example, the figure shows that baseline speeds on 3/1 and 5/1 Hybrid ARM MBS level off at mid-30s and mid-20s CPR as opposed to 8%-10% CPR for FRM MBS. Notice that the big jump in 3/1 prepayment rates around month 36: this is typical behavior for ARM pools around resets and we will return to this issue in the next section when we compare patterns of refinancing behavior on ARMs and FRMs.

Some of the characteristics of hybrid ARM prepayment behavior can be further clarified by studying the prepayment behavior of hybrid ARMs with different initial fixed-rate periods. For example, Figure 3 clearly brings out the relationship between a borrower's mobility rate and the term of the initial fixed-rate period on their hybrid ARM.

Figure 3. The Seasoning Ramp for Housing Turnover: ARMs and FRMs



Source: Banc of America Securities

Comparing Refinancing on ARM and FRM MBSs

The Refinance S-Curve

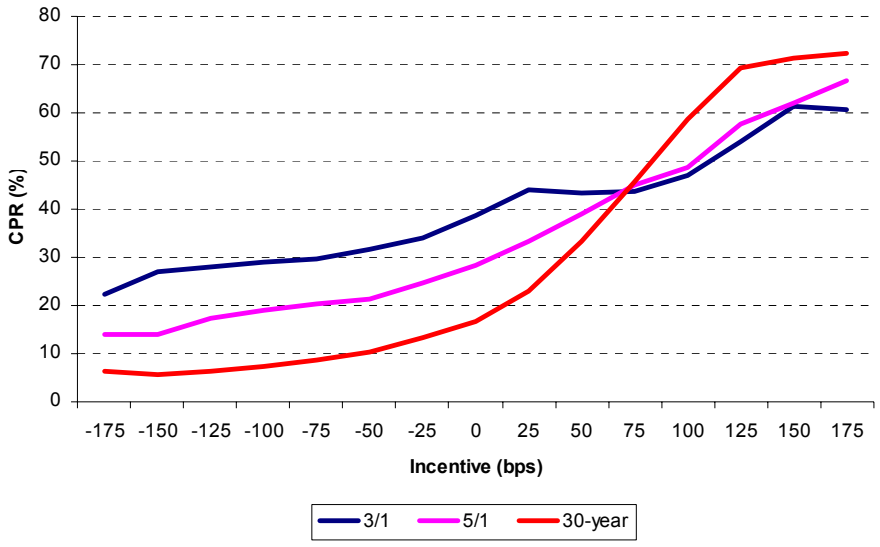
Figure 4 illustrates the prepayment response on 3/1, 5/1, and FRM MBSs over a wide range of interest rate incentives. Clearly, the portion of the graph corresponding to negative incentives corresponds to out-of-the-money prepays and shows the sensitivity of turnover rates on the different product types to interest rates. Notice that the separation between the prepayment speeds on different product types remains persistent

at large disincentives, consistent with the data presented in Figure 3.

The portion of the graph corresponding to positive incentives shows the differential response rates of the different product types to increasing incentive. The most noticeable feature of the figure is the acceleration in 30-year FRM prepays relative to 3/1s and 5/1s. Not only do prepayment rates on 30-year MBS level off somewhat higher than on 3/1s and 5/1s, they do so from a much lower base. The results in Figure 4 are controlled for loan size (and loan age) and are aggregated over several interest rate environments and thus give us a better idea of the refinancing responsiveness of ARMs versus FRMs than Figure 1, where peak speeds on the different product types looked much more similar.

To understand the data presented in Figure 4, we start by recalling that ARM borrowers have shorter holding periods for their housing than FRM borrowers. To understand the importance of the holding period in the refinancing decision, consider two borrowers who are both paying a mortgage rate of 6.50% and have the same loan balance. Assume prevailing mortgage rates are at 6%. In this case, the borrower with the longer expected tenure will be more motivated to refinance since they accumulate a greater savings in monthly payments.

Figure 4. The Refinancing S-Curve: ARMs and FRMs*



*All pools have a WALA between 12 to 24 months and a Loan Size between $175K to $250K.

