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Non-agency Hybrid ARM Prepayment Model

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Abstract

In the last few years, Non-agency Hybrid Adjustable-Rate Mortgages (Hybrid ARMs or Hybrids) originations have increased to a substantial amount and have begun to affect fixed rate MBS market. Hybrids provide a low teaser rate for a longer than one-year period to appeal to mortgage borrowers. After the teaser period, the payments follow a specified index plus a rate margin bound by some rate and payment constraints.

Our Hybrid Prepayment Model is constructed and calibrated based on the refinance experience of more than 700,000 non-agency loans from January 2002 to March 2006. While fundamental prepayment factors such as age, refinancing, and seasonality factors are interpreted similarly as its fixed rate counterpart, teaser factor and Loan-to-Value (LTV) ratio are additionally crucial for the overall prepayment behavior.

When we model Hybrid ARMs prepayment, initial reset period plays an essential role that affects the age and refinancing factors. During this "teaser" period, prepayment rises gradually due to the age factor. However, a sudden prepayment hump emerges right around the first reset date. The "teaser" effect becomes even more apparent for discount loans. This teaser effect can sustain for a few months and gradually dampens and dies out after a couple of additional mortgage rate resets. The reason for this refinancing wave is due to the unsmooth transition borrowers often face when paying at higher floating rates. After that, the prepayment behavior of Hybrids is similar to that of a seasoned ARM. This teaser factor makes shorter-reset hybrids season faster than longer-reset ones. The magnitude of the difference in prepayment level is increasingly apparent as the teaser rate gets higher and is captured by our teaser factor.

During the floating-rate period, the prepayment rate is less sensitive to the prevailing mortgage rates since the floating rates are adjusted periodically. However, the coupon rate during the teaser period can cause the prepayment level to differ significantly.

Non-agency sector consists of loans that fail to satisfy either the credit standard or the maximum size constraint as specified in agency pools. Unlike agency pools where defaults are backed directly or indirectly by the full-faith of the US government and thereby are considered prepayments, defaults in agency loans typically result in only portions of the original loan amount being recovered after going through the legal process for foreclosure and/or bankruptcy. Here the credit factor as implied by the LTV ratios has a significant impact on the overall prepayment behavior as lower income families tend to have higher LTV ratios, hence increase the chance of default as well as decrease the possibility of future prepayments. As well, loan documentation status, occupancy and buyer's purpose could also influence the credit factor.

The model captures the age, teaser, refinancing, burn-out, seasonality, and credit factors. The report displayed by the prepayment model will categorize the loans in terms of the originating year, teaser period, index and the major teaser coupon types in the originating year. The model is calibrated primarily on the non-agency whole loan sector. Default and delinquency behaviors are not captured in the current model. Future enhancement will help formulate a more representative model when the default and recovery statistics are incorporated.

I. Introduction

Hybrid ARMs have been gaining popularity in recent years due to its range of varieties targeting at people with different needs such as different expected durations of holding a house. Furthermore, the extended built-in low teaser rates before the first reset are designed to attract more home owners. Because of the explosive growth of the Hybrids origination, an increasing number of recent US residential MBS deals consist of a substantial portion of Hybrid ARMs. To fully price and evaluate these MBS deals, a hybrid ARM prepayment model needs to be developed.

Forming a hybrid prepayment model could be a daunting task due to the less predictable nature of Hybrids when compared to its fixed-rate counterpart. To determine the main parameters that control most of the resulting prepayment differences would be the most essential step toward the actual model implementation. Modeling Hybrids prepayment behaviors requires a few parameters in additional to the fixed rate ones. One of the most distinctive ones is the teaser factor. Around the end of the initial reset or the “teaser” period when the payment method is switched from fixed to floating, a sudden change of prepayment behaviors arises as borrowers anticipate the change of prepayment speed by prepaying or refinancing their mortgages at a lower rate. This trend is observed across all Hybrids with different teaser period, but is more apparent for Hybrids with shorter teaser period.

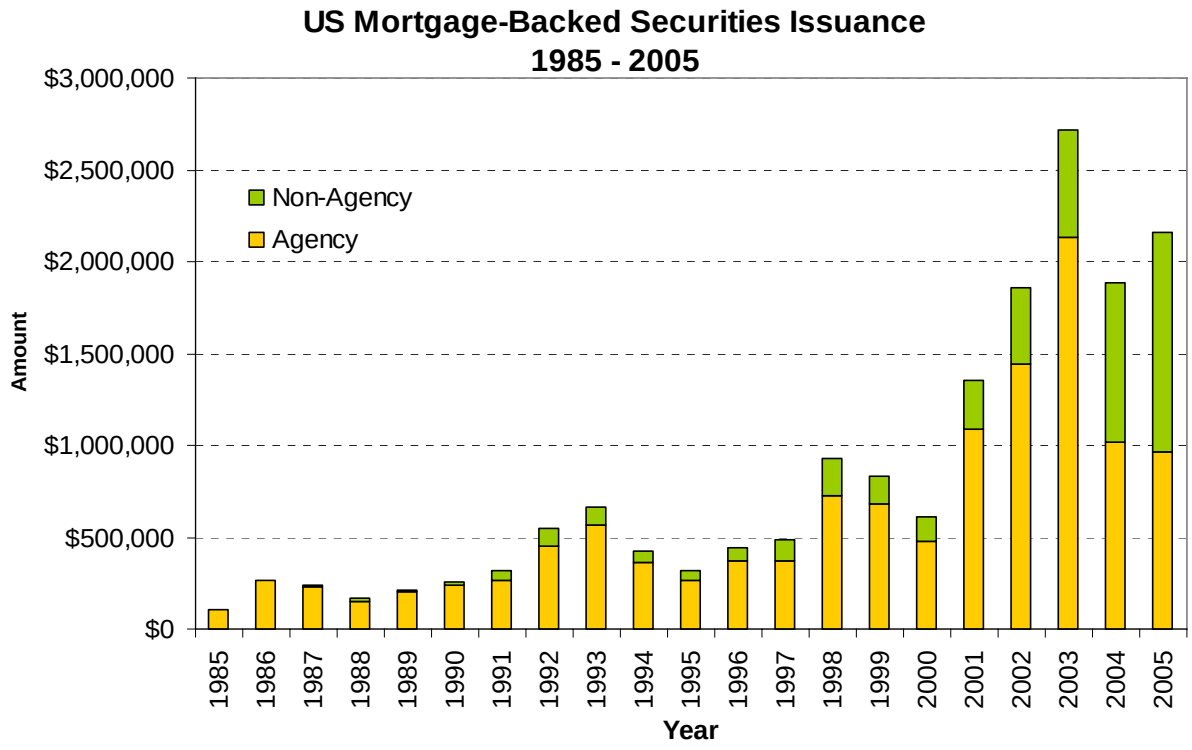
The paper focuses on non-agency mortgage sector because this sector is gaining a lot of momentum in terms of total market shares in the last four years (Section II Figure 1). The Hybrid ARM prepayment model in this sector would provide us more insights in this evolving market. Unlike the agency sector where defaults are considered prepayments, the non-agency sector has a broader range of diversities in terms of overall credit qualities and defaults are not backed by the US government. Currently, default and delinquency status are not implemented in our prepayment model. Future model will incorporate those two statuses in order to achieve a more precise model.

This paper will be arranged as follows. Section II provides a general non-agency mortgage market overview and provides some summary statistics based on our historical prepayment experience. In Section III, we will then stratify the data to analyze prepayment behaviors and portray our theoretic prepayment framework. Section IV illustrates the benchmark comparisons and Section V shows a sample of statistical model fitting of LIBOR 3/1 Hybrid ARM. Finally, a conclusion will be drawn after that.

II. Market Overview

Historically, the non-agency sector is insignificant when compared to the agency sector. However, since 2002 non-agency mortgage sector has been gaining market share at an extraordinary speed. Last year, the non-agency sector has officially surpassed the agency sector in terms of the total amount securitized (Figure 1). Today the non-agency sector is just as influential as the agency sector and more people have begun to pay more attention to this market and are looking to comprehend the products within the sector in order to price the deals with this type of underlying collaterals.