Source: Banc of America Securities

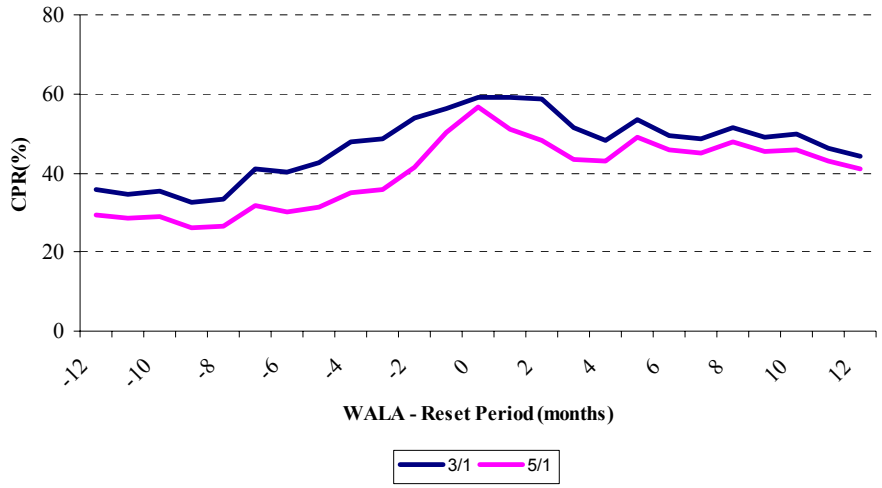
Behavior at Rate Reset

Another very distinctive feature of Hybrid ARM prepayments is the jump in prepayment speeds as borrowers reach their rate resets. In fact, as Figure 5 demonstrates, prepayment speeds jump from the mid-20s %CPR (for 5/1s) and the mid-30s %CPR (for 3/1s) to the low 60s % CPR at or near reset for Hybrid ARM pools.

There are a couple of reasons for this behavior. First, based on history, the fully-indexed rate to which a Hybrid ARM mortgage resets is often higher than the initial fixed rate

which means that the homeowner can face a fairly substantial payment shock at reset. The second point to note is that even if the reset rate is equal to or lower than the initial fixed rate, the "Switchers" in the Hybrid ARM pool may still refinance because of their aversion to having floating-rate mortgage payments. Empirical data show that the peak speeds we see in Figure 5 are a function both of the magnitude of the payment shock and prevailing rates on mortgage products that the Hybrid ARM borrower would consider refinancing into.

Figure 5. Hybrid ARM MBS Prepayments Around Rate Reset



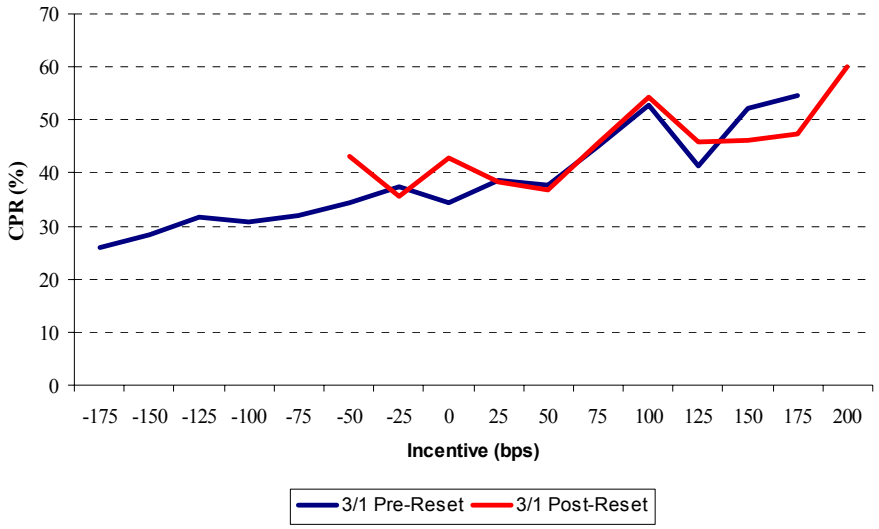
Source: Banc of America Securities

Behavior after Rate Reset

The final aspect of Hybrid ARM MBS prepayments we focus on is the prepayment behavior shown by these pools after reset. Unfortunately, we are somewhat hamstrung here by the relative youth of the Hybrid ARM MBS sector which leaves us with a relatively small number of pools that have actually experienced reset to draw inferences from. Figure 6 suggests that after controlling for incentive, the refinance response of Hybrid ARM MBS borrowers looks fairly similar pre- and post-reset.

This is a somewhat surprising result and appears to be different from the trends we saw in Figure 1. The nuance here is that in the previous figure, we were only looking at the 30-year mortgage rate to gauge the borrower's rate incentive. However, after reset, the Hybrid ARM borrower will probably look at prevailing 1/1 rates and the slope of the yield curve in deciding whether to refinance or not. Thus, the relative insensitivity of Hybrid ARM prepayments to 30-year mortgage rates in the refinance waves of 2001 was probably due to the steepness of the yield curve which made it costly for borrowers to refinance into a FRM at that juncture.

Figure 6. Hybrid ARM MBS Prepayments after Rate Reset



*Pre-reset pools have a WALA between 20 to 33 months and post-reset pools have a WALA of 39 months or more. Both sets of pools have loan sizes between $175K and $250K.

Source: Banc of America Securities

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