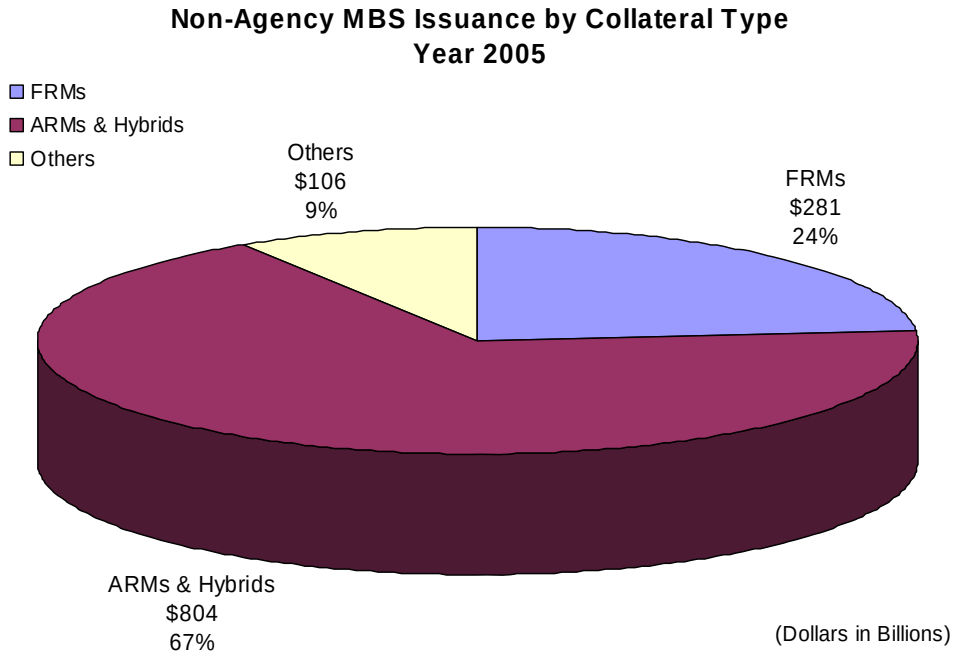
Figure 1



Sources: Bond Market Association

Within the non-agency sector, the flexibility of Hybrids creates lots of interest in today's market. As the result, a significant portion of collaterals in recent MBS issuance are ARMs and Hybrids. In Figure 2, as we can see, two-thirds of all the collaterals totaling $804 billions securitized in non-agency MBS deals during 2005 were ARMs and Hybrids. This ultimately reflects the importance of the Hybrids in the current residential mortgage market.

Figure 2



Sources: Bond Market Association

The data we used for describing our Hybrid model are based on the performance of more 700,000 whole loans as the collateral of non-agency MBS deals from 1/2002 to 3/2006. The following section describes our Hybrid modeling approach by introducing independent factors that would capture the essence of the prepayment behaviors based on the historical prepayment experience, statistics and trends.

III. Model Framework and its Components

Prepayment Components

Like fixed-rate mortgages, prepayment can be caused by relocation, refinance, curtailment, early payoff, or default. In our prepayment framework, we consider seven major factors to capture those behaviors:

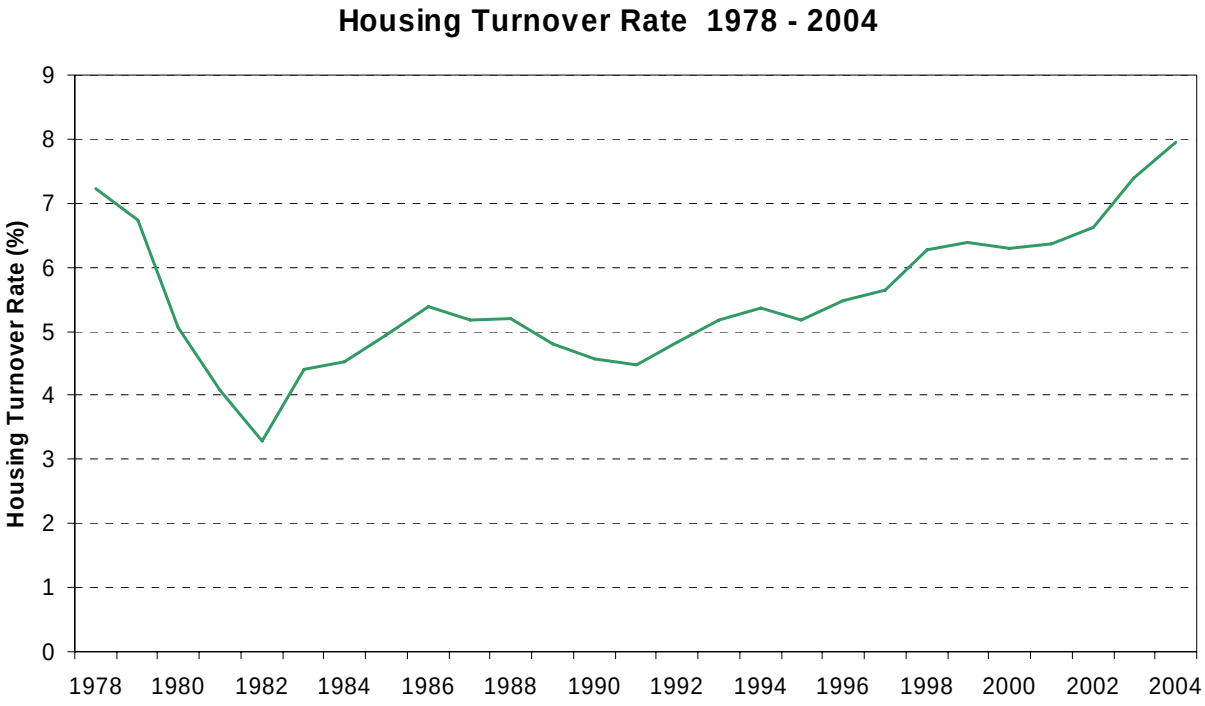
- Housing Turnover and Age
- Teaser Effect
- Interest Only (IO) Effect
- Refinancing
- Burnout
- Seasonality
- Credit Effect

Housing Turnover and Age

The two basic factors in modeling prepayment behaviors are housing turnover and age. In the following we will elaborate the two factors in greater detail. The speed of the overall housing turnover rate is crucial for the calibration of our prepayment model since it is used as the baseline prepayment speed and main factors affecting the prepayment would be multipliers to the baseline speed.

With the exception of cases in early 80s, housing turnover rate has been rising steadily for the last ten years. The result of rising housing turnover rate indicates the fact that home owners are more capable to move around more than they used to. To maintain the forecast capabilities of the model, baseline speeds need to be adjusted accordingly to reflect the latest housing turnover rates.

Figure 3

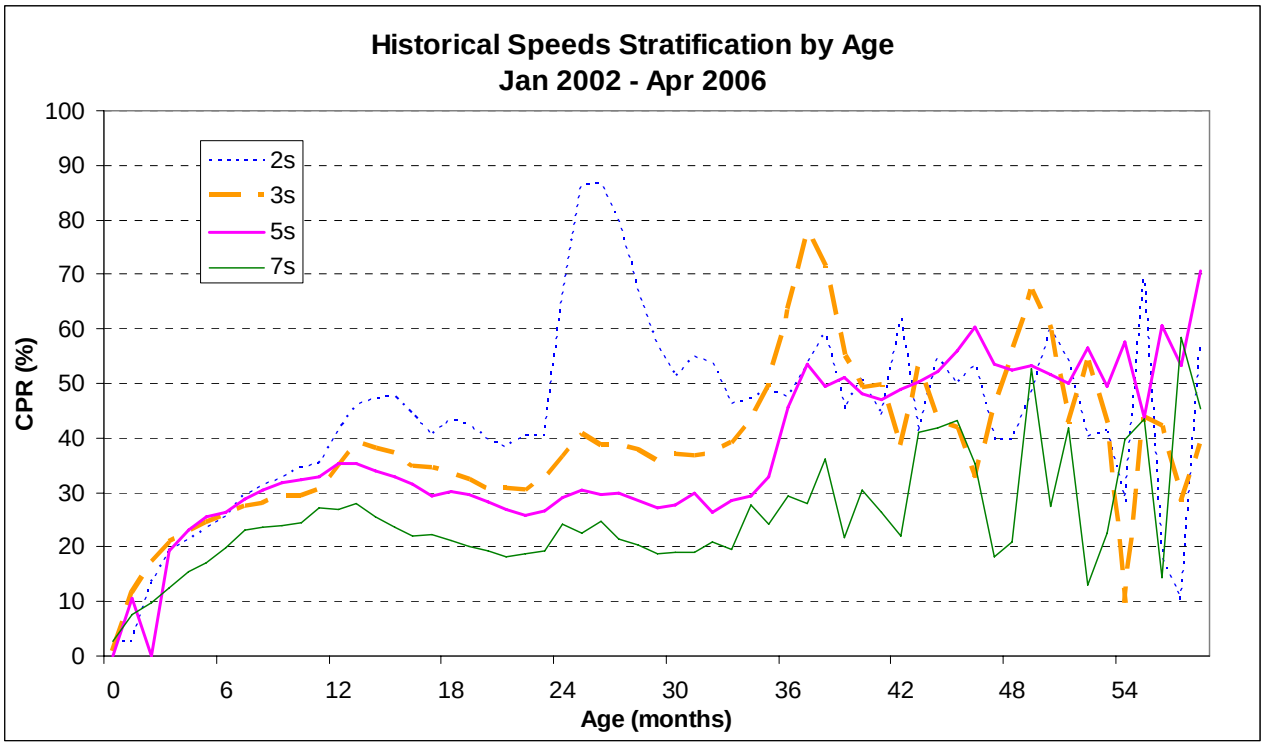


Sources: Bloomberg and Beyondbond

The initial origination fee and the loan closing expenses usually take a few years to depreciate, and that discourages the new mortgagors from prepaying their mortgages at the start of the mortgage term. This ramping-up effect is called the age factor. The following describe the characteristics of the age factor observed in Hybrids. Hybrids exhibit similar patterns initially during the first 12 months. For 2's, 3's and 5's Hybrids, the prepayment level climbs up from 0% to around 20% CPR within the first three months. After the third month, the climbing of the prepayment levels starts to slow down until right around the 12th month. The difference in prepayment levels can be readily observed after the 12th month when shorter Hybrids begin to show higher prepayment rates. The reason why shorter Hybrids show higher prepayment level could be simply due to the faster housing turnover

rates since shorter Hybrid loan borrowers are expected to move around more than longer Hybrid loan borrowers. After the first 12 months, the prepayment generally stays around the same level with a wave-like trend peaking around every 12 months. The age factor is illustrated in Figure 4.

Figure 4



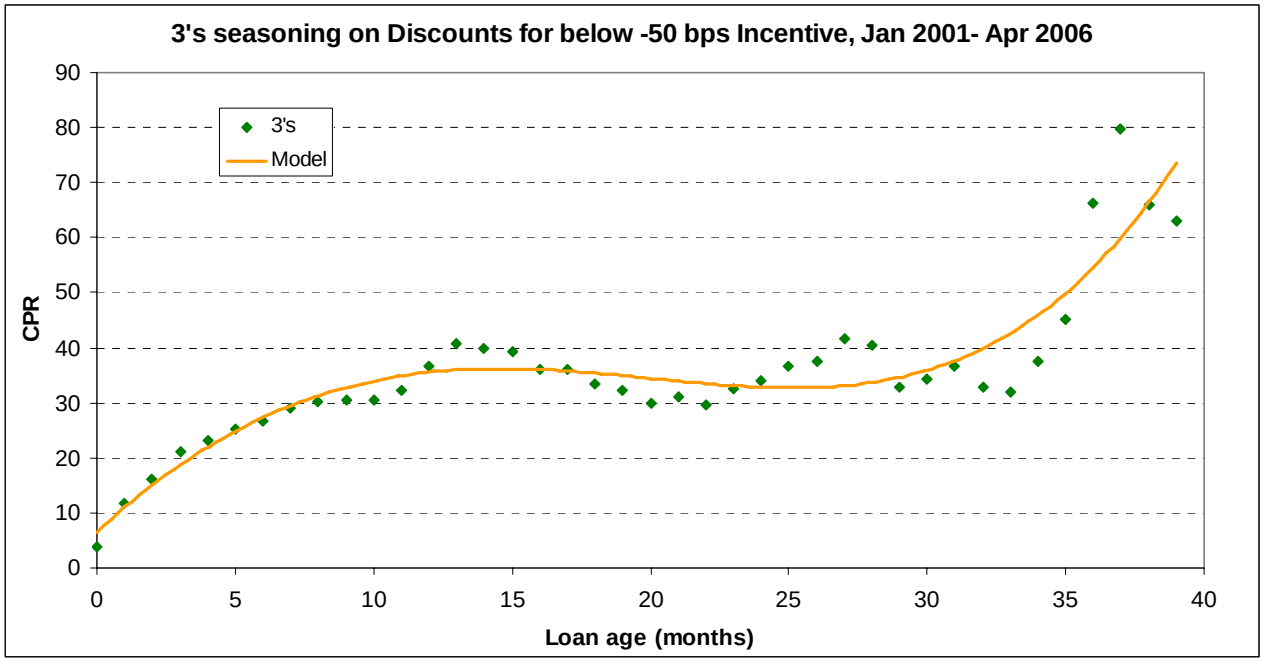
Sources: Beyondbond

Teaser Effect

The teaser effect is the most distinctive feature in Hybrid ARM products. We define the term as the behavior that tends to persist right around the first reset where borrowers seek alternatives to finance their mortgages or simply prepay them to avoid higher interests. In the following we will describe the empirical statistics gathered to support such effects.

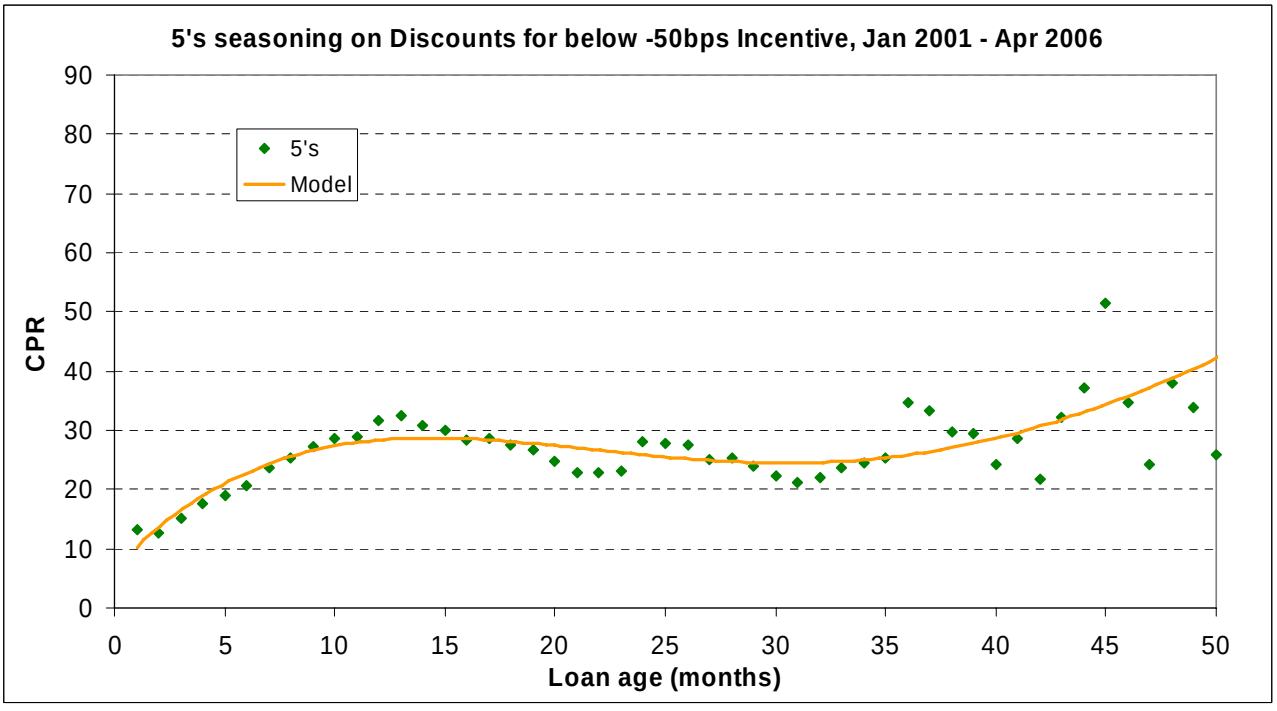
Approximately one to two months before the end of the teaser period, a sharp prepayment level rise occurs. The effect is increasingly apparent for shorter Hybrids since shorter Hybrids are exposed less to factors such as refinancing and burnout right before the end of the teaser period. The peak level is reached just about two months after the teaser period ends. In order to accurately capture this unique behavior, the teaser factor is introduced in our model to reflect this sudden jump. This spike happens because some borrowers have a difficult time adjusting to the higher floating rates and seek other alternatives to finance at more affordable rates using fixed-rate or Hybrid loans. For discount loans (50 bps below FNCL rate), the magnitude of the jump is much more significant because those borrowers who were paying teaser rates lower the market rates during the teaser period have an even tougher time adjusting to the floating rates after the teaser period. After the spike, the prepayment level continues to fluctuate and could sustain for 12 months or more. For discount loans, the effect is much more apparent as the cases where borrowers have the financial incentive to refinance were filtered out (Figure 5, 6).

Figure 5



Sources: Beyondbond

Figure 6



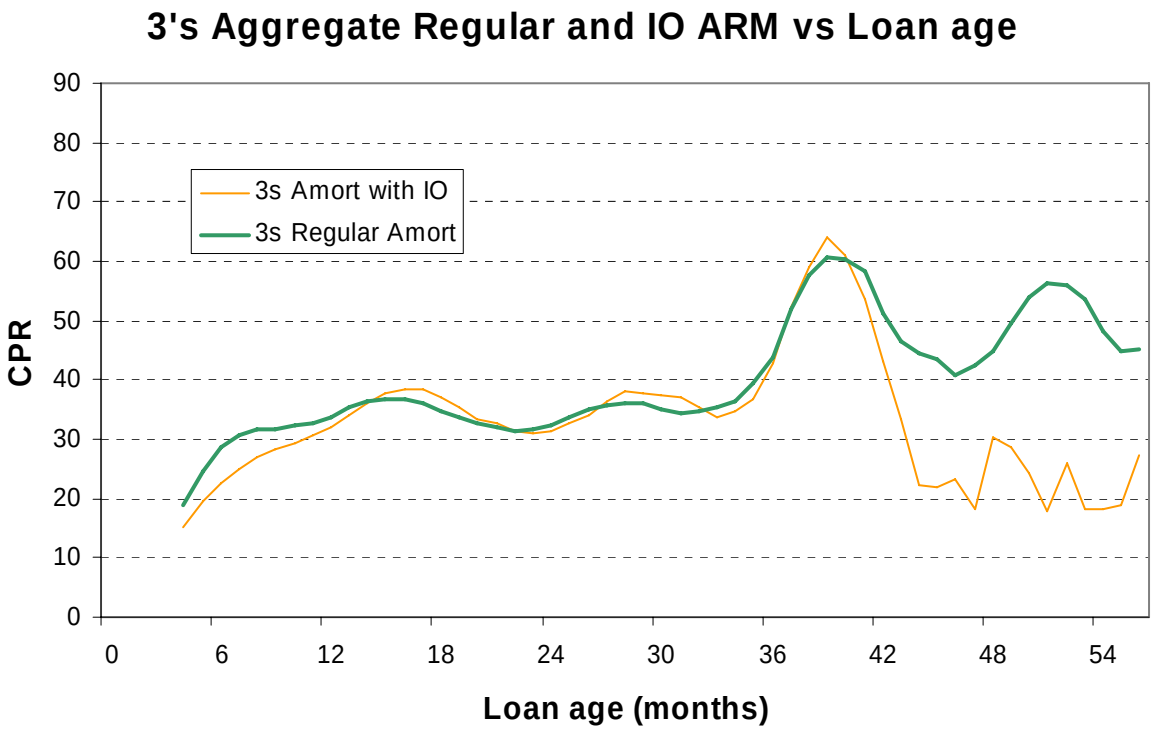
Sources: Beyondbond

Interest Only (IO) Effect

Interest Only mortgage loan is a special type of products where mortgage owners pay only the interest within a specified period. The interest payments are lower than the regular amortization payments because the overall balance is not reduced by any principal payment. Through our findings of Hybrid loans in non-agency US residential market, we discover that there are more Hybrid IO products than regular Hybrids in terms of total size of collaterals. Similar to the teaser effect, IO ARMs exhibit patterns around the end of the IO period. We define this as the IO effect. In the following we will describe the differences in terms of prepayment levels we observed from the loan performance data.

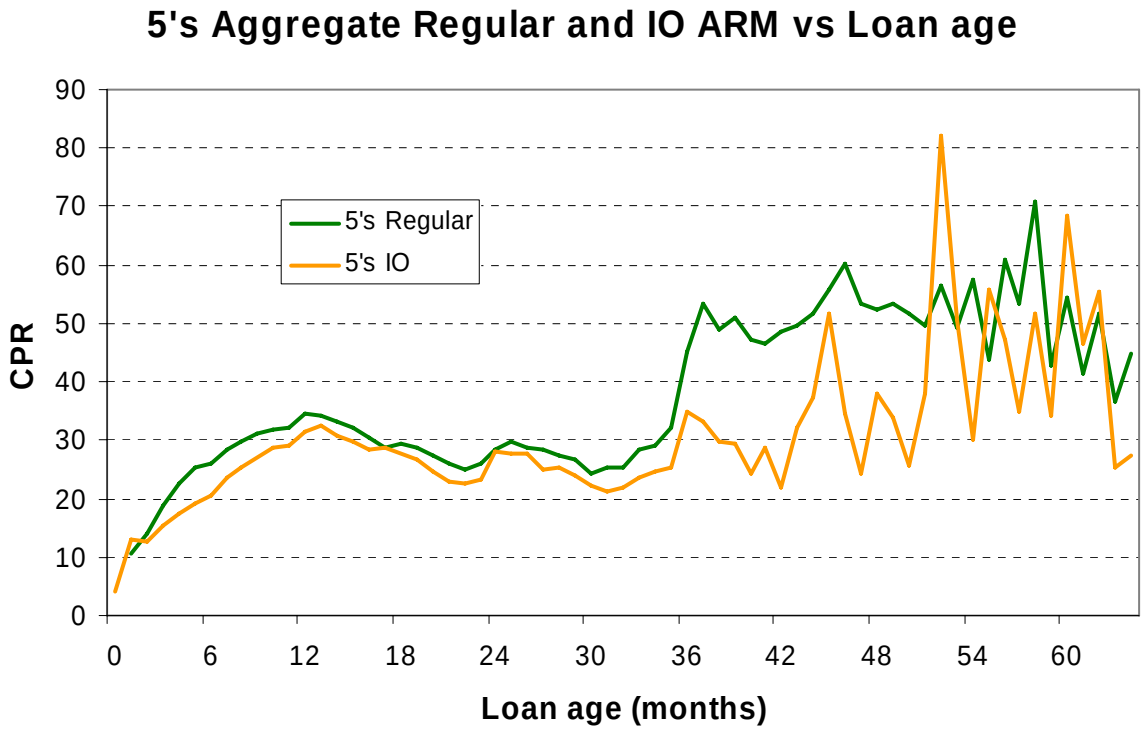
During the teaser period and before the end of the IO period, the prepayment level of regular ARMs and IO ARMs track each other fairly well with regular ARMs being slightly higher in the first 15 months. Around the end of the teaser period, IOs exhibit higher prepayment level than the regular ones. This is because the IO borrowers' payments are more sensitive to the interest rate movement since they are paying only the interest. Once the teaser period ends, they will have to start paying at higher floating rates. In addition, if the end of the IO period coincides with the end of the teaser period, the jump would be much higher. This may be because some IO borrowers prefer to keep their monthly payment low and would prefer to refinance into another IO ARM. For 3's IO ARMs, the both the IO and the teaser effects come into play. This is the case for most 3's in Hybrids where the IO period and the teaser period are both 36 months. After the IO period, the prepayment level for IO ARMs tends to stay lower than the regular ARMs. The trends are similar for both 3's and 5's. Figure 7 and 8 demonstrate the differences in prepayment levels between regular ARM and IO ARM in 3's and 5's.

Figure 7



Sources: Beyondbond

Figure 8

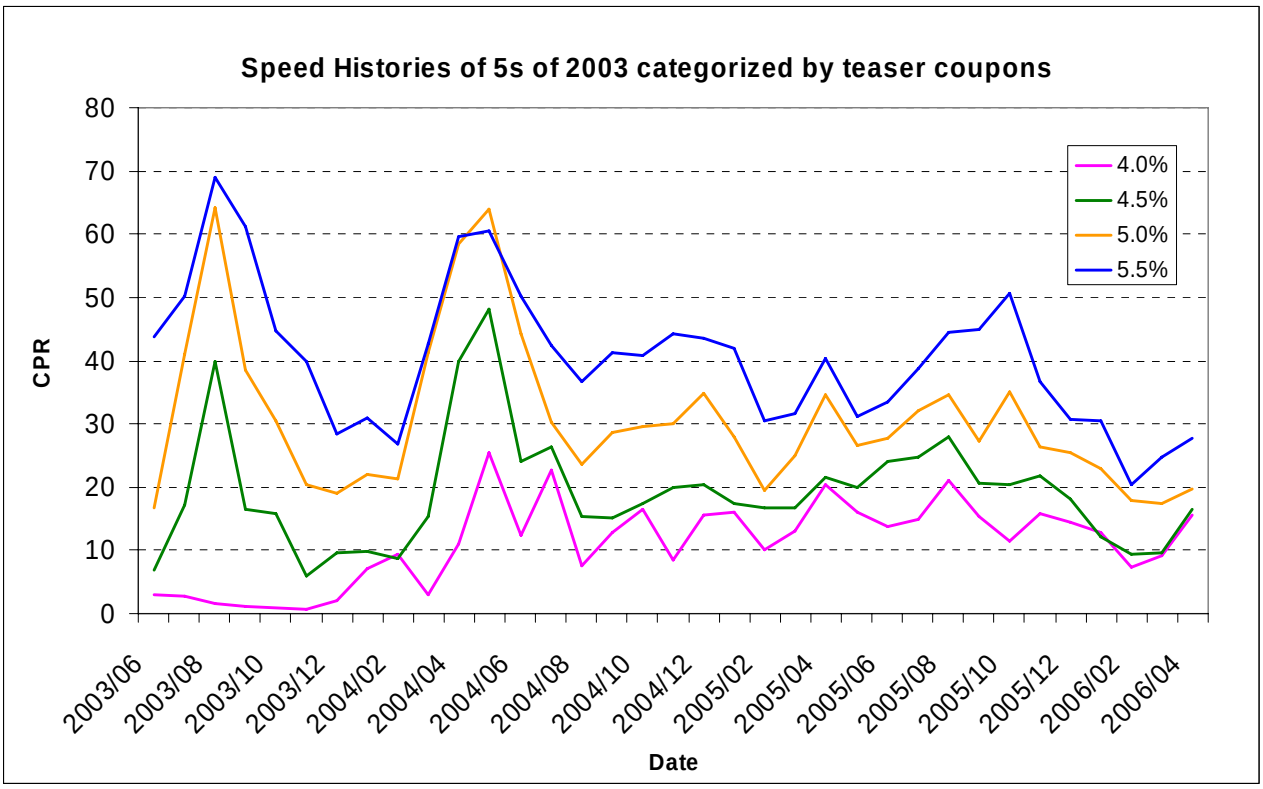


Sources: Beyondbond

Refinancing

The prepayment incentive, which stems from the refinancing portion and is measured by the difference between the mortgage rate and its prevailing refinancing rate, is commonly known as the refinance factor. As the refinancing factor increases, the financial incentive to refinance increases and thus it changes the prepayment behaviors. When the loans are grouped by their coupon rates during the teaser period, the differences of prepayment levels are quite apparent. They behave in similar patterns but loans with higher coupons tend to season faster due to the financial incentive to refinance while loans with lower rates tend to be locked-in in order for the borrowers to secure the low rates. The following graph shows the prepayment speed comparisons grouped by coupons set at the teaser period.

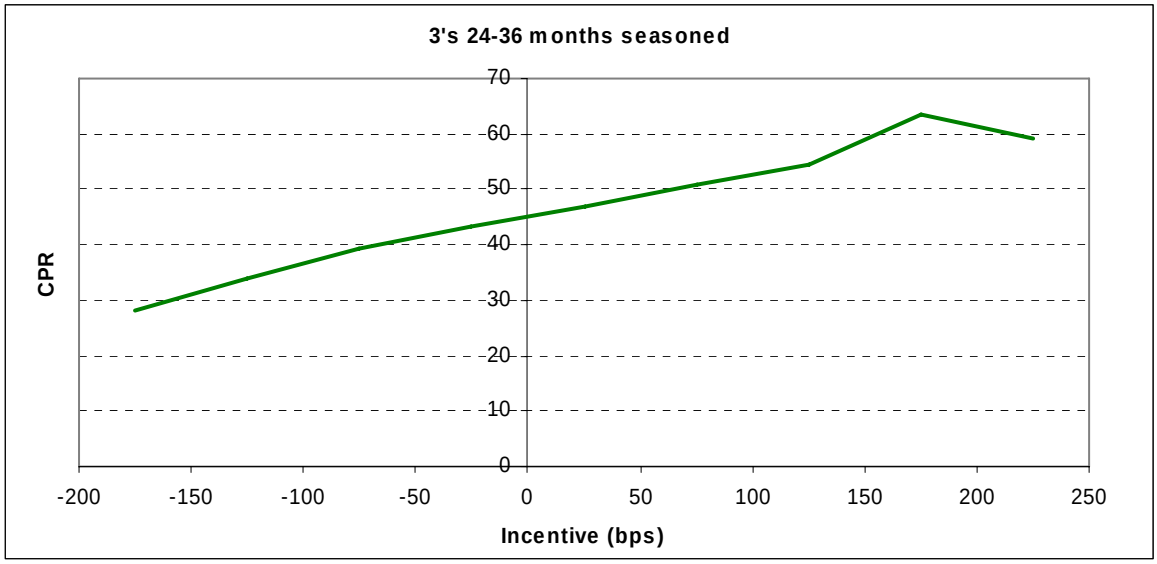
Figure 9



Sources: Beyondbond

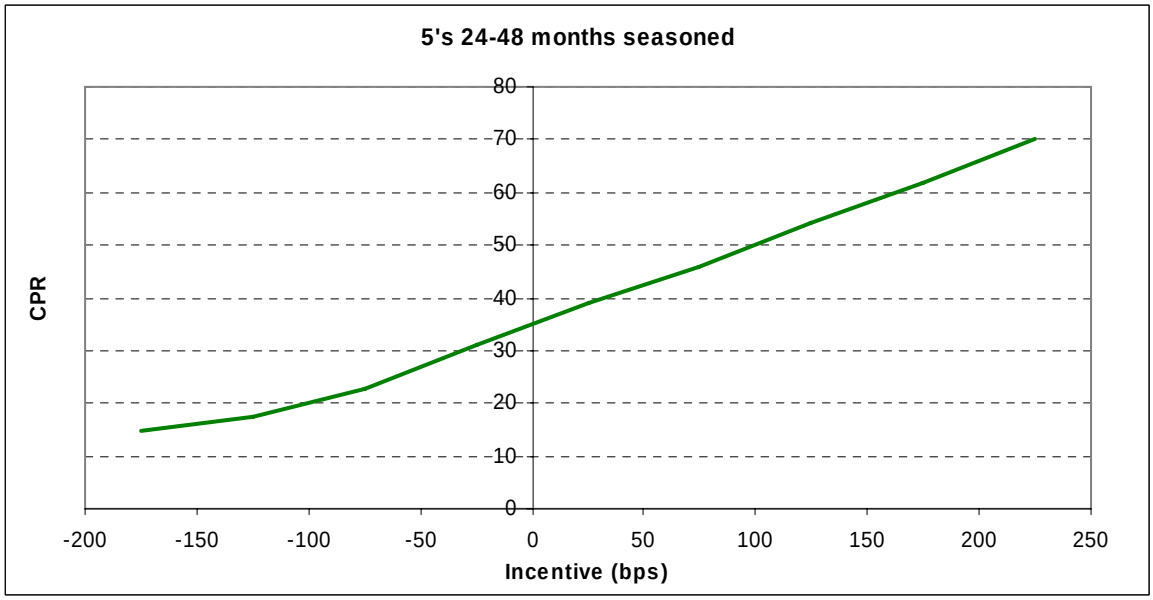
To produce the refinancing curve, the FNCL fixed rate is used here as the benchmark for the incentive calculation. The actual teaser rates could be as much as 50 bps lower than the FNCL rates. However, the overall shape of the incentive curves would still look similar. Figure 10, 11 and 12 shows the refinancing curve of 3's, 5's and 7's respectively.

Figure 10



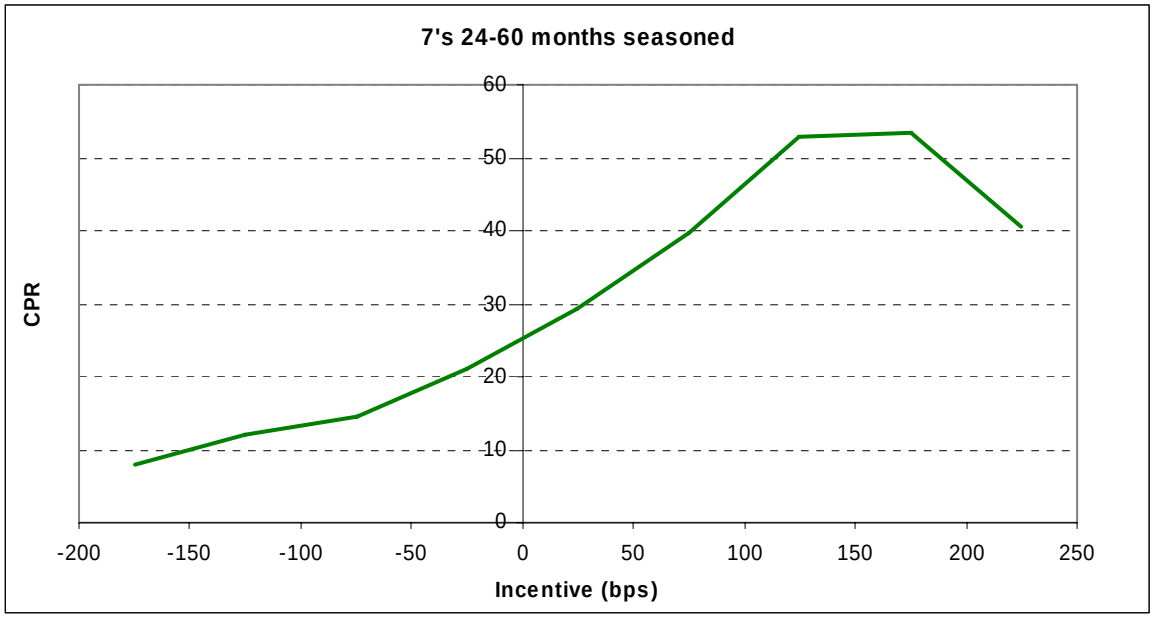
Sources: Beyondbond

Figure 11



Sources: Beyondbond

Figure 12



Sources: Beyondbond

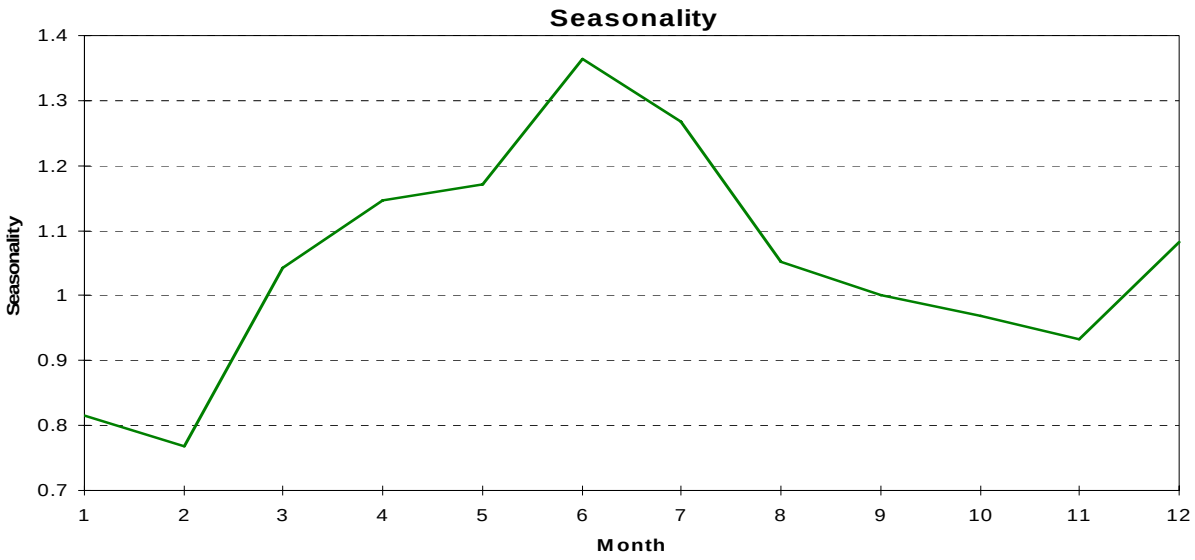
Burnout

The heterogeneity of the refinancing population, causing mortgagors to respond with different prepayment incentive reactions to the same refinancing rate, can be filtered out as the burnout. The prepayment level usually goes up steadily with occasional exceptions across the high incentive region. The major reason for this is due to the burnout phenomena in which borrowers have already refinanced previously to take advantages of the low rates and are less likely to refinance again without enough financial incentives. To capture such a path-dependant attribute, our prepayment model includes the burnout effect in order to reduce the chances of overestimating the overall prepayment level. The burnout phenomena can be observed in Figure 10 and 12 above.

Seasonality

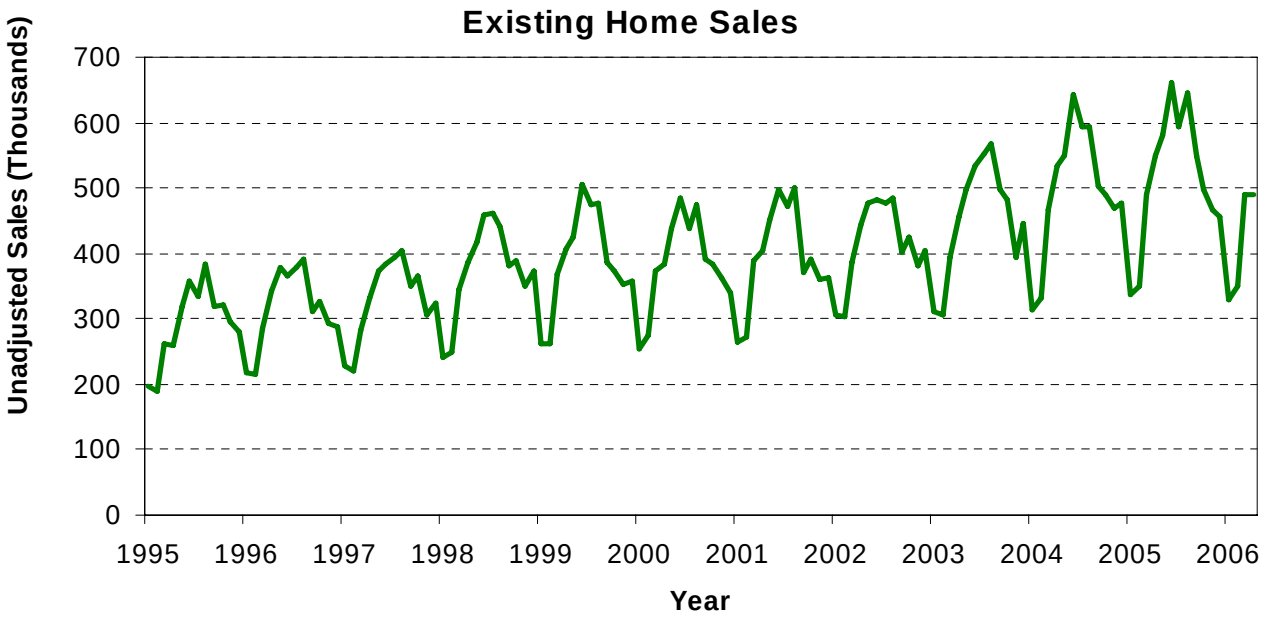
The mobility of mortgagors is affected by the timing of housing construction, school year, and weather considerations, which can be considered as factors of seasonality. The overall prepayment speeds are affected by different seasons and the trend is mainly due to different housing sales rates in different seasons of each year. As we can readily see from Figure 13, the peak of the housing sales is reached around June while the bottom is reached around February. Due to the highly periodic and predictable trend, a seasonality factor that looks similar to Figure 13 can be modeled. Figure 14 shows the historical housing sales trend characterized by different seasons of the year.

Figure 13



Sources: Bloomberg and Beyondbond

Figure 14

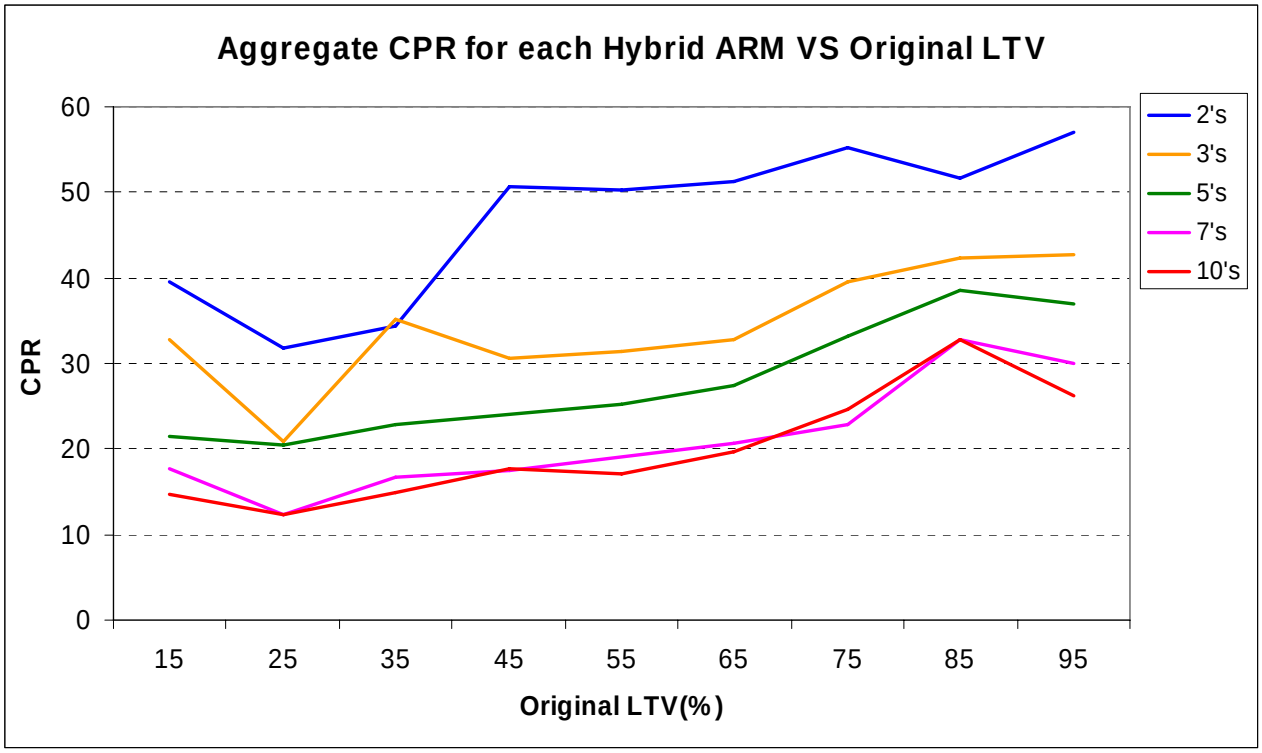


Sources: Bloomberg

Credit Effect

Credit effect is an important attribute in the non-agency sector since the diversity of credit quality range is much more apparent due to the non-standardized nature of the sector. Our prepayment model uses original LTV as a proxy for the credit effect. With the exception of 7's and 10's, shorter teaser period Hybrids exhibit consistently higher prepayment speeds. The prepayment speed is generally an increasing function of the original LTV. However, there seems to be drops in CPR level between 15% and 25% LTV and between 85% and 95% LTV. The drop of the former case is because mortgagors simply pay off their loans when the balances are low so they can stop paying the interest. The later case could be explained by the fact that owners with higher original LTV tend to have lower credit scores and hence less capable to prepay their mortgages.

Figure 15



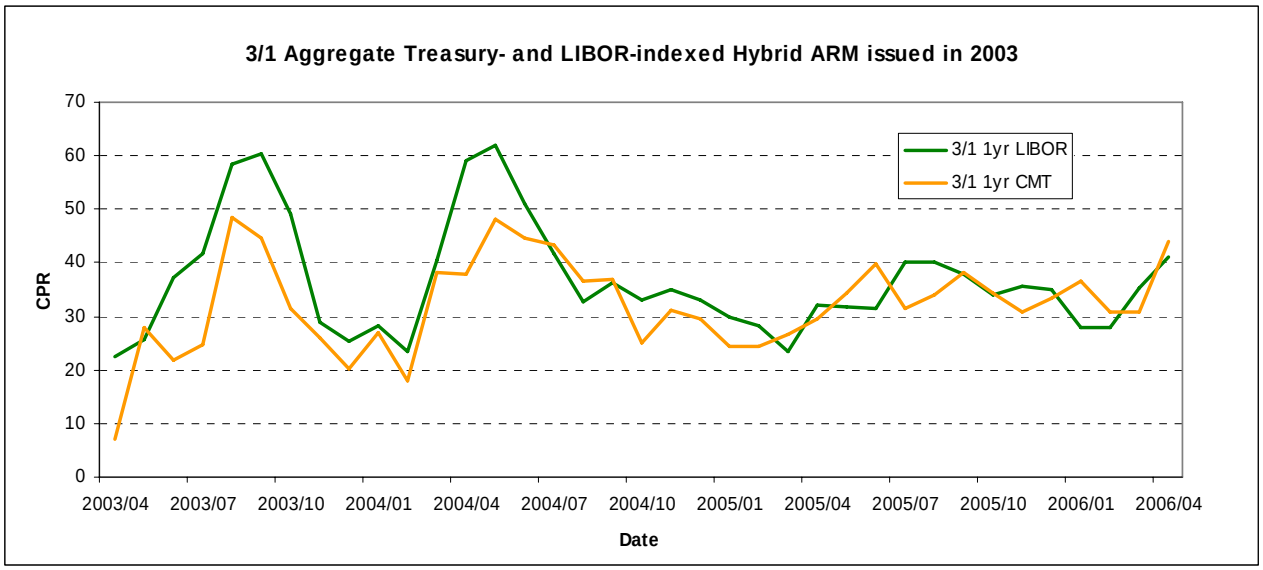
Sources: Beyondbond

IV. Benchmark Comparisons

The two major benchmarks of Hybrids in the US residential market are LIBOR (London InterBank Offered Rate) and CMT (Constant Maturity Treasury) indices. How the two types behave may be of some interest to MBS investors. Below we will illustrate how both types of Hybrids behave through our empirical findings.

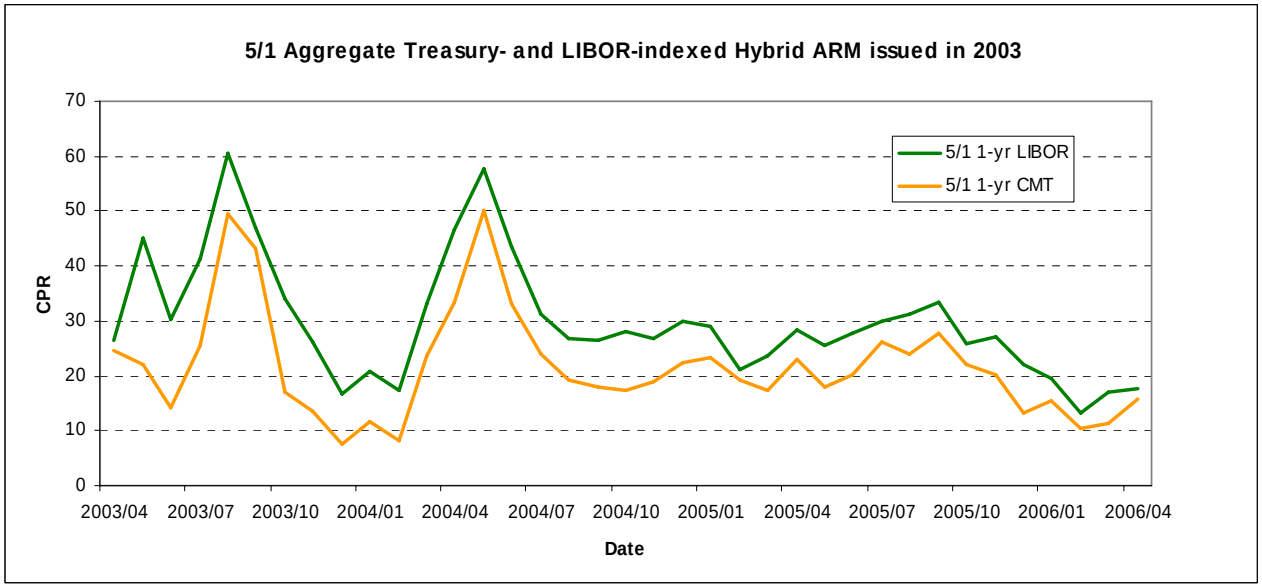
To make different indexed Hybrids more comparable, we pick one-year reset Hybrids for both benchmark comparisons. Here, the LIBOR-indexed 3's and 5's are faster than the CMT-indexed 3's and 5's, but the CMT-indexed 7's prepays faster than the LIBOR-indexed 7's. However, the differences of prepayment speeds do not persist indefinitely. The overall patterns look similar across Hybrids with different teaser periods. Here, shorter-teaser Hybrids exhibit prepayment levels than longer-teaser Hybrids indicating faster seasoning. Figure 16, 17 and 18 show the aggregate treasury- and LIBOR-indexed Hybrids issued in 2003 for 3/1, 5/1 and 7/1.

Figure 16



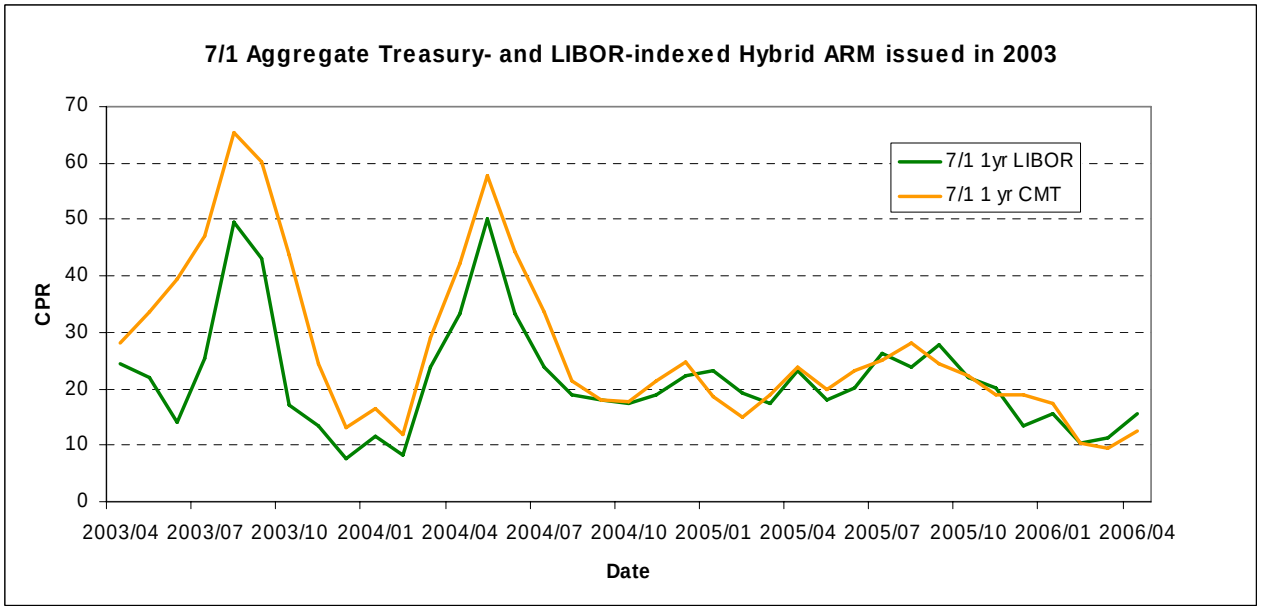
Sources: Beyondbond

Figure 17



Sources: Beyondbond

Figure 18

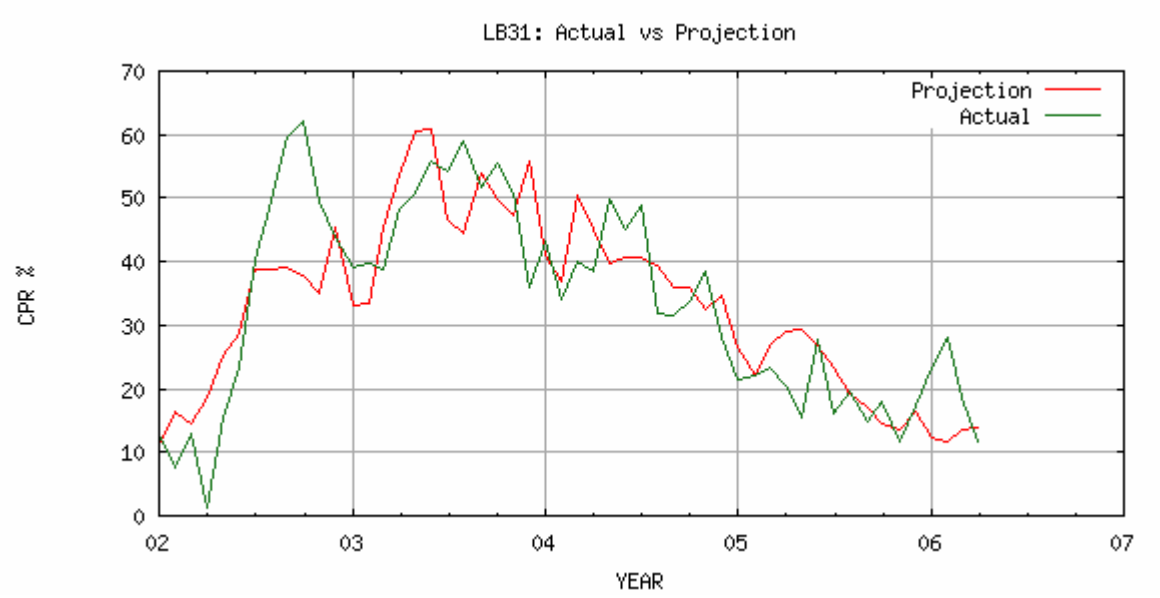


Sources: Beyondbond

V. Empirical Fitting

Taking into account all the factors mentioned above, we can model the prepayment behavior given the specified teaser period, reset frequency and the underlying benchmark. The following figure shows the sample projection result compared to the actual prepayment speeds for the LIBOR 3/1 with respect to the given month of the year.

Figure 19



Sources: Beyondbond

VI. Conclusion

Our model is based on more than 1,600 non-agency residential MBS deal data collected in the last six years. To reduce the possibilities of sample bias, we did not concentrate on any particular dealers, originators or trustees. The framework of our model was built and empirically back-tested. It can be used for a variety of MBS applications such as scenario analysis, options adjusted refinance and total rate of return when linked to the term structure of interest rates.

The actual framework of the model is based on the multiplicative factors mentioned above as they are the ones that are considered to have the most predictive power in terms of prepayment forecast. Careful choices of other inputs could be incorporated into the model later. In addition, default and delinquency analysis would be incorporated in the future.

Modeling prepayments is not a one-time job. Careful continuously fine-tuning of the model is necessary to maintain the forecast capability of the model. Thus, the model should be adjusted by including periodical prepayment data update for a better overall picture.

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